

RULES FOR THE CLASSIFICATION OF SHIPS

Part 3 – HULL EQUIPMENT
July 2025

CROATIAN REGISTER OF SHIPPING

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By the decision of the General Committee to the Croatian Register of Shipping,

RULES FOR THE CLASSIFICATION OF SHIPS
Part 3 – HULL EQUIPMENT

have been adopted on 27th June 2025 and shall enter into force on 1st July 2025

GENERAL TERMS AND CONDITIONS

(March 2022)

Article 1 GENERAL

1.1 CROATIAN REGISTER OF SHIPPING (hereinafter: the *Register*) shall at all times remain an independent contractor and neither the *Register* nor any of its officers, surveyors, auditors, inspectors, agents, appointers, officers or managers shall act as an employee, servant or agent of any other party in the performance of the Services rendered by the *Register*.

1.2 The *Register* acts as a service provider. The Services provided by the *Register* cannot be construed as a commitment by the *Register* to achieve any result or as a warranty.

1.3 The provision of Services is subject to these General Terms and Conditions. No other terms and conditions shall apply, either expressly or by implication, unless expressly agreed in writing between the Parties.

1.4 These General Terms and Conditions shall be incorporated into, or referred to in any Contract and shall prevail over and exclude any other terms and conditions that the Client may wish to impose.

Any amendments to and/or deviations from these General Terms and Conditions, as well as any additional terms and conditions of the Client, shall be binding or valid only if set forth in writing and duly signed by the authorised representatives of both Parties.

1.5 The invalidity of one or more provisions of these General Terms and Conditions shall not affect the remaining provisions.

1.6 The Client acknowledges that the latest version of these General terms and Conditions and the latest version of applicable Rules apply to the Services provided by the *Register*.

1.7 Definitions in these General Terms and Conditions take precedence over other definitions that may appear in other documents issued by the *Register*.

1.8 The Client should at all times be aware of the provisions of these General Terms and Conditions, as they may be further amended, with their latest up to date version available on the web site of the *Register*.

Article 2 DEFINITIONS

2.1 **Certificate** means either a class certificate or statutory certificate, statement, attestation, statement of compliance, and a report following the Services provided by the *Register*.

2.2 **Certification** means the activity of certification in application of international and national standards and international industry practice provided by the *Register*.

Certification is an appraisal given by the *Register* to the Client and cannot be construed as an implied or express warranty of safety, fitness for purpose, seaworthiness of the vessel or its value for sale, insurance or chartering.

The purpose of Certification is to provide classification and statutory services and assistance to the maritime industry, Flag State Administrations, and regulatory authorities relating to maritime safety and pollution prevention.

2.3 **Classification** includes all activities and Services provided by the *Register* in accordance with the Rules. Classification may or may not be accompanied by the issuance of a Certificate of class with reference to the Rules.

Certificate of class is valid only if issued by the *Register*.

However, Certificate of class should not be construed as a guarantee of the safety, fitness for purpose or seaworthiness of the vessel. It is merely an attestation that the vessel complies with the Rules developed and published by the *Register*.

In addition, the *Register* is not a guarantee of the safety of life or property at sea or the seaworthiness of a vessel because, although the classification of a vessel is based on the assumption that the vessel will be properly loaded, operated, and maintained by competent and qualified personnel, the *Register* has no control over how a vessel is operated and maintained between the periodic surveys it conducts.

2.4 **Statutory certification** means certification made by the *Register* on behalf of the Flag State Administrations when and to the extent that the *Register* has been authorised to do so by the respective Flag State.

Statutory certification and services include the assessment of vessels registered by the Flag State and/or ship management companies to determine whether such ships/companies comply with the applicable requirements of international conventions, codes and national legislation, and the issuance of, or assistance in the issuance of, the appropriate certificates and documents.

Statutory certification includes, but is not limited to, certification, survey, and issuance of statutory certificates on behalf of the Flag State.

In cases where the *Register* acts on behalf of Flag State Administrations, the *Register* shall follow guidance issued by IMO (Resolutions, Circulars, etc.) or by IACS through Unified Interpretations (UI), unless otherwise directed by the Flag State.

2.5 **Client** means the shipowner, company, shipyard and/or party requesting Services or taking ownership of a classed vessel. In cases where shipowners have authorized another party to operate the vessel on their behalf, that party shall be considered as the company.

In addition to the above the Client means the person and/or entity that has requested Services from the *Register* and that has entered into a Contract or an agreement for Services with the *Register*.

2.6 **Parties** means the *Register* and Client together.

2.7 **Party** means the *Register* or the Client.

2.8 **Contract** means the contract in the form of a written agreement between the Client and the *Register* requesting Services, including these General Terms and Conditions and the Rules.

The provisions related to the Contract in these General Terms and Conditions shall apply even if there is no written agreement between the Client and the *Register*.

The Client may request the *Register* in writing to make a change to the contracted Services. However, the *Register* shall not be obligated to accept or execute any such change until a written agreement has been signed with the Client regarding the compensation and the possible impact of the change on the schedule as an addendum to the originally contracted Services.

2.9 **Services** shall mean the services specified in 2.2, 2.3 and 2.4, but also other services related to certification, classification and statutory certification, such as, but not limited to: ISM Code certification, ISPS Code, MLC 2006 certification, fuel oil consumption reporting, IHM certification, approval of manufacturers and service providers, certification of materials and products, training activities, conformity assessment, and any other relevant activities such as third party inspections, testing, shore and shipboard trials.

The Services provided by the *Register* are performed on a random basis and in no case include a full inspection of all items.

The *Register* shall provide the Services in accordance with related Contract(s), the provisions of these General Terms and Conditions, Rules, the international and national standards, the international conventions, the EU Regulations, the Flag State requirements and the industry practices applicable to the particular Service and always assuming that the Client is aware of these standards and the industry practices.

When providing Services, the *Register* does not guarantee the accuracy of the information or advice provided.

In providing Services, the *Register* does not assess compliance with standards other than the Rules, international and national standards, international conventions, EU regulations, Flag State requirements and industry practice, to the extent agreed in writing or specified in the Contract.

2.10 The *Register* means the Croatian Register of Shipping, an entity organized and existing under Croatian law, which, according to the Law on the Croatian Register of Shipping (Official Gazette No. 1996/81, 2013/76 and 2020/62) and the Charter of the *Register*, is an independent, not-for-profit, but public welfare oriented, public foundation that performs tasks:

- classification of sea-going ships,
- statutory certification of sea-going ships on behalf of the Flag State Administrations,
- classification of inland navigation vessels,
- statutory certification of inland navigation vessels,
- statutory certification of recreational crafts,
- certification of materials and products,
- conformity assessment of recreational crafts,
- conformity assessment of marine equipment,
- conformity assessment of pressure vessels,
- certification/registration of quality management systems.

2.11 **Vessel** means a ship, vessel, unit or offshore structure of any kind, whether or not connected to the shore or sea/river bed, located at sea or in inland waters and intended for transportation or special operations on the water, as decided by the *Register*.

2.12 **Rules** means the Rules for the classification, guidelines, instructions, or other documented evidence of the *Register* related to the Services provided.

The competent interpretation of the requirements specified in the Rules or other regulations published by the *Register* shall be the exclusive responsibility of the *Register's* Head Office, notwithstanding any possible different interpretations by other parties.

In cases where the Rules do not contain detailed requirements, the specific approval by the *Register* shall be based on the principles of the Rules and shall ensure a safety standard equivalent to that of the Rules.

Article 3 RESPONSIBILITIES

3.1 It is the Client's responsibility to ensure that all surveys required for vessel's class maintenance are conducted in a timely manner and in accordance with the Rules.

3.2 The *Register* may suspend or withdraw the vessel's existing Certificate of class in the event of serious deficiencies and replace it with a new Certificate of class with a shortened period of validity during which the deficiencies are to be rectified.

In addition, the *Register* shall suspend or withdraw a vessel's Certificate of class if the deficiencies are of such a magnitude as to endanger the class of the vessel, its safety and integrity, the safety of the crew, passengers, or the marine environment, and shall require that the vessel is to be inspected at the first port of call where the necessary repairs are to be carried out.

3.3 The Client should inform the *Register*:

- (i) in the event of a change in the intended use of a vessel, a conversion and alteration of the hull, machinery installations and other equipment affecting the Class of the vessel assigned by the *Register*. Conversions and alterations must be made under the supervision of the *Register* and must comply with the requirements of the Rules and/or additional requirements of the *Register*,
- (ii) in cases where the vessel has been damaged to such an extent that the Class of the vessel is likely to be affected and the safety and integrity of the vessel is likely to be compromised. In such cases, the vessel must be surveyed at the first port of call or as further directed by the *Register*. The survey shall be to the extent deemed necessary by the *Register*, by taking into account the extent of the damage.
- (iii) in cases where class-related deficiencies and/or defects are found as a result of a Flag State inspection or Port State Control. Should the Client fail to notify the *Register* of the detention of the vessel by Port State Authorities due to class related deficiencies, the *Register* reserves the right to suspend or withdraw the Certificate of class.

3.4 The *Register* shall have full control over Certificates issued and may suspend or withdraw a Certificate at any time in its sole discretion if the Client fails to comply with the following requirements set forth in the *Rules for the Classification of Ships, Part 1 - General Requirements, Chapter 1 - General Information*, as applicable:

- (i) para. 5.3 - *Maintenance of the validity of Certificate of Class*,
- (ii) para. 5.4 - *Period of Validity*,
- (iii) para. 5.5 - *Extension of the Period of Validity*,
- (iv) para. 5.6 - *Suspension and Reinstatement of Class in the Case of Overdue Surveys*, and
- (v) para. 5.7 - *Withdrawal of Class*.

3.5 The *Register* may suspend or withdraw a Certificate at any time in its sole discretion if the Client fails to comply with the following requirements set forth in the *Rules for the Classification of Inland Navigation Vessels, Part 1 - Classification and Surveys, Chapter 1 - Principles of Classification*, as applicable:

- (i) para. 2.8 - *Maintenance of the Validity of the Certificate of Class*,
- (ii) para. 2.9 - *Extension of validity of the Certificate of Class*, and following requirements set forth in the *Rules for the Classification of Inland Navigation Vessels, Part 1 - Classification and Surveys, Chapter II - Classification*, as applicable:
- (iii) para. 2.1 - *Suspension of Class*,
- (iv) para. 2.2 - *Withdrawal of Class*.

3.6 In addition to clauses 3.2, 3.4 and 3.5 of this Article, the *Register* reserves the right to terminate the Services and related Contract in the event of a breach of the provisions of these General Terms and Conditions.

3.7 If the Client fails to provide the *Register* with the required access or information at the agreed times or fails to prepare for the Service in a timely manner, the *Register* may suspend the provision of the Service until it receives the Client's instructions for access and/or the required information.

The *Register* shall not be liable for the consequences of such suspension, and the Client shall be responsible for the *Register's* additional fees and other unnecessary costs and expenses incurred by the *Register*.

3.8 The Client is obliged to perform timely payments of the invoices for provided Services. However, the *Register* may retain or withhold any Service or Certificate to the Client in the case of outstanding payments, whether mutually related or not, arising out of the entire business relationship with the Client.

Article 4

HEALTH, SAFETY AND ENVIRONMENT

4.1 Both the *Register* and the Client shall apply reasonable standards to promote safety, health, and environmental protection and to provide a safe working environment for their personnel.

4.2 The Client shall provide the *Register* with all access and information necessary for the safe and efficient performance of the requested Services as required by the Rules.

4.3 During the survey, personnel of the *Register* should have secure access to all work that directly or indirectly affects the Service.

4.4 The *Register* has the right to refuse to conduct an activity or visit an area or site if the *Register* in its sole discretion, believes that relevant risks are unacceptable or are not adequately addressed, contained, or otherwise mitigated.

Such a decision shall suspend the obligations of both Parties under the Contract without incurring any liability or penalty until the Parties agree on how to proceed.

Article 5

THIRD PARTIES AND SUBCONTRACTORS

5.1 Each specific Contract, including any Certificates issued, relates specifically to the Client, and no rights, obligations, interests, claims, benefits or Certificates issued shall extend to any third party without the prior written consent of the *Register*.

5.2 The Client shall not be entitled to grant any right to use the Certificates to any third party without the prior written consent of the *Register*.

5.3 The Client shall not without *Register's* consent, cede, assign, transfer, subcontract or deal in any manner with all or any of its rights or obligations under any Service and related Contract.

5.4 With regard to third party rights to access information and Certificates under confidentiality clause reference is to be made to Article 9.

Article 6

TAXES

6.1 Each Party shall be responsible for and shall bear all taxes, duties or similar governmental charges levied or imposed on any activity of that Party.

6.2 Prices, fees, rates, or remuneration are exclusive of any form of sales tax, value added tax, administrative fees and services tax and/or other similar taxes, including any surcharges. If any such indirect tax is or becomes applicable to the Services provided under the Contract, the Client shall be responsible for the payment of such indirect taxes.

Article 7

PAYMENT OF INVOICES

7.1 The provision of Services by the *Register*, whether complete or not, shall include payment of fees thirty (30) days after issuance of the invoice for the portion of the Services performed.

7.2 In the event that the Client fails to meet the requirements for payment in accordance with the instalments and terms of payment contained herein, the *Register* reserves the right to charge the Client with the interest rate in accordance with the applicable laws of the Republic of Croatia.

7.3 If the Client disputes an invoice or part of an invoice, the Client shall notify *Register* thereof in writing without undue delay. If no notification is received by the due date, Client shall be deemed to have accepted the invoice in full. If only part of an invoice is disputed, the undisputed amount must be paid by the due date.

Consequently, no disputes arising between the *Register* and the Client shall interfere with prompt payment of invoices by the Client. Any rights of lien or retention in favour of the Client or otherwise, are hereby excluded.

7.4 In the event of cancellation of all or part of the Services prior to their final completion, the Client shall pay all costs incurred by the *Register* on pro-rata basis for the portion of the Services provided to date. In such event, the *Register* will not claim the Client for loss of profit or reduced income. All reasonable costs directly attributable to the early termination and all amounts due to the *Register* at that time shall become immediately due and payable.

7.5 In the event of termination of the Service and related Contract, the *Register* shall be entitled to retain any payments, deposits or prepayments of fees made by the Client prior to the date of termination up to the amount to which the *Register* is entitled.

Article 8

TERMINATION

8.1 The Parties shall have the right to terminate the Services and the related Contract(s) by written notice to the other Party, and without prejudice to Article 7, in the following cases:

- (i) if the other Party commits a material breach of these General Terms and Conditions and/or the Contract and fails to rectify such breach in accordance with clause 8.4 of this Article,
- (ii) if the other Party becomes insolvent, is unable to pay its debts as they become due, or becomes subject to bankruptcy proceedings, administration, receivership, dissolution, liquidation, winding up or otherwise ceases to carry on its business; or
- (iii) for convenience, after giving the other Party thirty (30) days' prior written notice of termination.

8.2 The Classification issued for the relevant vessel and the Certificates previously issued shall remain valid until the effective date of termination or, in the event of such termination, immediately, subject to compliance with Article 3 and Article 7.

8.3 If, in the reasonable opinion of the *Register*, the Client breaches or is suspected of breaching Article 14 or Article 15, the *Register* shall have the right to terminate the Service and related Contract with immediate effect.

8.4 Notwithstanding the provisions of clause 8.1 of this Article, the Party intending to terminate Services for non-compliance or breach of the provisions of these General Terms and Conditions shall notify the other Party of the non-compliance or violation of the provisions of these General Terms and Conditions and set a reasonable deadline of 15 (fifteen) days for the other Party to remedy the breaches of the provisions of these General Terms and Conditions.

If the Party fails to remedy the breaches of the provisions of these General Terms and Conditions within the aforementioned period, the other Party shall have the right to terminate Services without further notice.

8.5 Termination of the Service and related Contract pursuant to the provisions of these General Terms and Conditions shall not give either Party the right to claim any additional compensation, indemnity or reimbursement from the other Party as a result of such termination, but such termination shall not affect any rights or remedies available to a Party at the time the termination becomes effective or any obligations or liabilities incurred by a Party.

Article 9 CONFIDENTIALITY

9.1 The Parties agree to keep confidential all facts, data, information, etc. related to the other Party's business that they have learned in the course of providing Services. Such information and data shall not be disclosed by the Parties to any third party and shall not be used or misused to the detriment of the other Party.

9.2 The *Register* will keep confidential any data, plans or other technical information received from the Client and will not disclose it to any third party outside the *Register*, unless authorised by the Client. This obligation shall continue to apply after termination of the Services. This obligation shall not apply to any data, plans or other technical information that was in the possession of the *Register* prior to being disclosed to the *Register* by or on behalf of the Client, or that becomes publicly available through no fault of the *Register*, or is otherwise provided to the *Register* by an independent source that is under no obligation of confidentiality to the *Register*.

9.3 Certificates issued by the *Register* to the Client as a result of the Services provided shall not be covered by the confidentiality Article.

Notwithstanding the foregoing, the Client shall be entitled to disclose any data to its affiliates involved in the transactions related to the Services or the Client's core activities.

9.4 Notwithstanding clause 9.1 and clause 9.2 of this Article, the *Register* shall have the right to disclose the Confidential Information to the following parties if required by regulations of:

- (i) authorised representatives of the Flag State Administration,
- (ii) authorised audit teams (i.e., accreditation body or EC auditors),
- (iii) the International Association of Classification Societies (IACS),
- (iv) a court of competent jurisdiction, government agency, or other relevant public authority, in accordance with applicable law, court order, or other public regulation.

9.5 The Client acknowledges that the *Register* is required to provide access to information to the EU Commission or any person acting on its behalf in accordance with applicable EU requirements and that the Client shall give the EU Commission with unrestricted access to the vessels for the purpose of inspection.

9.6 The obligations in this Article shall survive the conclusion of the Service or the termination of related Contract and shall continue for as long as the relevant information remains confidential.

Article 10 INTELLECTUAL PROPERTY

10.1 Each Party shall be the sole owner of all rights to its Intellectual Property created before or after the effective date of these General Terms and Conditions, whether or not associated with any Contract between the Parties.

10.2 The Intellectual Property developed by the *Register* for the provision of the Services, including but not limited to drawings, calculations and reports, shall remain the exclusive property of the *Register*.

Article 11 PROFESSIONAL ETHICS

11.1 Each of the Parties warrants that, with respect to the matters contemplated herein, neither it nor its affiliates has made or will make, directly or indirectly, any offer, payment, gift or authorization of money to any government official or employee, political party, public official or candidate for the benefit or advantage thereof.

11.2 In providing the Services, the *Register* shall strictly adhere to the requirements of its Code of Ethics relating to business activities.

Article 12 FORCE MAJEURE

12.1 For the purposes of these General Terms and Conditions, the term "Force Majeure" includes any event that directly or indirectly prevents the Parties from fulfilling their obligations due to events beyond their control, such as: strikes, wars, riots, piracy, civil commotion, malicious damage, pandemic, compliance with laws or government orders, rules, regulations or directives, sanctions and embargoes, accidents, defects of plants or machinery, seizures, fires, floods, storms and the like.

12.2 If either Party is prevented or delayed from performing its obligations by Force Majeure, such Party shall promptly notify the other Party in writing of the circumstances of the Force Majeure and its influence and, after such notification, shall not be liable for performance of any obligations prevented by the influence of the Force Majeure during its duration. Upon termination of the influence of the Force Majeure, the same Party should proceed with the planned activities in order to fulfil its obligations.

12.3 If one of the Parties is prevented by Force Majeure in its activities and fulfilment of its obligations and this event lasts continuously for three (3) months, the other Party shall be entitled to terminate the Service and related Contract without liability.

12.4 Neither of the Parties shall be liable for non-compliance with these General Terms and Conditions due to Force Majeure. If one of the Parties is prevented from fulfilling its obligations under these General Terms and Conditions due to Force Majeure, it shall immediately notify the other Party in writing within a reasonable period of time, stating the reasons for the Force Majeure and providing relevant evidence, if any.

Article 13 INDEMNIFICATIONS

13.1 Each Party shall indemnify the other Party against all claims arising out of the performance of the Services in respect of bodily injury, illness or death of any of its employees or other representatives and in respect of loss of or damage to the Party's property.

This provision shall apply whether or not the damage is caused or contributed to by the negligence of the other Party. Both Parties are obliged to take out separate insurances for these liabilities.

13.2 The Client shall indemnify the *Register* from and against all claims arising from the Client's violation of the provisions of these General Terms and Conditions and from the misuse of the Certificates issued by the *Register*.

13.3 The Client shall indemnify the *Register* against any financial responsibility or amounts arising from non-payment, late payment or payment of withholding taxes to the non-relevant tax authority or any other relevant governmental body.

13.4 Each Party shall notify the other Party without undue delay as soon as it becomes aware of any incident that could give rise to a claim against the other Party in respect of the Service provided and related Contract.

Article 14 ANTI-CORRUPTION

14.1 Each Party agrees that in performing its obligations under any Service, it will ensure that its affiliates, employees and/or agents, subsidiaries, subcontractors, consultants, and any other persons providing Services will:

- (i) comply with all applicable anti-bribery and anti-corruption laws (collectively, Anti-Bribery Laws) and, in particular, do not, directly or indirectly, offer, promise, grant, authorise the payment of, or confer any financial or other benefit on any public or government official:
 - to a public or governmental official to obtain or retain business with the intent to influence such official in his or her capacity as an official, if such official is not permitted or required by written law to be influenced by the offer, promise or gift; or
 - to another person with the intent to induce or reward the improper performance of a function or activity or for any other illegal purpose,
- (ii) maintain adequate systems and procedures designed to prevent activities, practises, or conduct in connection with services that would constitute an offence under an anticorruption law; and
- (iii) take reasonable steps to prevent similar acts by customers, contractors, subcontractors, agents and other third parties, persons under its control or influence.

14.2 Any failure by a Party to comply with or ensure compliance with its obligations under this Article shall, notwithstanding anything to the contrary in these General Terms and Conditions, be deemed a breach of these General Terms and Conditions which shall entitle the other Party to suspend and/or terminate the Services by notice in writing with immediate effect without further liability to the other Party except for any liability which may have arisen prior to the date of termination or suspension (as the case may be).

14.3 If a Party elects to suspend the provision of Services under these General Terms and Conditions pursuant to this Article, it shall have the sole and absolute discretion to determine:

- (i) when it will resume performance (if at all); and
- (ii) extend the period for performance of its obligations under the Services in its sole discretion.

Article 15 SANCTIONS

15.1 Each Party shall conduct all activities in compliance with all laws, statutes, rules, economic and trade sanctions (including, but not limited to, U.S. sanctions and EU sanctions) and regulations applicable to such Party, including, but not limited to: child labour, forced labour, collective bargaining, discrimination, abuse, working hours and minimum wages, anti-bribery, anti-corruption, copyright and trademark protection, personal data protection.

15.2 Each Party hereby represents and warrants that it is not or will not be subject to any economic or trade sanctions ("Sanctions") imposed by the United States of America, the European Union, the United Kingdom, any EU Member State, or the United Nations with respect to any country and/or by any sanction giver with respect to any company/individual.

15.3 Each Party represents and warrants that it will strictly comply with all Sanctions.

15.4 Nothing in these General Terms and Conditions shall be construed as causing or obligating either Party to act or refrain from acting in a manner inconsistent with, punishable by, or prohibited by any Sanctions.

15.5 Neither Party shall be obligated to perform any obligation arising under these Terms and Conditions (including, without limitation, the obligation to):

- (i) perform, deliver, accept, sell, purchase, pay or receive any funds to, from or through any person or entity; or
- (ii) engage in any other action whatsoever,
if doing so violates or is inconsistent with sanctions and/or recommendations of international (intergovernmental) organisations to combat the financing of terrorism and other criminal activities and/or money laundering or exposes such Party to investigation or penalties.

15.6 In the event that a Party breaches any Sanctions or the Party's Business and/or Transactions arising out of or in connection with these General Terms and Conditions breach any Sanctions or otherwise violate the recommendations of one or more international (intergovernmental) organisations for combating the financing of terrorism and other criminal activities and/or money laundering, the other Party shall be entitled to terminate these General Terms and Conditions by written notice with immediate effect without incurring any liability to the other Party, except for liabilities (if any) incurred prior to the date of termination.

Article 16 LIABILITY

16.1 The *Register* is not, and cannot be considered as, an underwriter, consulting engineer, naval architect, shipbuilder, shipowner, or ship management company, nor can it assume the obligations and responsibilities associated with such functions, although the *Register's* experience may enable it to respond to inquiries about matters not covered by its Rules, policies, instructions, or other documented evidence.

16.2 The practices and procedures of the *Register* shall be selected by the *Register* in its sole and absolute discretion based on its experience and knowledge and in accordance with generally accepted professional standards in the relevant field of classification societies.

16.3 Nothing herein contained shall release any designer, naval architect or engineer, shipbuilder or manufacturer, shipyard, vendor, supplier, contractor or subcontractor, repairer or owner, from any information, report, certificate or similar document issued in connection with the provision of Services by the *Register*, operator, manager or other person or entity from any express or implied warranty or other contractual obligation or responsibility, or from any negligent act, error or omission of any kind whatsoever, nor shall they create any right, claim or benefit for any third party.

16.4 The *Register* shall exercise due care in the selection or appointment of its surveyors and all other employees whose presence and work is necessary for the provision of the Services.

16.5 If any person or entity using the Services of the *Register* suffers any loss, damage or expense that is or is shown to have been caused by a negligent act, omission or error of the *Register's* officers, surveyors, auditors, inspectors, agents, appointers, officers or managers, or those purporting to act in the name of and on behalf of the *Register*, or a negligent inaccuracy, advice, report or evidence given by or in the name of or/and on behalf of the *Register*, then the liability of the *Register* is limited in respect of any direct or indirect claim shall be limited to an amount not exceeding five times the fee charged or to be charged by the *Register* for the relevant Service.

16.6 Any liability for consequential damages is expressly excluded.

For purposes of this clause, consequential damages include, without limitation:

- (i) indirect or consequential damages,

- (ii) loss and/or delay of production, loss of products, loss of use, loss of bargain, loss of revenue, loss of profit or anticipated profit, loss of business and business interruption, in each case directly or indirectly.

16.7 The Parties are not entitled to assign the performance of obligations under these General Terms and Conditions or parts thereof to third parties without the prior written consent of the other Party.

16.8 If during the term of the Contract, there is a transfer of function due to change of status (merger, acquisition, division, etc.), all obligations and rights under these General Terms and Conditions and associated Contract will be transferred to the legal successor of the Party concerned.

Article 17 GOVERNING LAW AND RESOLVING OF DISPUTES

17.1 These General Terms and Conditions and any dispute or claim between the Parties arising from or in connection with it, or the Services provided hereunder, will be governed and interpreted in accordance with the English law.

17.2 The Parties shall use their reasonable efforts to resolve any claim or dispute arising in relation to rendered Service by negotiations within a reasonable time.

17.3 Should the Parties fail to resolve any claim or dispute by negotiations, the dispute shall be exclusively subject to the jurisdiction of the Permanent Arbitration Court with the Croatian Chamber of Economy in Zagreb, Republic of Croatia.

17.4 The Parties agree to keep the any arbitration proceedings confidential.

17.5 Notwithstanding the above, any claim not presented within three (3) months of the completion of the particular Services, or within three (3) months of from the date when the events which are relied on were first discovered by the Client, shall be deemed waived and absolutely time barred.

17.6 Any objections against the line adopted by any of the *Register's* servants in fulfilling their duties or against the conclusions reached are to be raised to the *Register* by the Party as soon as possible.

If the Party is not satisfied with the final conclusions and interpretations by the *Register* the arbitration lays upon the Commission for appeal for Classification and Statutory certification of ships, which is to be formed according to the Regulation 39 of the Charter of the *Register*.

REVIEW OF AMENDMENTS IN RELATION TO PREVIOUS EDITION OF THE RULES

RULES FOR THE CLASSIFICATION OF SHIPS

Part 3 – HULL EQUIPMENT

All major changes in respect to the Rules for the classification of ships, Part 3 – Hull equipment, edition July 2024, as last amended by Amendments No. 1, edition January 2025, throughout the text are shaded (if any).

Items not being indicated as corrected have not been changed.

The grammar and print errors, have been corrected throughout the Rules for the classification of ships and are not subject to above indication of changes.

This Part of the Rules includes the requirements of the following international Organisations:

International Maritime Organization (IMO)

Conventions: International Convention for the Safety of Life at Sea, 1974 (SOLAS 74) and all subsequent and applicable amendments adopted up to MSC 108
Protocol of 1988 relating to the International Convention for the Safety of Life at Sea, 1974, as amended (SOLAS PROT 1988)

International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78) and all subsequent and applicable amendments adopted up to MEPC 81

Protocol of 1997 to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto

Resolutions: MSC.474(102)

Circulars: MSC.1 Circ.1175/Rev.1, MSC.1 Circ.1619, MSC.1 Circ.1620, **MSC.1 Circ.1353/Rev.2**, **MSC.1/Circ.1362/Rev.2**

International Association of Classification Societies (IACS)

Unified Requirements (UR):

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1 GENERAL

1.1 APPLICATION

1.1.1 This Part of the *Rules for the classification of ships* (hereinafter referred to as: the Rules) applies to equipment, arrangements and outfit of sea-going ships sailing in a displacement condition.

1.1.2 As to hydrofoil ships, hovercraft, and other similar ships, the requirements of this Part of the Rules are applicable to the extent that is practicable and reasonable, and the equipment, arrangements and outfit of these ships are subject to special consideration by the **CROATIAN REGISTER OF SHIPPING** (hereinafter referred to as: the Register).

1.1.3 The application of this Part of the Rules to the installations and equipment of the passenger ships with length up to 45 m, engaged in restricted navigation areas (6, 7 and 8) in period from 1st April to 31st October only, may be agreed with the Register, on the case to case basis.

1.2 DEFINITIONS AND EXPLANATIONS

Those relating to general terminology of the Rules are given in the *Rules for the classification of ships, Part 1 - General requirements, Chapter 1-General information*.

1.2.1 Waterlines

1.2.1.1 **Damage waterline** - the waterline of a damaged ship after flooding of corresponding separate compartments or their combinations as provided in the *Rules for the classification of ships, Part 5 - Subdivision, 2*.

1.2.1.2 **Summer load waterline** - the waterline the upper edge of which passes through the centre of the ring of the load line mark when there is no fore-and-aft or athwart ships inclination.

1.2.1.3 **Summer timber load waterline** - the waterline indicated by the upper edge of the assigned summer timber load line.

1.2.1.4 **Subdivision load waterline** - the waterline used in determining the subdivision of the ship.

1.2.1.5 **Deepest subdivision load waterline** - the subdivision load waterline which corresponds to the summer draught to be assigned to the ship, see the *Rules for the classification of ships, Part 5 - Subdivision, 2.2*.

1.2.2 Main dimensions

1.2.2.1 **Rule length of ship, L** - distance, in [m], measured on the waterline at the scantling draught from the fore side of the stem to the after side at the rudder post, or the centre of the rudder stock, if there is no rudder post. L is not to be less than 96%, and need not be greater than 97%, of the extreme length on the waterline at the scantling draught.

In ships without rudder stock (e.g. ships fitted with azimuth thrusters), the Rule length L is to be taken equal

to 97% of the extreme length on the waterline at the scantling draught.

In ships with unusual stem or stern arrangements the Rule length L will be considered on a case by case basis and agreed with the Register.

1.2.2.2 **Subdivision length of ship, L_s** - the length, in [m], measured between perpendiculars taken at the extremities of the deepest subdivision load line.

1.2.2.3 **Draught of ship, d** - the vertical distance, in [m], measured amidships from the top of the plate keel, or from the intersection of the inner surface of the shell with the bar keel (the outer surface of a non-metal shell) to the summer load line.

1.2.2.4 **Depth of ship, D** - the vertical distance, in [m], measured at amidships, from the top of the plate keel or from the intersection of the inner surface of the outer shell with the bar keel, to the top of the freeboard deck beams at sides.

On ships with rounded gunwales, moulded depth is taken to be the distance to the intersection of the continuation of a line extending from the level of the upper freeboard deck and the outer edge of the side, as though the gunwale were of angular design.

If the upper freeboard deck has longitudinal steps and the raised part of the deck is above the point at which the lateral height of the ship is to be measured, the lateral height is measured up to the continuation of a line from the lower part of the deck and parallel to the upper part of the deck at ship's sides.

1.2.2.5 **Breadth of ship, B** - maximum breadth of ship, in [m], measured amidships from outside of frame to outside of frame in a ship with metal shell and to the outer surface of the hull in a ship with a shell of any other material.

1.2.2.6 **Scantling draught of ship, d_{sc}** - draught, in [m], at which the strength requirements for the scantlings of the ship are met and represents the full load condition. The scantling draught is to be not less than that corresponding to the assigned freeboard.

1.2.3 Superstructures and deckhouses

1.2.3.1 **Superstructure** - a decked structure on the freeboard deck extending from side to side of the ship or with the side plating not being inboard of the shell plating more than $0,04 \cdot B$.

Superstructures may either be complete, i.e. extending the full length of the ship L , or they may cover only a certain part of that length.

One or more tiers of such complete or detached superstructures may be erected.

1.2.3.2 **Deckhouse** - a decked structure above the strength deck the side plating being inboard of the shell plating more than $0,04 \cdot B$, with doors, windows, or other similar openings in the outer bulkheads.

1.2.3.3 **Trunk** - a deck structure on the upper deck, not reaching at least one of the sides by a distance exceeding 4% of the breadth B and having no doors, windows or other similar openings in the external bulkheads.

1.2.4 Tightness

1.2.4.1 Watertight - the term pertaining to closing appliances of openings, which means that under specified pressure the liquid is not to penetrate through the closed openings into the ship.

1.2.4.2 Weathertight - the term pertaining to closing appliances of openings, which means that in any sea conditions water is not to penetrate through the openings inside the ship. Such closing appliances shall withstand a hose test on condition that the outlet of the nozzle is equal to or over 12 mm in diameter and the head in the hose provided for water jet ejected upwards of not less than 0.2 MPa. The distance from the tested position is up to 1,5 m.

1.2.5 Decks

1.2.5.1 Upper deck - the uppermost continuous deck extending from fore to aft. The upper deck may be stepped.

1.2.5.2 Raised quarterdeck - the after upper part of a stepped deck, the forward lower part of which is taken as a portion of freeboard deck.

1.2.5.3 Freeboard deck - the deck from which the freeboard is measured.

In a ship having a deck with step, the lowest line of this deck and the continuation of the line parallel to upper part of the deck is taken as a freeboard deck.

1.2.5.4 Superstructure deckhouse or trunk deck - the deck forming the top of a superstructure, deckhouse or trunk.

1.2.5.5 Superstructure decks of the first, second, etc. tiers - the decks forming the top of the superstructures of the first, second, etc. tiers, counting from the freeboard deck.

1.2.5.6 Bulkhead deck - the deck up to which the main transverse watertight subdivision bulkheads are carried.

The bulkhead deck may be discontinuous, i.e. with step or steps formed both by main transverse watertight bulkheads reaching the keel and transverse watertight bulkheads not reaching the keel.

1.2.5.7 Lower decks - the decks below the upper deck.

1.2.5.8 Weather deck - deck which is completely exposed to the weather from above and from at least two sides.

1.2.6 Amidships and perpendiculars

1.2.6.1 Amidships - at the middle of the ship's length L .

1.2.6.2 Forward and after perpendicular - the vertical line passing in the centre line at the fore and after end of the ship's length L .

1.2.7 Type A and Type B ships

1.2.7.1 Type A ship - is one which:

- designed to carry only liquid cargoes in bulk.
- has a high integrity of the exposed deck with only small access openings to cargo compartments, closed by watertight

gasketed covers made of steel or an equivalent material, and

- has low permeability of loaded cargo compartments.

Type A ship must also have certain other features, specified in the *ICLL (International Convention on Load Lines, 1966, as amended)*.

1.2.7.2 Type B ship - a ship which does not meet requirements regarding Type A ships, and which is assigned a freeboard according to the *ICLL, 1966*.

1.2.8 Active means of the ship's steering - auxiliary means which develop a thrust at an angle of the centre line plane of the ship of the zero or small speed, irrespective of the ship's propulsive device operation and which are provided with their own drive motor.

1.3 SCOPE OF SUPERVISION

1.3.1 General provisions on the ship's supervision, surveys and classification are given in the *Rules for the classification of ships, Part 1 - General requirements, Chapter 1 - General information*. General provisions which apply to supervision during construction, surveys and classification of ships as well as provisions which apply to technical documentation submitted to the Register are specified in the *Rules for the classification of ships, Part 1 - General requirements, Chapter 1 to Chapter 5*.

1.3.2 The following items included into ship's equipment and arrangements are subject to the supervision during their manufacture:

1.3.2.1 Rudder:

- .1 rudder stock,
- .2 rudder blade,
- .3 propeller nozzle,
- .4 rudder shafts
- .5 pintles of rudder and propeller nozzles,
- .6 pintle bushes,
- .7 fastenings (bolts and nuts with horizontal flanged couplings and nuts with tapered couplings, bolts and nuts for connecting the rudder shaft and stern post),
- .8 parts limiting deviation of the angle of the rudder blade and rudder nozzle,
- .9 rudder stock bearings,
- .10 active means of ship steering.

1.3.2.2 Anchoring arrangement:

- .1 anchor,
- .2 chain cables or ropes,
- .3 anchor stoppers,
- .4 devices for securing and releasing the in-board end of chain cable or rope,
- .5 anchor hawse pipes.

1.3.2.3 Mooring arrangement:

- .1 mooring ropes,
- .2 mooring bollards, belaying cleats, fairleads, chocks, rollers and stoppers.

1.3.2.4 Towing arrangement:

- .1 towing lines,

- .2 towing bollards, bits, fairleads, chocks, and stoppers,
- .3 towing hooks and towing rails with fastenings for their securing to ship's hull,
- .4 towing snatch-block.

1.3.2.5 Signal masts:

- .1 metal, non-metallic masts,
- .2 standing ropes,
- .3 permanent attachments to masts and decks (eyeplates, hoops, etc.),
- .4 loose gear of masts and rigging (shackles, turnbuckles etc.).

1.3.2.6 Closing appliances of openings in hull, superstructures and deckhouses:

- .1 side and deck scuttles,
- .2 side shell doors,
- .3 doors in superstructures and deckhouses,
- .4 companion hatches, skylights and ventilating trunks,
- .5 ventilators,
- .6 manholes to deep and other tanks,
- .7 hatchway covers in dry cargo ships,
- .8 cargo tank hatchway covers in ships of carriage of liquid cargoes in bulk,
- .9 doors in watertight subdivision bulkheads.

1.3.2.7 Equipment of ship's spaces:

- .1 lining and battens in cargo holds,
- .2 exit doors from ship's spaces in escape routes,
- .3 stairways and vertical ladders,
- .4 guards rails, bulwarks and gangways
- .5 fixed and portable securing devices for cargo securing.

1.3.3 Survey of the manufacture of the items specified in 1.3.2.1.6, 1.3.2.1.8, 1.3.2.1.9, 1.3.2.2.5, 1.3.2.3.2, 1.3.2.4.2, 1.3.2.5, 1.3.2.6.5 and 1.3.2.7 is confined to consideration of the related technical documentation.

1.3.4 Where items specified in 1.3.2 are fitted the following documents are to be submitted:

- .1 assembly drawing,
- .2 calculations,
- .3 detail drawings if parts or assemblies are not manufactured in accordance with approved standards and specifications.

1.3.5 Materials for structural elements listed in Table 1.3.5-1 are to be in accordance the requirements of the *Rules for the classification of ships, Part 25 - Metallic materials*.

Materials for other items of equipment and arrangements, unless expressly provided otherwise in the Rules, shall meet the requirements specified in the design documentation approved by Register.

Welding of structural elements of ship's equipment is to be performed as specified in the *Rules for the classification of ships, Part 26 - Welding and Part 2 - Hull*.

Table 1.3.5-1

No.	ITEM	MATERIAL
1.	Rudder stocks and propeller nozzles including their flanges	Steel forgings Steel castings
2.	Parts of rudder	Steel forgings Steel castings Steel plates Steel profiles
3.	Rudder shafts, including their flanges	Steel forgings Steel castings
4.	Rudder pintles and pintle of propeller nozzles	Steel forgings Steel castings
5.	Fastenings (bolts and nuts of horizontal flange couplings and nuts for tapered couplings, bolts and nuts for connections of rudder shaft to flange couplings)	Steel forgings
6.	Towing hooks for a force of 10 kN and over, fastenings for their securing to ship's hull	Steel forgings Steel plates Steel profiles
7. ^(1,2)	Hatchways covers, side shell doors	Steel plates Steel profiles Light alloy plates Light alloy profiles
8. ^(1,2)	Sliding doors	Steel forgings Steel castings Steel plates Steel profiles
9.	Anchors	Steel forgings Steel castings
10.	Chain cables	Steel forgings

Notes:

- (1) The grades of rolled steel plates and profiles are to be selected in accordance with the *Rules for the classification of ships, Part 2 - Hull and Part 25 - Metallic materials*,
- (2) Welded structures and joints shall comply with the *Rules for the classification of ships, Part 2 - Hull and the Rules for the classification of ships, Part 26 - Welding*.

1.3.6 The following equipment and arrangements are subject to survey while the ship is under construction:

- .1 rudder,
- .2 anchor arrangement,
- .3 mooring arrangement,
- .4 towing arrangement,
- .5 masts and rigging,
- .6 openings in the hull, superstructures and deckhouses, and their closing appliances,
- .7 arrangement and equipment of ship compartments,
- .8 fixed and portable securing devices for cargo securing,
- .9 active means of ship's steering.

1.4 PERMISSIBLE STRESSES

1.4.1 Wherever the working stresses are mentioned in the text of this Part of the Rules, they mean equivalent stresses calculated from the formula:

$$\sigma_e = \sqrt{\sigma^2 + 3\tau^2}, \quad [\text{N/mm}^2],$$

where:

$$\begin{aligned} \sigma_e &= \text{equivalent stress,} & [\text{N/mm}^2]; \\ \sigma &= \text{normal stress,} & [\text{N/mm}^2]; \\ \tau &= \text{shear stress,} & [\text{N/mm}^2]. \end{aligned}$$

1.4.2 Permissible stresses with which the equivalent stresses are to be compared when verifying the strength conditions are established here in fractions of the yield point R_{eH} of material used. The yield point is not to be taken as more than 0,7 times the ultimate strength of material, unless expressly stated otherwise.

2 RUDDER

2.1 GENERAL

2.1.1 Basic assumptions

2.1.1.1 The following requirements apply to ordinary profile rudders, and to some enhanced profile rudders with special arrangements for increasing the rudder force.

2.1.1.2 These requirements apply to rudders made of steel for ships with $L \geq 24\text{m}$.

2.1.2 Design considerations

2.1.2.1 Effective means are to be provided for supporting the weight of the rudder without excessive bearing pressure, e.g. by a rudder carrier attached to the upper part of the rudder stock. The hull structure in way of the rudder carrier is to be suitably strengthened.

2.1.2.2 Suitable arrangements are to be provided to prevent the rudder from lifting.

2.1.2.3 In rudder trunks which are open to the sea, a seal or stuffing box is to be fitted above the deepest load waterline, to prevent water from entering the steering gear compartment and the lubricant from being washed away from the rudder carrier. If the top of the rudder trunk is below the waterline at scantling draught (without trim), two separate watertight seals/stuffing boxes are to be provided.

2.1.3 Materials

2.1.3.1 Welded parts of rudders are to be made of approved rolled hull materials.

2.1.3.2 Material factor k for normal and high tensile steel plating may be taken into account when specified in each individual rule requirement. The material factor k is to be taken as defined in the *Rules for the classification of ships, Part 2 - Hull, 1.4.2.2*, unless otherwise specified.

2.1.3.3 Steel grade of plating materials for rudders and rudder horns are to be in accordance with the *Rules for the classification of ships, Part 2 - Hull, 1.4.2.4*.

2.1.3.4 Rudder stocks, pintles, coupling bolts keys and cast parts of rudders are to be made of rolled, forged or cast carbon manganese steel in accordance with the *Rules for the classification of ships, Part 25 - Metallic materials, Section 3*.

2.1.3.5 For rudder stock, pintles, keys and bolts the specified minimum yield stress is not to be less than 200 N/mm^2 . The requirements of these requirements are based on a material's specified minimum yield stress of 235 N/mm^2 . If material is used having specified minimum yield stress differing from 235 N/mm^2 , the material factor k is to be determined as follows:

$$k = \left(\frac{235}{R_{eH}} \right)^e,$$

where:

- $e = 0.75$ for $R_{eH} > 235\text{ N/mm}^2$;
- $e = 1.00$ for $R_{eH} \leq 235\text{ N/mm}^2$
- R_{eH} = specified minimum yield stress of material used, in $[\text{N/mm}^2]$, is not to be taken greater than $0.7 \cdot R_m$ or 450 N/mm^2 , whichever is the smaller value.
- R_m = tensile strength of the material used, in $[\text{N/mm}^2]$.

2.1.4 Welding and design details

2.1.4.1 Slot-welding is to be limited as far as possible. Slot welding is not to be used in areas with large in-plane stresses transversely to the slots or in way of cut-out areas of semi-spade rudders.

When slot welding is applied, the length of slots is to be minimum 75 mm with breadth of $2t$, where t is the rudder plate thickness, in $[\text{mm}]$. The distance between ends of slots is not to be more than 125 mm . The slots are to be fillet welded around the edges and filled with a suitable compound, e.g. epoxy putty. Slots are not to be filled with weld.

Continuous slot welds are to be used in lieu of slot welds. When continuous slot welding is applied, the root gap is to be between $6\text{-}10\text{ mm}$. The bevel angle is to be at least 15° .

2.1.4.2 In way of the rudder horn recess of semi-spade rudders, the radii in the rudder plating except in way of solid part in cast steel are not to be less than 5 times the plate thickness, but in no case less than 100 mm . Welding in side plate is to be avoided in or at the end of the radii. Edges of side plate and weld adjacent to radii are to be ground smooth.

2.1.4.3 Welds in the rudder side plating subjected to significant stresses from rudder bending and welds between plates and heavy pieces (solid parts in forged or cast steel or very thick plating) are to be made as full penetration welds. In way of highly stressed areas e.g. cut-out of semi-spade rudder and upper part of spade rudder, cast or welding on ribs is to be arranged. Two sided full penetration welding is normally to be arranged. Where back welding is impossible welding is to be performed against ceramic backing bars or equivalent. Steel backing bars may be used and are to be fitted with continuous weld on one side to the the bevelled edge, see Figure 2.1.4.3. The bevel angle is to be at least 15° for one sided welding.

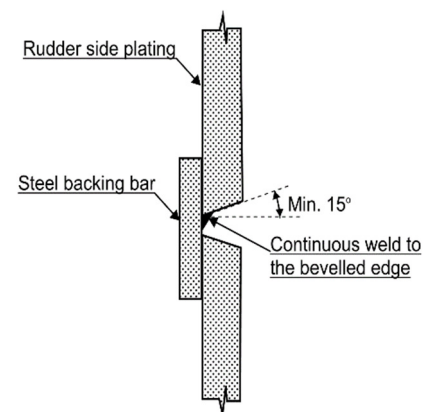


Figure 2.1.4.3

Use of steel backing bar in way of full penetration welding of rudder side plating

2.1.4.4 Requirements for welding and design details of rudder trunks are described in the *Rules for the classification of ships, Part 2 - Hull*, 12.3.4.1.

2.1.4.5 Requirements for welding and design details when the rudder stock is connected to the rudder by horizontal flange coupling are described in 2.6.1.4.

2.1.4.6 Requirements for welding and design details of rudder horns are described in the *Rules for the classification of ships, Part 2 - Hull*, 12.3.3.2.7.

2.1.5 Equivalence

2.1.5.1 The *Register* may accept alternatives to requirements given in these requirements, provided they are deemed to be equivalent.

2.1.5.2 Direct analyses adopted to justify an alternative design are to take into consideration all relevant modes of failure, on a case by case basis. These failure modes may include, amongst others: yielding, fatigue, buckling and fracture. Possible damages caused by cavitation are also to be considered.

2.1.5.3 If deemed necessary by the *Register*, lab tests, or full scale tests may be requested to validate the alternative design approach.

2.1.6 Rudder area

In order to achieve sufficient manoeuvring capability the size of the movable rudder area is recommended to be not less than obtained from the following formula:

$$A = 0.0175 \cdot C_1 \cdot C_2 \cdot C_3 \cdot C_4 \cdot L \cdot d, \quad [\text{m}^2]$$

where:

- C_1 = factor depending upon the ship type:
 = 0.9 for tankers and bulk carriers having a displacement of more than 50 000 t;
 = 1.7 for tugs and trawlers
 = 1.0 for other ships;
- C_2 = factor for the rudder type:
 = 0.9 for semi-spade rudders
 = 0.8 for double rudders (per rudder)
 = 1.0 for other type;
- C_3 = factor depending upon the
 = 1.0 for NACA-profiles and plate rudder
 = 0.8 for hollow profiles
- C_4 = factor depending upon the rudder arrangement
 = 1.0 for rudders in the propeller jet
 = 1.5 for rudders outside the propeller jet.

For semi-spade rudders 50% of the projected area of the rudder horn may be included into rudder area.

2.2 RUDDER FORCE AND RUDDER TORQUE

2.2.1 Rudder blades without cut-outs

(see Fig. 2.2.1.1)

2.2.1.1 The rudder force upon which the rudder scantlings are to be based is to be determined according to the following formula:

$$C_R = 132 \cdot A \cdot v^2 \cdot k_1 \cdot k_2 \cdot k_3$$

where:

C_R = rudder force, in [N];

A = area of rudder blade, in [m²]

v = maximum service speed, in [knots], with ship on summer load waterline. When the speed is less than 10 knots, v is to be replaced by the expression:

$$v_{min} = \frac{(v + 20)}{3};$$

For the astern condition the maximum astern speed as defined in *SOLAS Regulation II-1/3.15* is to be used, however, in no case taken less than:

$$v_{astern} = 0.5 \cdot v$$

k_1 = factor depending on the aspect ratio A ;

$k_1 = (A + 2)/3$, with A not to be taken greater than 2;

$$A = \frac{b^2}{A_t},$$

b = mean height of the rudder area, in [m]. Mean breadth and mean height of rudder are calculated according to Fig. 2.2.1.1.

A_t = sum of rudder area A and area of rudder post or rudder horn, if any, within the height b , in [m²];

k_2 = factor depending on the type of the rudder profile according to Table 2.2.1.1;

$k_3 = 0,8$ for rudders outside the propeller jet;
 =1,15 for rudders behind a fixed propeller nozzle;
 =1,0 otherwise.

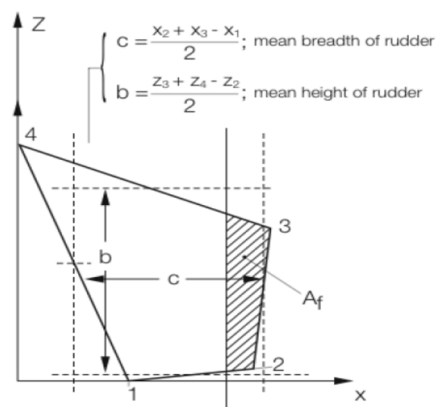


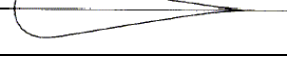
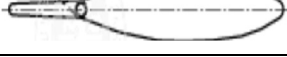
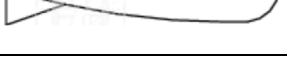
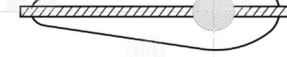


Figure 2.2.1.1

Table 2.2.1.1

Profile / type of rudder	k_2	
	Ahead condition	Astern condition
NACA – 00 series Gottingen 	1,10	0,80
Hollow profiles 	1,35	0,90
Flat side profiles 	1,10	0,90
High lift rudders 	1,70	1,30
Fish tails 	1,40	0,80
Single plate 	1,00	1,00
Mixed profiles (e.g. HSVA)	1,21	0,90

2.2.1.2 Rudder torque

The rudder torque is to be calculated for both the ahead and astern condition according to the formula:

$$Q_R = C_R \cdot r, \text{ in [Nm]}$$

where:

$$r = c (\alpha - K_A), \text{ in [m];}$$

$$c = \text{mean breadth of rudder area, in [m], (see Fig. 2.2.1.1);}$$

$$\alpha = 0,33 \text{ for ahead condition;}$$

$$\alpha = 0,66 \text{ for astern condition;}$$

$$K_A = \frac{A_f}{A},$$

where:

$$A_f = \text{portion of the rudder blade area situated ahead of the centre line of the rudder stock.}$$

$$r_{min} = 0,1 \cdot c, \text{ in [m], for ahead condition.}$$

2.2.2 Rudder blades with cut-outs (semi-spades rudders)

2.2.2.1 The total rudder force C_R is to be calculated according 2.2.1.1. The pressure distribution over the rudder area, upon which the determination of rudder torque and rudder blade strength are to be based, is to be derived as follows:

The rudder area may be divided into two rectangular or trapezoidal parts with areas A_1 and A_2 , so that $A=A_1+A_2$, see Fig. 2.2.2.1.

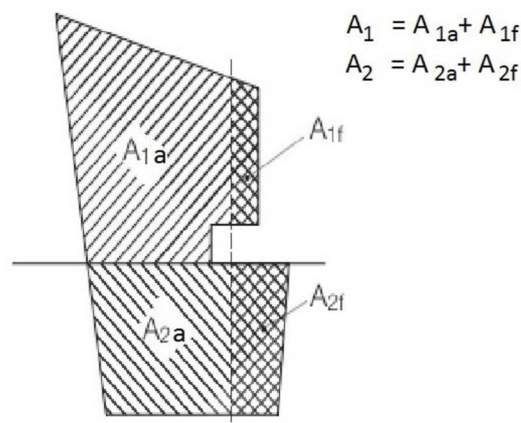


Figure 2.2.2.1

The levers r_1 and r_2 are to be determined as follows:

$$r_1 = c_1 (\alpha - K_1), \text{ in [m];}$$

$$r_2 = c_2 (\alpha - K_2), \text{ in [m];}$$

c_1, c_2 = mean breadth of partial areas A_1, A_2 determined, where applicable, in accordance with Fig. 2.2.1.1

$$K_1 = \frac{A_{1f}}{A_1};$$

$$K_2 = \frac{A_{2f}}{A_2};$$

A_{1a} = portion of A_1 situated aft of the centre line of the rudder stock

A_{1f} = portion of A_1 situated ahead of the centre line of the rudder stock

A_{2a} = portion of A_2 situated aft of the centre line of the rudder stock

A_{2f} = portion of A_2 situated ahead of the centre line of the rudder stock

$\alpha = 0,33$ for ahead condition

$\alpha = 0,66$ for astern condition

For parts of a rudder behind a fixed structure such as the rudder horn:

$\alpha = 0,25$ for ahead condition

$\alpha = 0,55$ for astern condition

The resulting force of each part may be taken as:

$$C_{R1} = C_R \cdot \frac{A_1}{A}, \quad [\text{N}]$$

$$C_{R2} = C_R \cdot \frac{A_2}{A}, \quad [\text{N}]$$

2.2.2.2 The resulting torque of each part may be taken as:

$$Q_{R1} = C_{R1} \cdot r_1, \quad [\text{Nm}]$$

$$Q_{R2} = C_{R2} \cdot r_2, \quad [\text{Nm}]$$

2.2.2.3 The total rudder torque is to be calculated for both the ahead and astern condition according to the formula:

$$Q_R = Q_{R1} + Q_{R2}, \quad [\text{Nm}]$$

For ahead condition Q_R is not to be taken less than:

$$Q_{Rmin} = 0,1 \cdot C_R \cdot \frac{A_1 \cdot c_1 + A_2 \cdot c_2}{A}$$

2.3 RUDDER STRENGTH CALCULATION

2.3.1 The rudder force and resulting rudder torque as given in 2.2 causes bending moments and shear forces in the rudder body, bending moments and torques in the rudder stock, supporting forces in pintle bearings and rudder stock bearings and bending moments, shear forces and torques in rudder horns and heel pieces. The rudder body is to be stiffened by horizontal and vertical webs enabling it to act as bending girder.

2.3.2 The bending moments, shear forces and torques as well as the reaction forces are to be determined by a direct calculation or by an approximate simplified method considered appropriate by the *Register*. For rudders supported by sole pieces or rudder horns these structures are to be included in the calculation model in order to account for the elastic support of the rudder body. Guidelines for calculation of bending moment and shear force distribution are given in 2.4.2.3 to 2.4.2.5.

2.4 RUDDER STOCK SCANTLINGS

2.4.1 The diameter of rudder stock

The rudder stock diameter required for the transmission of the rudder torque is to be dimensioned such that the torsional stress is not exceeding the following value:

$$\tau_t = 68 / k, \quad [\text{N/mm}^2]$$

The rudder stock diameter for the transmission of the rudder torque is therefore not to be less than:

$$d_t = 4,2 \cdot \sqrt[3]{Q_R \cdot k}, \quad [\text{mm}]$$

where:

Q_R = total rudder torque, in [Nm], as calculated in 2.2.1 and 2.2.2.

k = material factor for the rudder stock as given in 2.1.3.5.

2.4.2 Rudder stock scantlings due to combined loads

2.4.2.1 If the rudder stock is subjected to combined torque and bending, the equivalent stress in the rudder stock is not to exceed $118 / k$, in [N/mm²].

k = material factor for the rudder stock as given in 2.1.3.5.

The equivalent stress is to be determined by the formula:

$$\sigma_e = \sqrt{\sigma_b^2 + 3\tau_t^2}, \quad [\text{N/mm}^2]$$

Bending stress:

$$\sigma_b = \frac{10,2 \cdot 10^3 \cdot M}{d_c^3}, \quad [\text{N/mm}^2]$$

Torsional stress:

$$\tau_t = \frac{5,1 \cdot 10^3 \cdot Q_R}{d_c^3}, \quad [\text{N/mm}^2]$$

The rudder stock diameter is therefore not to be less than:

$$d_c = d_t \cdot \sqrt[6]{1 + \frac{4}{3} \left(\frac{M}{Q_R} \right)^2}, \quad [\text{mm}],$$

where:

M = bending moment, in [Nm], at the station of the rudder stock considered.

For a spade rudder with trunk extending inside the rudder, the rudder stock scantlings shall be checked against the two cases defined in 2.9.3.

2.4.2.2 When calculating the diameter of the rudder stock, cognizance must be taken of SOLAS II-1/29.3.3 and 29.4.3.

In this regard, the diameter mentioned in *SOLAS II-1/29.3.3*, 29.4.3 and 29.14 should be taken as having been calculated for rudder stock of mild steel with a yield strength of 235 N/mm² (i.e. with a material factor $k=1$).

See also *IACS Unified Interpretation SC153*.

2.4.3 Before significant reductions in rudder stock diameter are granted due to the application of steel with specified minimum yield stress exceeding 235 N/mm², the *Register* may require the evaluation of the rudder stock deformations. Large deformations of the rudder stock are to be avoided in order to avoid excessive edge pressures in way of bearings.

2.5 RUDDER BLADE

2.5.1 Permissible stresses

The section modulus and the web area of a horizontal section of the rudder blade are to be such that the following stresses will not be exceeded:

- a) In general, except in way of rudder recess sections where b) applies
- bending stress:
 $\sigma_b \leq 110/k$, N/mm²
- shear stress:

- $\tau \leq 50/k$, N/mm²
- equivalent stress:
 $\sigma_e = \sqrt{\sigma^2 + 3\tau^2} \leq 120/k$ N/mm²
- k = material factor for the rudder plating as given in 2.1.3.2.
- b) In way of the the recess for the rudder horn pintle on semi-spade rudders
- bending stress:
 $\sigma_b \leq 75$, N/mm²
 - shear stress:
 $\tau \leq 50$, N/mm²
 - equivalent stress:
 $\sigma_e = \sqrt{\sigma^2 + 3\tau^2} \leq 100$, N/mm²

Note: The stresses in b) apply equally to high tensile and ordinary steels.

2.5.2 Rudder plating

The thickness of the rudder side, top and bottom plating is not to be less than:

$$t = 5.5 \cdot s \cdot \beta \cdot \sqrt{k} \cdot \sqrt{T_{sc} + \frac{C_R \cdot 10^{-4}}{A}} + 2.5, \quad [\text{mm}]$$

where:

- T_{sc} = scantling draught, in [m];
 C_R = rudder force, in [N], according 2.2.1;
 A = rudder area, in [m²];

$$\beta = \sqrt{1.1 - 0.5 \left(\frac{s}{b} \right)^2}; \quad \text{max } 1.0, \text{ if } b/s \geq 2.5;$$

- s = smallest unsupported width of plating, in [m];
 b = greatest unsupported width of plating, in [m];
 k = material factor for the rudder plating as given in 2.1.3.2.

The thickness of the nose plates may be increased to the discretion of the *Register*. The thickness of web plates is not to be less than the greater of 70% of the rudder side plating thickness and 8 mm.

The rudder plating in way of the solid part is to be of increased thickness per 2.5.3.4.

2.5.3 Connections of rudder blade structure with solid parts

2.5.3.1 Solid parts in forged or cast steel, which house the rudder stock or the pintle, are normally to be provided with protrusions, except where not required as indicated below.

These protrusions are not required when the web plate thickness is less than:

- 10 mm, for web plates welded to the solid part on which the lower pintle of a semi-spade rudder is housed and for vertical web plates welded to the solid part of the rudder stock coupling of spade rudders.

- 20 mm, for other web plates.

2.5.3.2 The solid parts are in general to be connected to the rudder structure by means of two horizontal web plates and two vertical web plates.

2.5.3.3 Minimum section modulus of the connection with the rudder stock housing.

The section modulus of the cross-section of the structure of the rudder blade, in [cm³], formed by vertical web plates and rudder plating, which is connected with the solid part where the rudder stock is housed is to be not less than:

$$W_s = c_s \cdot d_c^3 \left(\frac{H_E - H_x}{H_E} \right) \frac{k}{k_s} 10^{-4}, \quad [\text{cm}^3]$$

where:

- c_s = coefficient, to be taken equal to:
 = 1.0 if there is no opening in the rudder plating or if such openings are closed by a full penetration welded plate
 = 1.5 if there is an opening in the considered cross-section of the rudder
- d_c = rudder stock diameter, in [mm]
 H_E = vertical distance between the lower edge of the rudder blade and the upper edge of the solid part, in [m]
 H_x = vertical distance between the considered cross-section and the upper edge of the solid part, in [m]
 k = material factor for the rudder blade plating as given in 2.1.3.2.
 k_s = material factor for the rudder stock as given in 2.1.3.5.

The actual section modulus of the cross-section of the structure of the rudder blade is to be calculated with respect to the symmetrical axis of the rudder.

The breadth of the rudder plating, in [m], to be considered for the calculation of section modulus is to be not greater than:

$$b = s_v + 2 H_x / 3, \text{ in [m]}$$

where:

- s_v = spacing between the two vertical webs, in [m], see Fig. 2.5.3.3.

Where openings for access to the rudder stock nut are not closed by a full penetration welded plate, they are to be deducted.

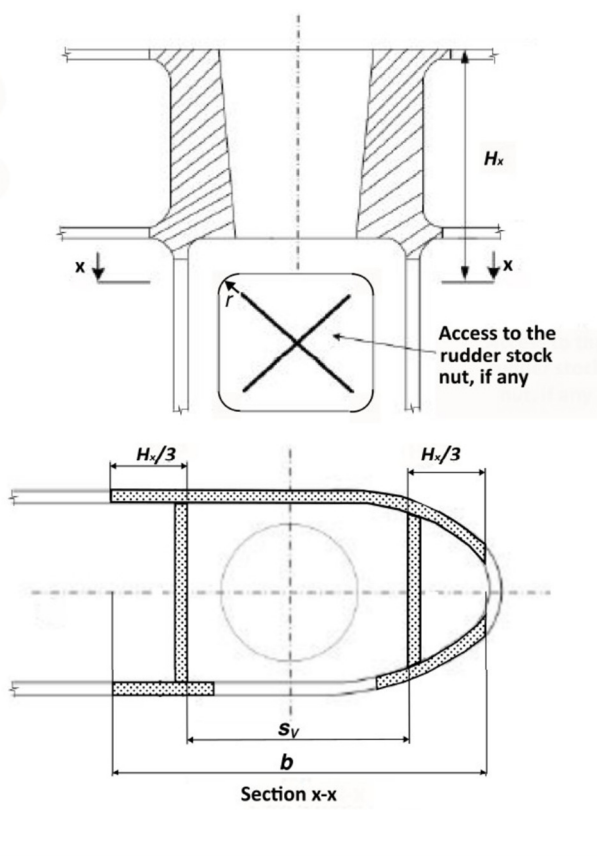


Figure 2.5.3.3 Cross-section of the connection between rudder blade structure and rudder stock housing, example with opening in only one side shown

2.5.3.4 The thickness of the horizontal web plates connected to the solid parts, in [mm], as well as that of the rudder blade plating between these webs, is to be not less than the greater of the following values:

$$t_H = 1.2 t, \quad [\text{mm}],$$

$$t_H = 0.045 d_s^2 / s_H, \quad [\text{mm}].$$

where:

- t = defined in 2.5.2,
- d_s = diameter, in [mm], to be taken equal to:
 - = d_c , as per 2.4.2, for the solid part housing the rudder stock,
 - = d_p , as per 2.7.1, for the solid part housing the pintle,
- s_H = spacing between the two horizontal web plates, in [mm].

The increased thickness of the horizontal webs is to extend fore and aft of the solid part at least to the next vertical web.

2.5.3.5 The thickness of the vertical web plates welded to the solid part where the rudder stock is housed as well as the thickness of the rudder side plating under this solid part is to be not less than the values obtained, in [mm], from Table 2.5.3.5.

Table 2.5.3.5

Type of rudder	Thickness of vertical web plates, in [mm]		Thickness of rudder plating, in [mm]	
	Rudder blade without opening	Rudder blade with opening	Rudder blade without opening	Area with opening
Rudder supported by sole piece	1.2 t	1.6 t	1.2 t	1.4 t
Semi-spade and spade rudders	1.4 t	2.0 t	1.3 t	1.6 t
t = thickness of the rudder plating, in [mm], as defined in 2.5.2				

The increased thickness is to extend below the solid piece at least to the next horizontal web.

2.5.4 Single plate rudders

2.5.4.1 Mainpiece diameter

The mainpiece diameter is calculated according to 2.4.1 and 2.4.2 respectively. For spade rudders the lower third may taper down to 0.75 times stock diameter.

2.5.4.2 Blade thickness

The blade thickness is not to be less than:

$$t_B = 1.5 \cdot s \cdot v \sqrt{k} + 2.5, \quad [\text{mm}],$$

where:

- s = spacing of stiffening arms, in [m]; not to exceed 1 m;
- v = speed of ship, in [knots], see 2.2.1.1;
- k = material factor for the rudder plating as given in 2.1.3.2

2.5.4.3 Arms

The thickness of the arms is not to be less than the blade thickness:

$$t_a = t_b, \quad [\text{mm}],$$

The section modulus is not to be less than:

$$W_a = 0.5 s C_l^2 v^2 k, \quad \text{in } [\text{cm}^3];$$

C_l = horizontal distance from the aft edge of the rudder to the centreline of the rudder stock, in [m].

k = material factor as given in 2.1.3.2 or 2.3.5 respectively.

2.6.3 Cone couplings with key

2.6.3.1 Tapering and coupling length

Cone couplings without hydraulic arrangements for mounting and dismounting the coupling should have a taper *c* on diameter of 1:8-1:12,

where

$$c = \frac{d_o - d_u}{l}, \text{ see Fig. 2.6.3.1-1 and Fig. 2.6.3.1-3}$$

The diameters *d_o*, in [mm], and *d_u*, in [mm], are shown in Fig. 2.6.3.1-1 and the cone length, *l_c*, in [mm], is defined in Fig. 2.6.3.1-3.

The cone coupling is to be secured by a slugging nut. The nut is to be secured, e.g. by a securing plate.

The cone shapes are to fit exactly. The coupling length *l*, in [mm], is to be, in general, not less than 1.5*d_o*.

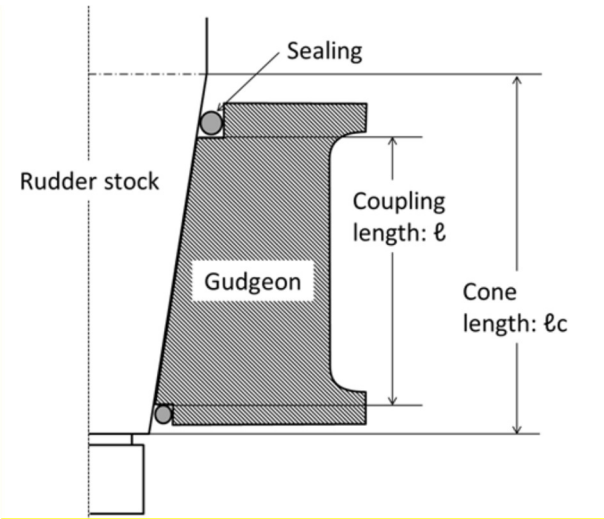


Figure 2.6.3.1-3 Cone length and coupling length

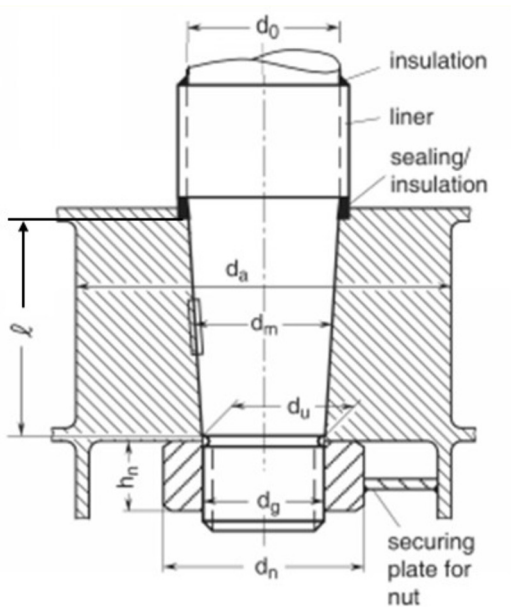


Figure 2.6.3.1-1 Cone coupling with key

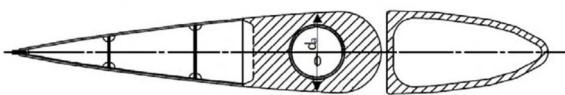


Figure 2.6.3.1-2 Gudgeon outer diameter (*d_a*) measurement

2.6.3.2 Dimensions of key

For couplings between stock and rudder a key is to be provided, the shear area of which, in [cm²], is not to be less than:

$$a_s = \frac{17.55 \cdot Q_F}{d_k \cdot R_{eH1}}$$

where:

Q_F = design yield moment of rudder stock, in [Nm]

$$Q_F = 0.02664 \frac{d_t^3}{k}$$

Where the actual diameter *d_{ia}* is greater than the calculated diameter *d_t*, the diameter *d_{ia}* is to be used. However, *d_{ia}* applied to the above formula need not be taken greater than 1.145 *d_t*.

d_t = stock diameter, in [mm], according to 2.4.1,

k = material factor for stock as given in 2.1.3.5,

d_k = mean diameter of the conical part of the rudder stock, in [mm], at the key,

R_{eH1} = specified minimum yield stress of the key material, in [N/mm²].

The effective surface area, in [cm²], of the key (without rounded edges) between key and rudder stock or cone coupling is not to be less than:

$$a_k = \frac{5 \cdot Q_F}{d_k \cdot R_{eH2}}$$

where:

R_{eH2} = specified minimum yield stress of the key, stock or coupling material, in [N/mm²], whichever is less.

2.6.3.3 The dimensions of the slugging nut are to be as follows (see Fig. 2.6.3.1-1):

- external thread diameter: $d_g \geq 0,65 \cdot d_o$
- height of nut: $h_n \geq 0,6 d_g$
- outer diameter of nut: $d_n \geq 1,2 \cdot d_u$ or $1,5 d_g$

whichever is the greater.

2.6.3.4 Push up

It is to be proved that 50% of the design yield moment is solely transmitted by friction in the cone couplings. This can be done by calculating the required push-up pressure and push-up length according to 2.6.4.2 and 2.6.4.3 for a torsional moment $Q'_F = 0.5Q_F$.

2.6.3.5 Notwithstanding the requirements in 2.6.3.2 and 2.6.3.4, where a key is fitted to the coupling between stock and rudder and it is considered that the entire rudder torque is transmitted by the key at the couplings, the scantlings of the key as well as the push-up force and push-up length are to be at the discretion of the Register.

2.6.4 Cone couplings with special arrangements for mounting and dismantling the couplings

2.6.4.1 Where the stock diameter exceeds 200 mm, the press fit is recommended to be effected by a hydraulic pressure connection. In such cases the cone is to be more slender, $c \approx 1:12$ to $\approx 1:20$.

In case of hydraulic pressure connections the nut is to be effectively secured against the rudder stock or the pintle.

For the safe transmission of the torsional moment by the coupling between rudder stock and rudder body the push-up pressure and the push-up length are to be determined according to 2.6.4.2 and 2.6.4.3 respectively.

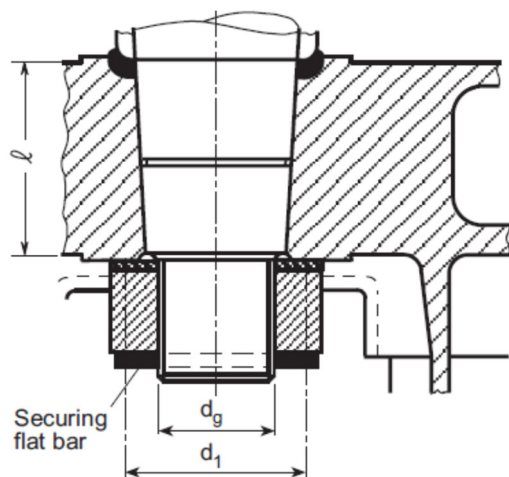


Figure 2.6.4.1 Cone coupling without key

2.6.4.2 Push-up pressure

The push-up pressure is not to be less than the greater of the two following values:

$$p_{req1} = \frac{2Q_F}{d_m^2 \cdot \ell \cdot \pi \cdot \mu_0} 10^3, \quad [\text{N/mm}^2]$$

$$p_{req2} = \frac{6M_c}{\ell^2 \cdot d_m} 10^3, \quad [\text{N/mm}^2]$$

where:

Q_F = design yield moment of rudder stock, as defined in 2.6.3.2, in [Nm],

d_m = mean cone diameter in [mm], see Fig. 2.6.3.1-1,

ℓ = coupling length, in [mm],

μ_0 = frictional coefficient, equal to 0.15,

M_c = bending moment in rudder stock at the top of the cone coupling (e.g. in case of spade rudders), in [Nm].

For a spade rudder with trunk extending inside the rudder, the rudder stock scantlings shall be checked against the two cases defined in 2.9.3.

It has to be proved by the designer that the push-up pressure does not exceed the permissible surface pressure in the cone. The permissible surface pressure, in [N/mm²], is to be determined by the following formula:

$$p_{perm} = \frac{0.95R_{eH} (1 - \alpha^2)}{\sqrt{3 + \alpha^4}} - p_b, \quad [\text{N/mm}^2]$$

where:

$$p_b = \frac{3.5M_c}{\ell^2 \cdot d_m} 10^3$$

R_{eH} = specified minimum yield stress of the material of the gudgeon, in [N/mm²],

α = d_m / d_a ,

d_m = diameter, in [mm], see Fig. 2.6.3.1-1,

d_a = outer diameter of the gudgeon, in [mm], see Fig. 2.6.3.1-1 and Fig. 2.6.3.1-2.

The least diameter is to be considered.

The outer diameter of the gudgeon, in [mm], shall not be less than $1.5 d_o$, with d_o defined in Fig. 2.6.3.1-1.

2.6.4.3 Push-up length

The push-up length $\Delta \ell$, in [mm], is to comply with the following formula:

$$\Delta \ell_1 \leq \Delta \ell \leq \Delta \ell_2$$

where:

$$\Delta \ell_1 = \frac{p_{req} \cdot d_m}{E \left(\frac{1 - \alpha^2}{2} \right) \cdot c} + \frac{0.8 \cdot R_{tm}}{c}, \quad [\text{mm}],$$

$$\Delta \ell_2 = \frac{p_{perm} \cdot d_m}{E \cdot \left(\frac{1 - \alpha^2}{2} \right) \cdot c} + \frac{0.8 \cdot R_{tm}}{c}, \quad [\text{mm}]$$

- R_m = mean roughness, in [mm], taken equal to 0.01,
 c = taper on diameter defined in 2.6.3.1-1, in [mm].

Note:

In case of hydraulic pressure connections the required push-up force P_e , in [N], for the cone may be determined by the following formula:

$$P_e = p_{req} \cdot d_m \cdot \pi \cdot \ell \cdot \left(\frac{c}{2} + 0.02 \right)$$

The value 0.02 is a reference for the friction coefficient using oil pressure. It varies and depends on the mechanical treatment and roughness of the details to be fixed.

Where due to the fitting procedure a partial push-up effect caused by the rudder weight is given, this may be taken into account when fixing the required push-up length, subject to approval by the *Register*.

2.7 PINTLES

2.7.1 Scantlings

The pintle diameter, in [mm], is not to be less than:

$$d_p = 0.35 \sqrt{B \cdot k_p}$$

where:

- B = relevant bearing force, in [N],
 k_p = material factor for pintle as given in 2.1.3.5

2.7.2 Couplings

2.7.2.1 Tapering

Pintles are to have a conical attachment to the gudgeons with a taper on diameter not greater than:

- 1:8 - 1:12, for keyed and other manually assembled pintles applying locking by slugging nut,
 1:12 - 1:20, on diameter for pintles mounted with oil injection and hydraulic nut.

2.7.2.2 Push-up pressure for pintle

The required push-up pressure for pintle in case of dry fitting, in N/mm², is to be determined by p_{req1} as given below.

The required push-up pressure for pintle in case of oil injection fitting, in [N/mm²], is to be determined by the maximum pressure of p_{req1} and p_{req2} as given below:

$$p_{req1} = 0.4 \frac{B d_0}{d_m^2 \ell}, \text{ [N/mm}^2\text{]}$$

$$p_{req2} = \frac{6 M_{bp}}{\ell^2 d_m} 10^3, \text{ [N/mm}^2\text{]}$$

where:

B = supporting force in the pintle bearing, in [N], e.g. B_1 as defined in Figure 2.9.5-1 for semi-spade rudder.

d_0 = pintle diameter, in [mm], see Fig. 2.6.3.1.

M_{bp} = bending moment in the pintle cone coupling to be determined by:

$$M_{bp} = B \ell_a, \text{ [Nm]}$$

ℓ_a = length between middle of pintle-bearing and top of contact surface between cone coupling and pintle in [m], see figure 2.7.2.2.

The required push up length, $\Delta \ell_1$, is to be calculated similarly as in 2.6.4.3, using the required push-up pressure as defined above, and properties for the pintle bearing.

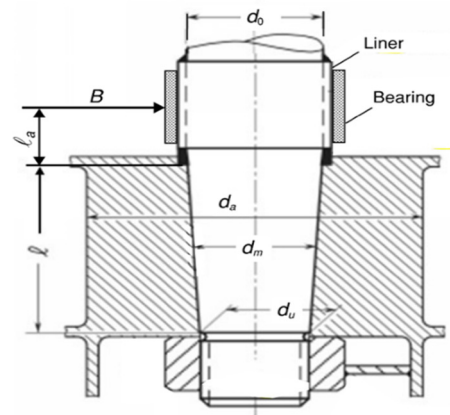


Figure 2.7.2.2 Pintle cone coupling indicating ℓ_a

2.7.3 The minimum dimensions of threads and nuts are to be determined according to 2.6.3.3

2.7.4 Pintle housing

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

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

2.8 RUDDER STOCK BEARING, RUDDER SHAFT BEARING AND PINTLE BEARING

2.8.1 Liners and bushes

2.8.1.1 Rudder stock bearing

Liners and bushes are to be fitted in way of bearings. For rudder stocks and pintles having diameter less than 200 mm, liners in way of bushes may be provided optionally. The minimum thickness of liners and bushes is to be equal to:

$t_{min} = 8$ mm, for metallic materials and synthetic material,

$t_{min} = 22$ mm, for lignum material.

2.8.1.2 Pintle bearing

The thickness of any liner or bush, in [mm], is neither to be less than:

$$t = 0.01\sqrt{B}$$

where:

$$B = \text{relevant bearing force, in [N],}$$

nor than the minimum thickness defined in 2.8.1.1.

2.8.2 Minimum bearing surface

An adequate lubrication is to be ensured.

The bearing surface A_b (defined as the projected area: length \times outer diameter of liner) is not to be less than:

$$A_b = \frac{P}{q_a}, \quad [\text{mm}^2]$$

where:

P = reaction force, in [N], in bearing as determined in 2.3.2;

q_a = allowable surface pressure according to the Table 2.8.2.

The allowable surface pressure q_a for the various combinations is to be taken as reported in the table below. Higher values than given in the table may be taken in accordance with maker's specifications if they are verified by tests.

Table 2.8.2

Bearing material	q_a [N/mm ²]
lignum vitae	2.5
white metal, oil lubricated	4.5
synthetic material with hardness greater than 60 Shore D ¹⁾	5.5 ²⁾
steel ³⁾ , bronze and hot-pressed bronze-graphite materials	7.0

Notes:

- 1) Indentation hardness test at 23°C and with 50% moisture, according to a recognised standard. Synthetic bearing materials is to be of approved type.
- 2) Surface pressures exceeding 5.5 N/mm² may be accepted in accordance with bearing manufacturer's specification and tests, but in no case more than 10 N/mm².
- 3) Stainless and wear-resistant steel in an approved combination with stock liner.

2.8.3 Bearing dimensions

The length/diameter ratio of the bearing surface is not to be greater than 1.2.

The bearing length L_p of the pintle is to be such that

$$D_p \leq L_p \leq 1.2 D_p$$

where:

D_p = actual pintle diameter measured on the outside of liners.

2.8.4 Bearing clearances

With metal bearings, clearances should not be less than $\frac{d_b}{1000} + 1.0$ mm on the diameter. If non-metallic

bearing material is applied, the bearing clearance is to be specially determined considering the material's swelling and thermal expansion properties. This clearance is not to be taken less than 1.5 mm on bearing diameter unless a smaller clearance is supported by the manufacturer's recommendation and there is documented evidence of satisfactory service history with a reduced clearance.

2.9 GUIDELINES FOR CALCULATION OF BENDING MOMENT AND SHEAR FORCE DISTRIBUTION

2.9.1 General

The evaluation of bending moments, shear forces and support forces for the system rudder-rudder stock may be carried out for some basic rudder types as outlined in 2.9.2 - 2.9.6.

2.9.2 Spade rudder

2.9.2.1 Data for the analysis

$l_{10} \div l_{30}$ = lengths of the individual girders of the system, in [m], see Fig. 2.9.2,

$I_{10} \div I_{30}$ = moments of inertia of these girders, in [cm⁴].

Load of rudder body:

$$P_R = \frac{C_R}{l_{10} \cdot 10^3}, \quad [\text{kN/m}]$$

2.9.2.2 Moments and forces

The moments and forces may be determined by the following formulae:

$$M_b = C_R \left[l_{20} + \frac{l_{10} \cdot (2 \cdot c_1 + c_2)}{3 \cdot (c_1 + c_2)} \right], \quad [\text{Nm}],$$

$$B_3 = M_b / l_{30}, \quad [\text{N}],$$

$$B_2 = C_R + B_3, \quad [\text{N}].$$

The maximum moment, M_C , in top of the cone coupling as shown in Figure 2.9.2 is applicable for the connection between the rudder and the rudder stock.

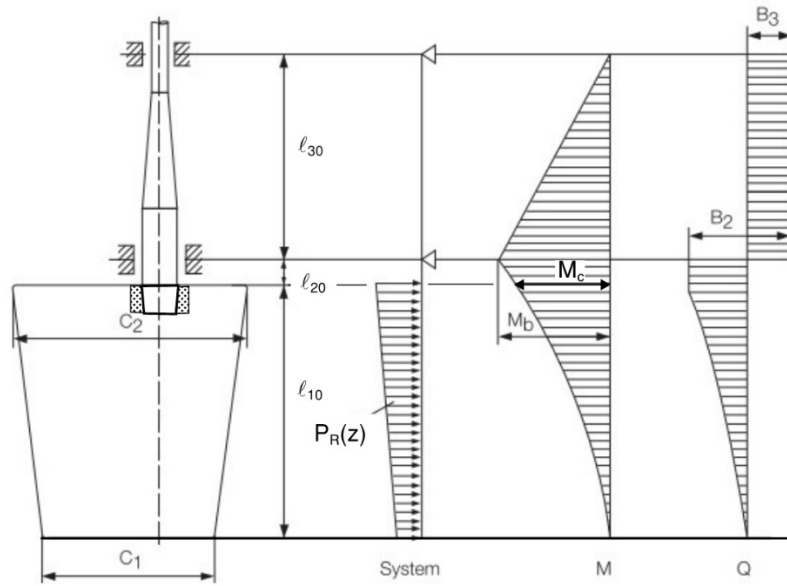


Figure 2.9.2
Spade rudder

2.9.3 Spade rudder with trunk

2.9.3.1 Data for the analysis

$l_{10} \div l_{30}$ = lengths of the individual girders of the system, in [m], see Fig. 2.9.3,
 $I_{10} \div I_{30}$ = moments of inertia of these girders, in [cm⁴].

Load of rudder body:

$$P_R = \frac{C_R}{(l_{10} + l_{20}) \cdot 10^3}, \quad [\text{kN/m}].$$

2.9.3.2 Moments and forces

For a spade rudder with trunk extending inside the rudder, the strength shall be checked against the following two cases:

1. pressure applied on the entire rudder area
2. pressure applied only on rudder area below the middle of neck bearing.

The moments and forces for the two cases defined above may be determined according to Figure 2.9.3-1 and Figure 2.9.3-2, respectively.

$$M_{CR1} = C_{R1} (CG_{1Z} - l_{10}), \quad [\text{Nm}],$$

$$M_{CR2} = C_{R2} (l_{10} - CG_{2Z}), \quad [\text{Nm}],$$

where:

- C_{R1} = rudder force over the rudder blade area A_1
- C_{R2} = rudder force over the rudder blade area A_2
- CG_{1Z} = vertical position of the centre of gravity of the rudder blade area A_1 , from base
- CG_{2Z} = vertical position of the centre of gravity of the rudder blade area A_2 , from base

$$C_R = C_{R1} + C_{R2}$$

$$B_3 = (M_{CR2} - M_{CR1}) / (l_{20} + l_{30})$$

$$B_2 = C_R + B_3$$

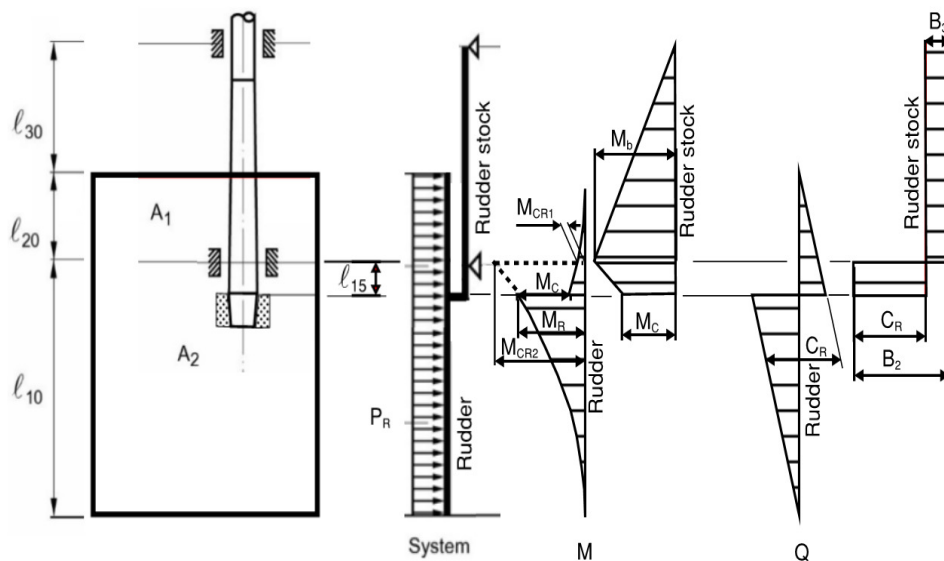


Figure 2.9.3-1
Spade rudder with trunk (case 1)

Full rudder force $C_R = C_{R1} + C_{R2}$ and total rudder torque $Q_R = Q_{R1} + Q_{R2}$ with rudders stock bending moment $M_b = M_{CR2} - M_{CR1}$

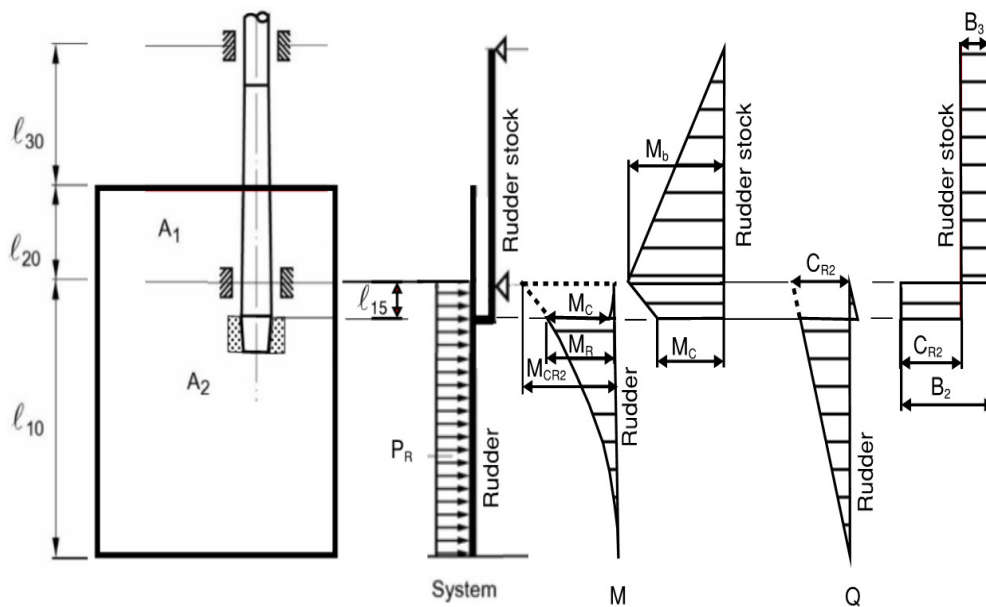


Figure 2.9.3-2
Spade rudder with trunk (case 2)

Rudder force C_{R2} corresponding to rudder torque Q_{R2} acting at rudder blade area A_2 with rudders stock bending moment $M_b = M_{CR2}$

2.9.4 Rudder supported by sole piece

2.9.4.1 Data for the analysis

$\ell_{10} - \ell_{50}$ = lengths of the individual girders of the system in [m],
 $I_{10} - I_{50}$ = moments of inertia of these girders, in [cm⁴].

For rudders supported by a sole piece the length ℓ_{20} is the distance between lower edge of rudder body and centre of sole piece and I_{20} the moment of inertia of the pintle in the sole piece.

I_{50} = moment of inertia of sole piece around the z-axis, in [cm⁴];
 ℓ_{50} = effective length of sole piece, in [m];

Load of rudder body:

$P_R = C_R / (\ell_{10} 10^3)$, in [kN/m],
 Z = spring constant of support in the sole piece
 $Z = 6.18 I_{50} / \ell_{50}^3$ [kN/m].

2.9.4.2 Moments and forces

Moments and shear forces are indicated in Fig. 2.9.4

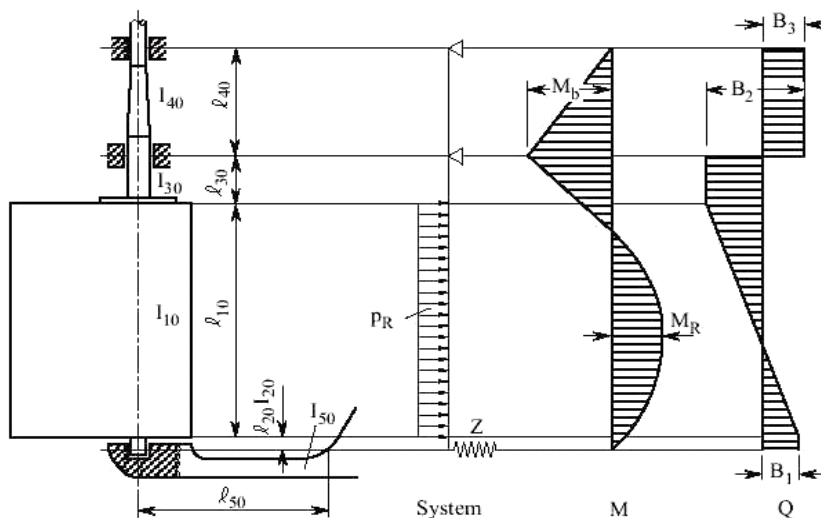


Figure 2.9.4 Rudder supported by sole piece

2.9.5 Semi spade rudder with one elastic support

2.9.5.1 Data for the analysis

$\ell_{10} - \ell_{50}$ = lengths of the individual girders of the system in [m];
 $I_{10} - I_{50}$ = moments of inertia of these girders in [cm⁴];
 Z = spring constant of support in the rudder horn;
 $Z = 1 / (f_b + f_i)$, in [kN/m], for the support in the rudder horn (Fig. 2.9.5-1);
 f_b = unit displacement of rudder horn, in [m], due to a unit force of 1 kN acting in the centre of support;
 $f_b = 1.3 d^3 / (6.18 I_n)$, in [m/kN], (guidance value);
 I_n = moment of inertia of rudder horn around the x-axis, in [cm⁴], (see also Fig. 2.9.5-1);

f_i = unit displacement due to torsion;
 $f_i = d \cdot e^2 \sum \mu_i / t_i / (3.14 \cdot 10^8 \cdot F_T^2)$, [m/kN];
 F_T = mean sectional area of rudder horn, in [m²];
 u_i = breadth, in [mm], of the individual plates forming the mean horn sectional area;
 t_i = thickness within the individual breadth u_i in [mm];
 d = height of the rudder horn, in m, defined in Fig. 2.9.5-1. This value is measured downwards from the upper rudder horn end, at the point of curvature transition, to the mid-line of the lower rudder horn pintle;
 e = distance as defined in Fig. 2.9.5-2

Load of rudder body:

$PR_{10} = C_{R2} / (\ell_{10} \times 10^3)$, [kN/m];
 $PR_{20} = C_{R1} / (\ell_{10} \times 10^3)$, [kN/m];

for C_R, C_{R1}, C_{R2} , see 2.2.

2.9.5.2 Moments and forces

Moments and shear forces are indicated in Fig.

2.9.4.

2.9.5.3 Rudder horn

The loads on the rudder horn are as follows:

$M_b =$ bending moment $= B_1 z$, [Nm],

$M_{bmax} = B_1 d$, [Nm]

$q =$ shear force $= B_1$, [N],

$M_T(z) =$ torsional moment $= B_1 e(z)$, [Nm],

An estimate for B_1 is:

$B_1 = C_R b / (\ell_{20} + \ell_{30})$, [N]

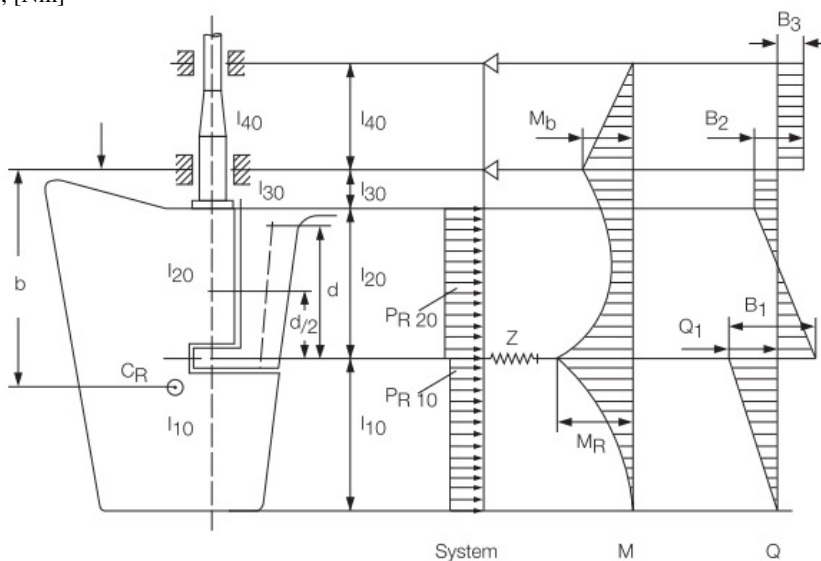


Figure 2.9.5-1 Semi spade rudder with one elastic support

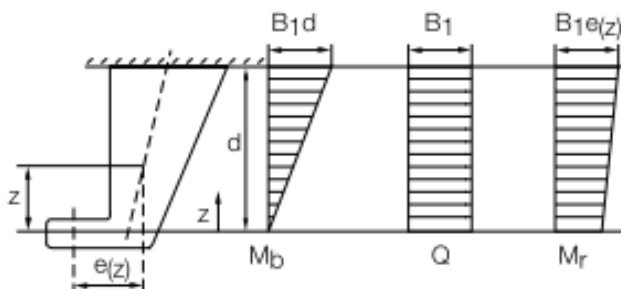


Figure 2.9.5-2 Rudder horn

2.9.6 Semi spade rudder with 2-conjugate elastic support

terms of horizontal displacements, y_i , by the following equations:

2.9.6.1 Data for the analysis

K_{11}, K_{12}, K_{22} : rudder horn compliance constants calculated for rudder horn with 2-conjugate elastic supports (Fig. 2.9.6-1). The 2-conjugate elastic supports are defined in

- at the lower rudder horn bearing:

$y_1 = -K_{12} B_2 - K_{22} B_1$

- at the upper rudder horn bearing:

$$y_2 = -K_{11} B_2 - K_{12} B_1$$

where:

y_1, y_2 = horizontal displacements, in [m], at the lower and upper rudder horn bearings, respectively.

B_1, B_2 = horizontal support forces, in [kN], at the lower and upper rudder horn bearings, respectively.

K_{11}, K_{12}, K_{22} = obtained, in [m/kN], from the following formulae:

$$K_{11} = 1.3 \frac{\lambda^3}{3EJ_{1h}} + \frac{e^2 \lambda}{GJ_{th}}$$

$$K_{12} = 1.3 \cdot \left(\frac{\lambda^3}{3EJ_{1h}} + \frac{\lambda^2 \cdot (d - \lambda)}{2EJ_{1h}} \right) + \frac{e^2 \lambda}{GJ_{th}}$$

$$K_{22} = 1.3 \cdot \left[\frac{\lambda^3}{3EJ_{1h}} + \frac{\lambda^2 \cdot (d - \lambda)}{EJ_{1h}} + \frac{\lambda \cdot (d - \lambda)^2}{EJ_{1h}} + \frac{(d - \lambda)^3}{3EJ_{2h}} \right] + \frac{e^2 d}{GJ_{th}}$$

d = height of the rudder horn, in [m], defined in Fig. 2.9.6-1. This value is measured downwards from the upper rudder horn end, at the point of curvature transition, to the mid-line of the lower rudder horn pintle.

λ = length, in [m], as defined in Fig. 2.9.6-1. This length is measured downwards from the upper rudder horn end, at the point of curvature transition, to the mid-line of the upper rudder horn bearing. For $\lambda = 0$, the above formulae converge to those of spring constant Z for a rudder horn with 1-elastic support, and assuming a hollow cross section for this part.

e = rudder-horn torsion lever, in [m], as defined in Fig. 2.9.6-1 (value taken at $z = d/2$).

J_{1h} = moment of inertia of rudder horn about the x axis, in [m⁴], for the region above the upper rudder horn bearing. Note that J_{1h} is an average value over the length λ (see Fig. 2.9.6-1).

J_{2h} = moment of inertia of rudder horn about the x axis, in [m⁴], for the region between the upper and lower rudder horn bearings. Note that J_{2h} is an average value over the length $d - \lambda$ (see Fig. 2.9.6-1).

J_{th} = torsional stiffness factor of the rudder horn, in [m⁴].

For any thin wall closed section:

$$J_{th} = \frac{4 \cdot F_T^2}{\sum \frac{u_i}{t_i}}$$

F_T = mean of areas enclosed by outer and inner boundaries of the thin walled section of rudder horn, in [m²].

u_i = length, in [mm], of the individual plates forming the mean horn sectional area.

t_i = thickness, in [mm], of the individual plates mentioned above.

Note that the J_{th} value is taken as an average value, valid over the rudder horn height.

Load of rudder body:

$$P_{R10} = C_{R2} / (\ell_{10} \times 10^3) \text{ [kN/m];}$$

$$P_{R20} = C_{R1} / (\ell_{10} \times 10^3) \text{ [kN/m];}$$

for C_R, C_{R1}, C_{R2} , see 2.2.

2.9.6.2 Moments and forces

Moments and shear forces are indicated in Fig. 2.9.6-1.

2.9.6.3 Rudder horn bending moment

The bending moment acting on the generic section of the rudder horn is to be obtained, in [Nm], from the following formulae:

- between the lower and upper supports provided by the rudder horn:

$$M_H = F_{A1} z$$

- above the rudder horn upper-support:

$$M_H = F_{A1} z + F_{A2} (z - d_{lu})$$

where:

F_{A1} = support force at the rudder horn lower-support, in [N], to be obtained according to Fig. 2.9.6-1, and taken equal to B_1 .

F_{A2} = support force at the rudder horn upper-support, in [N], to be obtained according to Fig. 2.9.6-1, and taken equal to B_2 .

z = distance, in m, defined in Fig. 2.9.6-2, to be taken less than the distance d , in [m], defined in the same figure.

d_{lu} = distance, in [m], between the rudder-horn lower and upper bearings (according to Fig. 2.9.6-1, $d_{lu} = d - \lambda$).

2.9.6.4 Rudder horn shear force

The shear force Q_H acting on the generic section of the rudder horn is to be obtained, in [N], from the following formulae:

- between the lower and upper rudder horn bearings:

$$Q_H = F_{A1}$$

- above the rudder horn upper-bearing:

$$Q_H = F_{A1} + F_{A2}$$

where:

F_{A1}, F_{A2} = support forces, in [N].

The torque acting on the generic section of the rudder horn is to be obtained, in [Nm], from the following formulae:

- between the lower and upper rudder horn bearings:

$$M_T = F_{A1} e(z)$$

- above the rudder horn upper-bearing:

$$M_T = F_{A1} e(z) + F_{A2} e(z)$$

where:

F_{A1}, F_{A2} = support forces, in [N],

$e(z)$ = torsion lever, in [m], defined in Fig. 2.9.6-2.

2.9.6.5 Rudder horn shear stress calculation

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

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

$$\tau_s = \frac{F_{A1}}{A_H}$$

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

$$\tau_T = \frac{M_T \cdot 10^3}{2 \cdot F_T \cdot t_H}$$

For solid rudder horn, τ_T is to be considered by the *Register* on a case by case basis.

For a generic section of the rudder horn, located in the region above its upper bearing, the following stresses are to be calculated:

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

$$\tau_s = \frac{F_{A1} + F_{A2}}{A_H}$$

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

$$\tau_T = \frac{M_T \cdot 10^3}{2 \cdot F_T \cdot t_H}$$

For solid rudder horn, τ_T is to be considered by the *Register* on a case by case basis where:

F_{A1}, F_{A2} = support forces, in [N];

A_H = effective shear sectional area of the rudder horn, in [mm²], in *y*-direction;

M_T = torque, in [Nm];

F_T = mean of areas enclosed by outer and inner boundaries of the thin walled section of rudder horn, in m²;

t_H = plate thickness of rudder horn, in [mm].
For a given cross section of the rudder horn, the maximum value of τ_T is obtained at the minimum value of t_H .

2.9.6.6 Rudder horn bending stress calculation

For the generic section of the rudder horn within the length *d*, the following stresses are to be calculated:

σ_B = bending stress, in [N/mm²], to be obtained from the following formula:

$$\sigma_B = \frac{M_H}{W_X}$$

where:

M_H = bending moment at the section considered, in [Nm].

W_X = section modulus, in [cm³], around the *X*-axis (see Fig. 2.9.6-2).

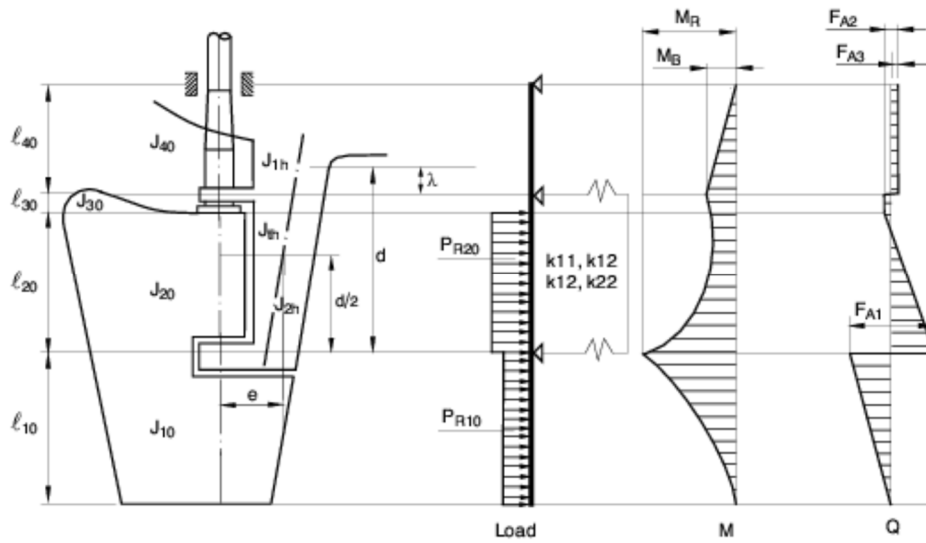


Figure 2.9.6 -1 Semi spade rudder with one elastic support

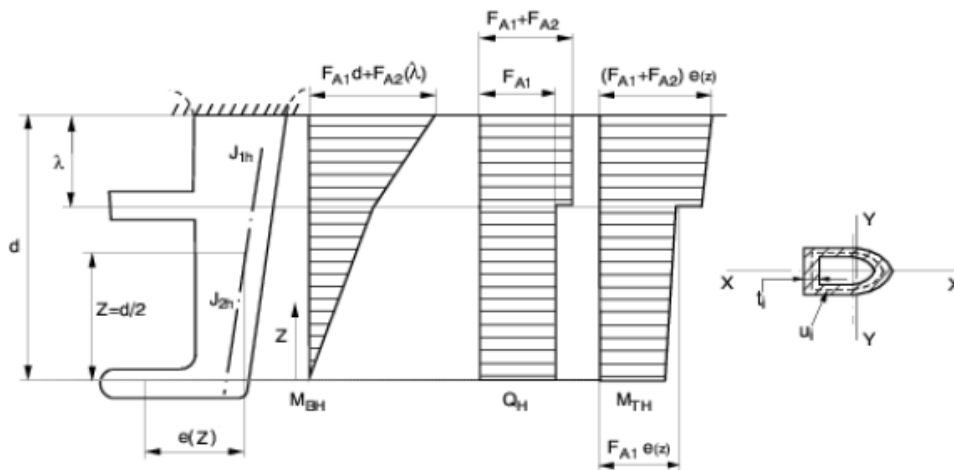


Figure 2.9.6 -2 Rudder horn

2.10 PROPELLER NOZZLES

2.10.1 General

The following requirements are applicable to propeller nozzles having an inner diameter up to 5 m.

Special attention is to be given to the support of fixed nozzles at the hull structure.

2.10.2 Design pressure

The design pressure for propeller nozzles is to be determined by the following formula:

$$p_d = c \cdot p, \quad [\text{kN/m}^2]$$

where:

$$p = \varepsilon \frac{P_s}{A_p}, \quad [\text{kN/m}^2];$$

P_s = maximum shaft power, in [kW];

A_p = propeller disc area, in [m²];

$$= \frac{D^2 \cdot \pi}{4}$$

D = propeller diameter, in [m];

ε = factor according to the following formula:

$$\varepsilon = 0.21 - 2 \cdot 10^{-4} \frac{P_s}{A_p}$$

$\varepsilon_{\min} = 0,1;$

$c = 1,0$ in zone 2;

$c = 0,5$ in zones 1 and 3;

$c = 0,35$ in zone 4

For nozzle zones see Fig. 2.10.2.

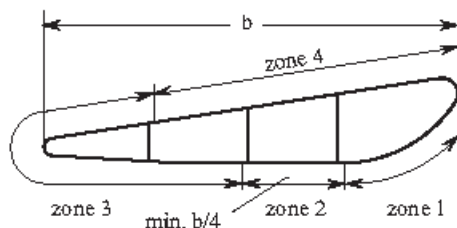


Figure 2.10.2

2.10.3 Plate thickness

2.10.3.1 The thickness of the nozzle shell plating is not to be less than:

$$t = 5 \cdot s \cdot \sqrt{p_d} + 2.5, \quad [\text{mm}]$$

$$t_{min} = 7.5 \text{ mm}$$

where:

$$s = \text{spacing of ring stiffeners, in [m]}$$

2.10.3.2 The web thickness of the internal stiffening ring is not to be less than the nozzle plating for zone 3, however, in no case be less than 7,5 mm.

2.10.4 Section modulus

The section modulus of the cross section shown in Fig. 2.10.2 around its neutral axis is not to be less than:

$$W = n \cdot d^2 \cdot b \cdot v^2, \quad [\text{cm}^3]$$

where:

- d - inner diameter of nozzle, in [m];
- b - length of nozzle, in [m],
- $n = 0,7$ for fixed nozzles;
- $n = 1,0$ for rudder nozzles;
- v = speed of ship according 2.2.1.1.

2.10.5 Welding

The inner and outer nozzle shell plating is to be welded to the internal stiffening rings as far as practicable by double continuous welds. Plug welding is only permissible for the outer nozzle plating.

2.11 REQUIREMENTS FOR THE SHIPS WITH POLAR AND ICE CLASS NOTATION

2.11.1 For the ships with polar class notations see the *Rules for the classification of ships, Part 29 – Polar Class Ships and Ice Class Ships*, 3.11.

2.11.2 For the ships with ice class notations see the *Rules for the classification of ships, Part 29 – Polar Class Ships and Ice Class Ships*, 8.11.

3 ANCHORING ARRANGEMENT

3.1 GENERAL PROVISIONS

3.1.1 The anchoring equipment required herewith is intended for temporary mooring of a ship within a harbour or sheltered area when the ship is awaiting berth, tide, etc. IACS Recommendation No. 10 "Anchoring, Mooring and Towing Equipment" may be referred to for recommendations concerning anchoring equipment for ships in deep and unsheltered water.

3.1.2 The equipment is therefore not designed to hold a ship off fully exposed coasts in rough weather or to stop a ship, which is moving or drifting. In this condition the loads on the anchoring equipment increase to such a degree that its components may be damaged or lost owing to the high energy forces generated, particularly in large ships.

3.1.3 The anchoring equipment required herewith is designed to hold a ship in good holding ground in conditions such as to avoid dragging of the anchor. In poor holding ground the holding power of the anchors is significantly reduced.

3.1.4 The Equipment Number (E_n) formulae for anchoring equipment as given in 3.2.1, 3.2.3 and 3.2.4 are based on an assumed maximum current speed of 2.5 m/s, maximum wind speed of 25 m/s and a minimum scope of chain cable of 6, the scope being the ratio between length of chain paid out and water depth. For ships with an equipment length, as defined in 3.2.2, greater than 135 m, alternatively the required anchoring equipment can be considered applicable to a maximum current speed of 1.54 m/s, a maximum wind speed of 11 m/s and waves with maximum significant height of 2 m.

Table 3.1.2-1 Anchoring and mooring equipment

Equipment letter	Equipment number		Stockless bower anchor			Stud link chain cables			Stream wire or chain		Tow line ²⁾		Mooring line ³⁾			
	Exc.	Not exc.	No.	Mass per anchor	Stream anchor	Total length	Min. diameter			Length	Breaking strength	Minimum length	Ship design minimum breaking load	No.	Length of each line	Ship design minimum breaking load
							Mild steel CRS-L1	Special quality CRS-L2	Extra special quality CRS-L3							
			[kg]	[kg]	[m]	[mm]	[mm]	[mm]	[m]	[kN]	[m]	[kN]		[m]	[kN]	
A1	10	15	2	35	-	110		-	-	-	-	-	-	2	30	29
A2	15	20	2	50	-	137,5	1)	-	-	-	-	-	-	2	30	29
A3	20	25	2	65	-	165		-	-	-	-	-	-	2	40	29
A4	25	30	2	80	-	165	11	-	-	-	-	-	-	2	50	29
A5	30	40	2	105	35	192,5	11	-	-	55	55	120	65	2	50	29
A6	40	50	2	135	45	192,5	12,5	-	-	70	60	150	81	2	60	29
A7	50	70	2	180	60	220	14	12,5	-	80	64.7	180	98	3	80	37
A8	70	90	2	240	80	220	16	14	-	85	73.5	180	98	3	100	40
A9	90	110	2	300	100	247,5	17,5	16	-	85	80	180	98	3	110	42
B1	110	130	2	360	120	247,5	19	17,5	-	90	89.2	180	98	3	110	48
B2	130	150	2	420	140	275	20,5	17,5	-	90	98.1	180	98	3	120	53
B3	150	175	2	480	165	275	22	19	-	90	107.9	180	98	3	120	59
B4	175	205	2	570	190	302,5	24	20,5	-	90	117.7	180	112	3	120	64
B5	205	240	2	660	-	302,5	26	22	20,5	-	-	180	129	4	120	69
B6	240	280	2	780	-	330	28	24	22	-	-	180	150	4	120	75
B7	280	320	2	900	-	357,5	30	26	24	-	-	180	174	4	140	80
B8	320	360	2	1020	-	357,5	32	28	24	-	-	180	207	4	140	85
B9	360	400	2	1140	-	385	34	30	26	-	-	180	224	4	140	96
C1	400	450	2	1290	-	385	36	32	28	-	-	180	250	4	140	107
C2	450	500	2	1440	-	412,5	38	34	30	-	-	180	277	4	140	117
C3	500	550	2	1590	-	412,5	40	34	30	-	-	190	306	4	160	134
C4	550	600	2	1740		440	42	36	32			190	338	4	160	143
C5	600	660	2	1920		440	44	38	34			190	370	4	160	160
C6	660	720	2	2100		440	46	40	36			190	406	4	160	171
C7	720	780	2	2280		467,5	48	42	36			190	441	4	170	187
C8	780	840	2	2460		467,5	50	44	38			190	479	4	170	202
C9	840	910	2	2640		467,5	52	46	40			190	518	4	170	218
D1	910	980	2	2850		495	54	48	42			190	559	4	170	235
D2	980	1060	2	3060		495	56	50	44			200	603	4	180	250
D3	1060	1140	2	3300		495	58	50	46			200	647	4	180	272

Table 3.1.2-1 - continued

Equipment letter	Equipment number		Stockless bower anchor			Stud link chain cables				Stream wire or chain		Tow line ²⁾		Mooring line ³⁾		
	Exc.	Not exc.	No.	Mass per anchor	Stream anchor	Total length	Min. diameter			Length	Breaking strength	Minimum length	Ship design minimum breaking load	No.	Length of each line	Ship design minimum breaking load
							Mild steel CRS-L1	Special quality CRS-L2	Extra special quality CRS-L3							
				[kg]	[kg]	[m]	[mm]	[mm]	[mm]	[m]	[kN]	[m]	[kN]		[m]	[kN]
D4	1140	1220	2	3540		522,5	60	52	46			200	691	4	180	293
D5	1220	1300	2	3780		522,5	62	54	48			200	738	4	180	309
D6	1300	1390	2	4050		522,5	64	56	50			200	786	4	180	336
D7	1390	1480	2	4320		550	66	58	50			200	836	4	180	352
D8	1480	1570	2	4590		550	68	60	52			220	888	5	190	352
D9	1570	1670	2	4890		550	70	62	54			220	941	5	190	362
E1	1670	1790	2	5250		577,5	73	64	56			220	1024	5	190	384
E2	1790	1930	2	5610		577,5	76	66	58			220	1109	5	190	411
E3	1930	2080	2	6000		577,5	78	68	60			220	1168	5 ⁴⁾	190 ⁴⁾	437 ⁴⁾
E4	2080	2230	2	6450		605	81	70	62			240	1259			
E5	2230	2380	2	6900		605	84	73	64			240	1356			
E6	2380	2530	2	7350		605	87	76	66			240	1453			
E7	2530	2700	2	2700	-	632,5	90	78	68	-	-	260	1471			
E8	2700	2870	2	8300	-	632,5	92	81	70	-	-	260	1471			
E9	2870	3040	2	8700	-	632,5	95	84	73	-	-	260	1471			
F1	3040	3210	2	9300	-	660	97	84	76	-	-	280	1471			
F2	3210	3400	2	9900	-	660	100	87	78	-	-	280	1471			
F3	3400	3600	2	10500	-	660	102	90	78	-	-	280	1471			
F4	3600	3800	2	11100	-	687,5	105	92	81	-	-	300	1471			
F5	3800	4000	2	11700	-	687,5	107	95	84	-	-	300	1471			
F6	4000	4200	2	12300	-	687,5	111	97	87	-	-	300	1471			
F7	4200	4400	2	12900	-	715	114	100	87	-	-	300	1471			
F8	4400	4600	2	13500	-	715	117	102	90	-	-	300	1471			
F9	4600	4800	2	14100	-	715	120	105	92	-	-	300	1471			
G1	4800	4800	2	14700	-	742,5	122	107	95	-	-	300	1471			
G2	5000	5000	2	15400	-	742,5	124	111	97	-	-	300	1471			
G3	5200	5200	2	16100	-	742,5	127	111	97	-	-	300	1471			
G4	5500	5800	2	16900	-	742,5	130	114	100	-	-	300	1471			
G5	5800	6100	2	17800	-	742,5	132	117	102	-	-	300	1471			
G6	6100	6500	2	18800	-	742,5	-	120	107	-	-	300	1471			
G7	6500	6900	2	20000	-	770	-	124	111	-	-	300	1471			
G8	6900	7400	2	21500	-	770	-	127	114	-	-	300	1471			
G9	7400	7900	2	23000	-	770	-	132	117	-	-	300	1471			
H1	7900	8400	2	24500	-	770	-	137	122	-	-	300	1471			
H2	8400	8900	2	26000	-	770	-	142	127	-	-	300	1471			
H3	8900	9400	2	27500	-	770	-	147	132	-	-	300	1471			
H4	9400	10000	2	29000	-	770	-	152	132	-	-	300	1471			
H5	10000	10700	2	31000	-	770	-	-	137	-	-					
H6	10700	11500	2	33000	-	770	-	-	142	-	-					
H7	11500	12400	2	35500	-	770	-	-	147	-	-					
H8	12400	13400	2	38500	-	770	-	-	152	-	-					
H9	13400	14600	2	42000	-	770	-	-	157	-	-					
I1	14600	16000	2	46000	-	770	-	-	162	-	-					

1) Chain cables or wire ropes may be used, chain cable breaking load or actual breaking strength of rope being not less than 44 kN.
2) Towing lines are recommendations only.
3) Guidance for mooring lines for ships with equipment number $En > 2000$ is given in *IACS Rec. No. 10*.
4) Value is applicable for ships with equipment number $1930 < En \leq 2000$.

Table 3.1.2-2 Equipment for fishing vessels

Equipment letter	Equipment number		Stockless bower anchors		Stud link chain cables for anchors			Mooring line		
	Exceeding	Not exceeding	Number	Mass anchor	Total length	Min. diameter		Number	Minimum length of each line	Ship design minimum breaking load
						Mild steel CRS-L1	Special quality CRS-L2			
				[kg]	[m]	[mm]	[mm]		[m]	[kN]
a1		to 30	2	70	137.5	¹⁾	-	2	40	25
a2	30	40	2	80	165	11.0	-	2	50	29
a3	40	50	2	100	192.5	11.0	-	2	60	29
a4	50	60	2	120	192.5	12.5	-	2	60	29
a5	60	70	2	140	192.5	12.5	-	2	80	29
a6	70	80	2	160	220	14	12.5	2	100	34
a7	80	90	2	180	220	14	12.5	2	100	36.8
a8	90	100	2	210	220	16	14	2	110	36.8
a9	100	110	2	240	220	16	14	2	110	39
b1	110	120	2	270	247.5	17.5	16	2	110	39
b2	120	130	2	300	247.5	17.5	16	2	110	44
b3	130	140	2	340	275	19	17,5	2	120	44
b4	140	150	2	390	275	19	17,5	2	120	49
b5	150	175	2	480	275	22	19	2	120	54
b6	175	205	2	570	302.5	24	20,5	2	120	59
b7	205	240	2	660	302.5	26	22	2	120	64
b8	240	280	2	780	330	28	24	3	120	71
b9	280	320	2	900	357.5	30	26	3	140	78
c1	320	360	2	1020	357.5	32	28	3	140	85.8
c2	360	400	2	1140	385	34	30	3	140	93
c3	400	450	2	1290	385	36	32	3	140	101
c4	450	500	2	1440	412.5	38	34	3	140	108
c5	500	550	2	1590	412.5	40	34	4	160	113
c6	550	600	2	1740	440	42	36	4	160	118
c7	600	660	2	1920	440	44	38	4	160	123
c8	660	720	2	2100	440	46	40	4	160	127

¹⁾ Chain cables or wire ropes may be used, cable breaking load or minimum breaking strength of wire rope being no less than 44 kN.

3.1.5 It is assumed that under normal circumstances a ship uses only one bow anchor and chain cable at a time.

3.1.6 For all ships of unrestricted service, except fishing vessels, the equipment for anchoring, mooring and towing is to be selected from Table 3.1.2-1, and for fishing vessels from Table 3.1.2-2.

3.1.7 In addition to planned anchoring for normal operations, anchoring equipment is also important for ship safety in emergency situations such as loss of manoeuvrability, unscheduled repairs and other unexpected situations.

3.1.8 The anchoring equipment required herewith applies to self-propelled vessels over 100 GT, except for:

- inland navigation vessels,
- military vessels,
- government ships operated for non-commercial purposes,
- high speed and light crafts,
- yachts

3.1.9 The anchoring equipment required herewith applies to vessels with unrestricted service. The requirements given in item 3.6 apply to vessels with restricted service area of navigation.

3.1.10 Unrestricted service means a vessel engaged on international voyages, and not bounded by any limitations on operating environment reflected in vessel class notation.

3.1.11 Manufacture of anchors and anchor chain cables is to be in accordance with the *Rules, Part 25 - Metallic materials*, Sections 6 and 7.

3.1.12 As an alternative to the prescriptive approach, direct force calculation may be performed to determine the necessary anchoring equipment for monohull ships with length less than 90 meters. This direct calculation is based on force calculation on anchoring lines considering drag forces due to wind and current. The requirements for direct calculation are shown in the Appendix B of *IACS Recommendation. No. 10 - Chain, Anchoring, Mooring and Towing Equipment*.

3.2 EQUIPMENT NUMBER

3.2.1 The equipment of anchors and chain cables for ships of unrestricted service is to be as given in Table 3.1.2-1 and is to be based on an Equipment Number EN calculated as follows:

$$EN = \Delta^{2/3} + 2(hB + S_{fm}) + 0.1A$$

where:

- Δ = moulded displacement, in [t], to the summer load waterline,
- B = moulded breadth, in [m],
- h = effective height, in [m], from the summer load waterline to the top of the uppermost house,
 $h = a + \sum h_i$
- a = vertical distance at hull side from the summer load waterline amidships to the upper deck, in [m],
- h_i = height, in [m], on the centreline of each tier of houses having a breadth greater than $B/4$, for the lowest tier h_1 is to be measured at centreline from the upper deck or from a notional deck line where there is local discontinuity in the upper deck, see Fig. 3.2.1-1 for an example,
- A = side projected area, in [m²], of the hull, superstructures and houses and funnels above the summer load waterline which are within the equipment length of the ship and also have a breadth greater than $B/4$. The side projected area of the funnel is considered in A when A_{FS} is greater than zero. In this case, the side projected area of the funnel should be calculated between the upper deck, or notional deck line where there is local discontinuity in the upper deck, and the effective height h_F .
- S_{fun} = effective front projected area of the funnel, in [m²], defined as:
 $S_{fun} = A_{FS} - S_{shield}$
- A_{FS} = front projected area of the funnel, in [m²], calculated between the upper deck at centreline, or notional deck line

where there is local discontinuity in the upper deck, and the effective height h_F . A_{FS} is taken equal to zero if the funnel breadth is less than or equal to $B/4$ at all elevations along the funnel height.

h_F = effective height of the funnel, in [m], measured from the upper deck at centreline, or notional deck line where there is local discontinuity in the upper deck, and the top of the funnel. The top of the funnel may be taken at the level where the funnel breadth reaches $B/4$.

S_{shield} = the section of front projected area A_{FS} , in [m²], which is shielded by all deck houses having breadth greater than $B/4$. If there are more than one shielded section, the individual shielded sections i.e. $S_{shield1}$, $S_{shield2}$ etc as shown in figure 2 to be added together. To determine S_{shield} , the deckhouse breadth is assumed B for all deck houses having breadth greater than $B/4$ as shown for $S_{shield1}$, $S_{shield2}$ in Fig. 3.2.1-2.

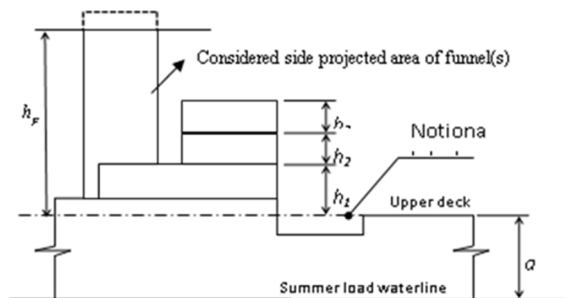


Figure 3.2.1-1

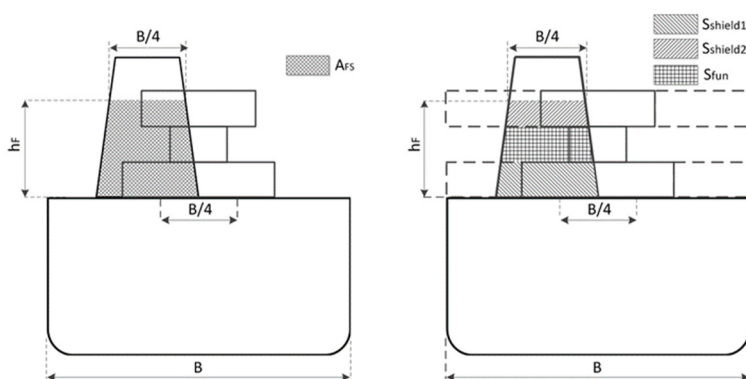


Figure 3.2.1-2

3.2.2 When calculating h , sheer and trim are to be ignored, i.e. h is the sum of freeboard amidships plus the height (at centreline) of each tier of houses having a breadth greater than $B/4$.

If a house having a breadth greater than $B/4$ is above a house with a breadth of $B/4$ or less then the wide house is to be included but the narrow house ignored.

Screens or bulwarks 1,5 m or more in height are to be regarded as parts of houses when determining h and A .

The height of the hatch coamings and that of any deck cargo, such as containers, may be disregarded when determining h and A .

With regard to determining A , when a bulwark is more than 1,5 m high, the area shown as A_2 (see Fig. 3.2.2) is to be included in A .

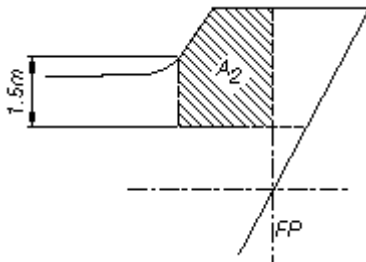


Figure 3.2.2

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

When several funnels are fitted on the ship, the above parameters are taken as follows:

h_F : effective height of the funnel, in [m], measured from the upper deck, or notional deck line where there is local discontinuity in the upper deck, and the top of the highest funnel. The top of the highest funnel may be taken at the level where the sum of each funnel breadth reaches $B/4$.

A_{FS} : sum of the front projected area of each funnel, in [m²], calculated between the upper deck, or notional deck line where there is local discontinuity in the upper deck, and the effective height h_F . A_{FS} is to be taken equal to zero if the sum of each funnel breadth is less than or equal to $B/4$ at all elevations along the funnels height.

A : side projected area, in [m²], of the hull, superstructures, houses and funnels above the summer loadwaterline which are within the equipment length of the ship. The total side projected area of the funnels is to be considered in the side projected area of the ship, A , when A_{FS} is greater than zero. The shielding effect of funnels in transverse direction may be considered in the total side projected area, i.e., when the side projected areas of two or more funnels fully or partially overlap, the overlapped area needs only to be counted once.

The total length of chain given in Tables 3.1.2-1 and 3.1.2-2 is to be divided in approximately equal parts between the two bower anchors.

3.2.3 The equipment number E_n of a floating crane is to be determined by the following expression:

$$E_n = 1.5 \cdot \Delta^{2/3} + 2 \cdot B \cdot h + 2 \cdot S + 0.1 \cdot A,$$

where Δ , B , h and A are to be calculated according to 3.2.1: in determining value A , the area of the upper structure of the floating crane exposed to cross wind (during navigation) is to be calculated as the area bound by the construction contour of the floating crane.

S = the projection of the area, in [m²], exposed to wind (during navigation) on the cross section of the midship, which extends above the upper edge of the uppermost deckhouse included in the calculation of h ; in this projection the area exposed to wind is to be taken as the surface bound by the construction contour of the floating crane.

3.2.4 For tugs of unrestricted service the equipment is to be provided in compliance with these requirements.

However, the term $2,0 \cdot B \cdot h$ expressed in formula for equipment number E_n in 3.2.1, may be substituted by:

$$2,0 (a \cdot B + \Sigma h_i \cdot b_i)$$

where:

a , B and h_i are as defined in 3.2.1

b_i = breadth, in [m], of the widest superstructure or deckhouse of each tier having a breadth greater than $B/4$.

For tugs under 45 m in length intended for towing service only, one anchor may be used onboard provided that the second anchor and its relevant chain cable holds readily available to be installed. In case of loss of anchor, the tug is to remain in port until replace anchor equipment is installed onboard.

For tugs of limited service, the equipment is to be provided at the discretion of the *Register*.

3.2.5 For dredgers of unrestricted service having normal ship shape of underwater part of the hull the anchoring equipment is to be provided in accordance with these requirements.

When calculating the Equipment Number bucket ladders and gallows are not to be included. If however a dredger has unusual design of the underwater part of the hull, *Register* is free to modify the requirements to anchoring equipment.

For dredgers of limited service, the equipment is to be provided at the discretion of the *Register*.

Dredgers with unusual design of the underwater part of the hull are not covered by alternative methodology using direct force calculation for anchoring equipment described in the Appendix B of *IACS Recommendation. No. 10*.

3.2.6 The equipment of anchors and chain cables given in Table 3.1.2-2 for fishing vessels operating in unrestricted service is based on the equipment number EN which should be calculated as follows:

$$EN = \Delta^{2/3} + 2Bh + 0.1A$$

where:

Δ = moulded displacement, in [t], to the maximum design waterline,

B = greatest moulded breadth, in [m],

h = effective height, in [m], from the maximum design waterline to the top of the uppermost house.

$$= a + \Sigma h_i$$

a = distance, in [m], from the maximum design waterline to the upper edge of the uppermost complete deck at the side amidships,

h_i = height, in [m], on the centreline of each tier of houses having breadth greater than $B/4$.

For the lowest tier h is measured at centreline from the upper deck or from a notional deck line where there is local discontinuity in the upper deck.

When calculating h , sheer and trim can be ignored.

A = side-projected area, in [m²], of the hull, within the length of the ship between perpendiculars, and of superstructures and houses above the maximum design waterline having a width greater than $B/4$.

Screens and bulwarks more than 1.5 m in height should be regarded as parts of houses when determining h and A .

3.3 ANCHORS

3.3.1 General

The bower anchors are to be connected to their chain cables and positioned on board ready for use.

The stream anchor should be ready to be connected with its cable.

Ships with Equipment Number of 205 and less may have the second bower anchor as spare one on condition that provision is made for its quick getting ready for use.

Unmanned barges and pontoons where length is less than 30 m the anchor may be dispensed with and where length is greater than 30 m may have only one bower anchor.

3.3.2 Anchor mass

The mass, per anchor, of bower anchor given in the Tables 3.1.2-1 and 3.1.2-2 is required for anchors of equal mass.

The mass of individual anchor may vary to 7% of the Table mass provided that the total mass of anchors is not less than that required for anchors of equal mass.

When special type of anchors designated "high holding power anchor" of proven superior holding ability are used as bower anchors, the mass of each anchor may be 75% of the mass required for ordinary stockless bower anchors in the Tables 3.1.2-1 and 3.1.2-2.

The mass of the stocked anchor, when used, and that of stream anchor, excluding the stock, is to be 80% of the mass required in the Tables 3.1.2-1 and 3.1.2-2 for stockless bower anchors and the mass of the stock is to be 20%.

The mass of the heads of stockless anchor including pins and fittings are not to be less than 60% of the total mass of the anchor.

3.3.3 High holding power anchors (HHP)

3.3.3.1 A 'high holding power' anchor is an anchor with a holding power of at least twice that of an ordinary stockless anchor of the same mass. A HHP anchor is to be suitable for ship's use and is not to require prior adjustment or special placement on the sea bottom.

3.3.3.2 For approval and/or acceptance as a high holding power anchor satisfactory full scale tests according to 3.3.3.2 – 3.3.3.6 are to be made confirming that the anchor has a holding power of at least twice that of an ordinary stockless anchor of the same mass.

3.3.3.2 Full scale tests are to be carried out at sea on various types of bottom, normally, soft mud or silt, sand or gravel and hard clay or similar compounded material. The tests are to be applied to anchors of mass which are as far as possible representative of the full range of sizes proposed.

3.3.3.3 For a definite group within the range, the two anchors selected for testing (ordinary stockless anchor and HHP anchor, respectively) are to be of approximately the same mass and tested in association with the size of chain required for that anchor mass. Where an ordinary stockless anchor is not available, for testing of HHP anchors a previously approved HHP anchor may be used in its place. The length of the cable with each anchor is to be such that the pull on the shank remains horizontal. For this purpose a scope of 10 is considered normal but a scope of not less than 6 may be accepted. Scope is defined as the ratio of length of cable to depth of water.

3.3.3.4 Three tests are to be taken for each anchor and each type of bottom. The stability of the anchor and ease of breaking out are to be noted where possible. Tests are to be carried out from a tug but alternatively shore based tests may be accepted. The pull is to be measured by dynamometer. Measurements of pull, based on the RPM/bollard pull curve of the tug may be accepted as an alternative to a dynamometer.

3.3.3.5 For approval and/or acceptance for a range of HHP anchor sizes, tests are to be carried out for at least two anchor sizes. The mass of the maximum size approved is not to be more than 10 times the mass of the largest size tested.

3.3.3.6 The holding power test load is not to exceed the proof load of the anchor.

3.3.3.7 The use of a super high holding power anchors (SHHP) is limited to restricted service vessels and subject to special consideration by the *Register*.

3.3.4 Manufacture

3.3.4.1 Anchors may be of forged, cast or welded construction. Fabricated anchors are to be manufactured in accordance with approved welding procedures using approved welding consumables and carried out by qualified welders.

3.3.4.2 Materials, manufacture, testing and certification of anchors is to be in accordance with the *Rules for the classification of ships, Part 25 - Metallic materials*, Section 6.

3.3.5 Testing

3.3.5.1 Anchors of all sizes are to be proof tested with the test loads stipulated in the Table 3.3.5.1.

3.3.5.2 The proof load is to be applied on the arm or on the palm at a spot which, measured from the extremity of the bill, is one-third of the distance between it and the centre of the crown, see figure below. In the case of stockless anchors, both arms are to be tested at the same time, first on one side of the shank, then reversed and tested on the other.

3.3.5.3 Before application of proof test load the anchors are to be examined to be sure that castings are reasonably free of surface imperfections of harmful nature. After proof load testing the anchors are to be examined for cracks and other defects. On completion of the proof load tests the anchors made in more than one piece are to be examined for free rotation of their heads over the complete angle. In every test the difference between the gauge lengths (as shown in Fig. 3.3.5.3) where one-tenth of the required load was applied first and where the load has been reduced to one-tenth of the required load from the full load may be permitted not to exceed 1%.

3.3.5.4 The HHP anchor is to be proof tested with load required by Table 3.3.5.1 for an anchor mass equal to 1.33 times the actual mass of the HHP anchor. The proof loading procedure and examination procedure for HHP anchors are to comply with those for ordinary anchors, 3.3.5.1 - 3.3.5.3.

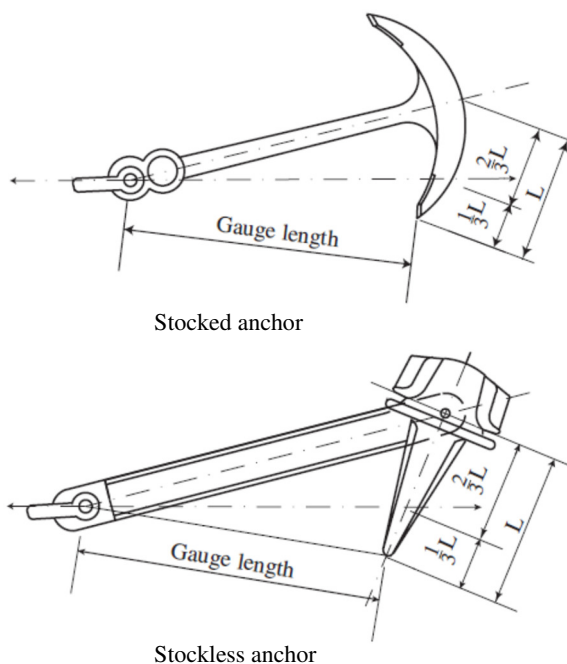


Figure 3.3.5.3

Table 3.3.5.1 Proof loads for anchors

Anchor weight [kg]	Proof load ¹⁾ [kN]	Anchor weight [kg]	Proof load ¹⁾ [kN]	Anchor weight [kg]	Proof load ¹⁾ [kN]	Anchor weight [kg]	Proof load ¹⁾ [kN]
50	23.2	1250	239	5000	661	12500	1130
55	25.2	1300	247	5100	669	13000	1160
60	27.1	1350	255	5200	667	13500	1180
65	28.9	1400	262	5300	685	14000	1210
70	30.7	1450	270	5400	691	14500	1230
75	32.4	1500	278	5500	699	15000	1260
80	33.9	1600	292	5600	706	15500	1270
90	36.3	1700	307	5700	713	16000	1300
100	39.1	1800	321	5800	721	16500	1330
120	44.3	1900	335	5900	728	17000	1360
140	49	2000	349	6000	735	17500	1390
160	53.3	2100	362	6100	740	18000	1410
180	57.4	2200	376	6200	747	18500	1440
200	61.3	2300	388	6300	754	19000	1470
225	65.8	2400	401	6400	760	19500	1490
250	70.4	2500	414	6500	767	20000	1520
275	74.9	2600	427	6600	773	21000	1570
300	79.5	2700	438	6700	779	22000	1620
325	84.1	2800	450	6800	786	23000	1670
350	88.8	2900	462	6900	794	24000	1720
375	93.4	3000	474	7000	804	25000	1770
400	97.9	3100	484	7200	818	26000	1800
425	103	3200	495	7400	832	27000	1850
450	107	3300	506	7600	845	28000	1900
475	112	3400	517	7800	861	29000	1940
500	116	3500	528	8000	877	30000	1990
550	124	3600	537	8200	892	31000	2030
600	132	3700	547	8400	908	32000	2070
650	140	3800	557	8600	922	34000	2160
700	149	3900	567	8800	936	36000	2250
750	158	4000	577	9000	949	38000	2330
800	166	4100	586	9200	961	40000	2410
850	175	4200	595	9400	975	42000	2490
900	182	4300	604	9600	987	44000	2570
950	191	4400	613	9800	998	46000	2650
1000	199	4500	622	10000	1010	48000	2730
1050	208	4600	631	10500	1040		
1100	216	4700	638	11000	1070		
1150	224	4800	645	11500	1090		
1200	231	4900	653	12000	1110		

¹⁾ Proof loads for intermediate mass are to be determined by linear interpolation.

3.4 CHAIN CABLES AND ROPES FOR BOWER ANCHORS

3.4.1 The anchor chain cable is to be as required by the Tables 3.1.2-1 and 3.1.2-2 for the calculated Equipment Number for the ship. The chain cable is to be tested in accordance with Table 3.4.4-2 to the proof loads corresponding to those for the required chain cable.

3.4.2 Materials, manufacture, testing and certification of anchor chain cables is to be in accordance with the *Rules for*

the classification of ships, Part 25 - Metallic materials, Section 7.

3.4.3 Bower anchors are to be associated with stud link chain cables for one of the grades listed in Table 3.4.3.

The designation 'Grade CRS-L1' may be replaced, at discretion of the *Register*, by 'Grade CRS-L1a' where R_m is greater than 300 but not exceeding 400 N/mm² or by 'Grade CRS-L1b' where R_m is greater than 400 but not exceeding 490 N/mm².

Table 3.4.3 Grades of chain cables

Material	Grade	R_m , [N/mm ²]
Mild steel	CRS-L1	300 to 490
Special quality steel	CRS-L2	490 to 690
Extra special quality steel	CRS-L3	> 690

3.4.4 The design and/or standard breaking loads (BL) and proof loads (PL) of stud link chain cables are given in Table 3.4.4-1 for the chain diameter, d , in [mm].

The test load values, rounded off from the loads above are to be used for testing and acceptance of chain cables, are given in Table 3.4.4-2.

3.4.5 Ship with equipment number of 205 and less, in which the second bower anchor is permitted to be spare one may be equipped with only one chain cable the length of which is to be one half of that given in the equipment Table 3.1.2-1 for two chains.

3.4.6 For equipment numbers EN up to 90, as an alternative to stud link chain cables, short link chain cables may be used.

3.4.7 For the supply vessels the diameter of the chain cables is to be determined according to Table 3.1.2-1 two lines above than required equipment number. The length of chain cables of these ships is to be agreed with Register taking account specified depth and condition of anchorage. The length of chain cables of unmanned barges is to be two times length or 40 m, whichever is greater.

3.4.8 Wire rope may be used in place of chain cable on ships:

1. With less than 90 m in length and which will need an anchor for emergency purposes, i.e., not intended to use their anchor in normal temporary anchoring operation, or
2. With the anchoring equipment used for positioning with a minimum of 4 points anchoring, e.g., for cable or pipe laying.

3.4.9 Use of wire rope is subject to the following conditions:

- .1 The length of the wire rope is to be equal to 1.5 times the corresponding tabular length of chain cable in the Tables 3.1.2-1 and 3.1.2-2 and their strength is to be equal to that of tabular chain cable of Grade CRS-L1 in the Table 3.4.2.
- .2 The anchor weight shall be increased by 25 % compared to the anchor associated with the chain cable according to Table 3.4.2.
- .3 A short length of chain cable is to be fitted between the wire rope and anchor having a length of 12.5 m or the distance between anchor in stowed position and winch, whichever is less.
- .4 All surfaces being in contact with the wire need to be rounded with a radius of not less

than 10 times the wire rope diameter (including stem).

- .5 Steel wire shall be selected to fit for purpose based on the manufacturer recommendation and shall be provided with guidance for maintenance and inspection.

Wire ropes of trawl winches on fishing vessels complying with these requirements may be used as anchor chain cables.

3.4.9 The chain cables are to be composed of separate chain length, except for the chains less than 15 mm in diameter, which need not be divided into chain lengths.

The lengths of chains are to be interconnected with joining links. The use of joining shackles instead of joining links is to be specially considered by *Register*.

Depending on their location in the chain cable the lengths are divided into:

- anchor part fastened to the anchor (forerunner),
- intermediate lengths,
- inboard part, secured to the chain cable releasing device.

3.4.10 To be considered a separate length, the anchor part must be provided with a swivel, end link, and an adequate number of common and enlarged links. If the dimensions of the relevant part of the cable chain are sufficient to form a length, the anchor length may consist of a swivel, end link and joining link only.

On cable chains divided into lengths a swivel must be attached as close as possible to the anchor. The swivel pins shall point toward the middle of the chain cable. The chain length is to be connected to the anchor by means of an end shackle with pin.

3.4.11 The intermediate length is to be no shorter than 25 m and no longer than 27,5 m, and it is to have an odd number of links. The totals for the length of two chains given in the equipment table include only the sums of the middle lengths, without anchor and inboard lengths. If there are an odd number of intermediate lengths, then the chain cable on the right side is to have one length more than the chain cable on the left side.

3.4.12 The inboard end length of each chain shall consist of a special link of enlarged size which, however, shall pass freely through the wildcat of the anchor machinery secured to the chain cable releasing device, and of a minimum number of common and enlarged links which are necessary to constitute and independent chain length. The inboard end chain length may consist of one end link only, provided the relation between the dimensions of the chain cable parts and the chain cable-releasing device allows of such arrangement.

In all other respects the chain cables for bower anchors shall comply with the requirements of the *Rules for the classification of ships, Part 25 - Metallic materials, 7*.

The end of each wire rope is to be spliced into a thimble, clamp or socket and in order to increase the anchor holding power and the damping of jerk loads, the end of each wire rope is to be connected to the anchor by means of a chain cable section of at least 12.5 meters in length and having the same strength as the wire rope, see also 3.4.8.2. The chain cable section is to be secured to the wire rope fitting and the anchor

shackle by means of joining shackles being equal to the wire ropes in strength.

The length of the chain cable section may be included into 1,5 times the length of wire ropes specified in the previous paragraph.

3.4.13 The wire ropes anchors are to have at least 114 wires and not less than one natural fibre core. The wires of the

ropes are to have at least thin zinc coating in accordance with applicable standards.

In all other respects, the wire ropes for anchors shall meet the requirement of the *Rules for the classification of ships, Part 25 - Metallic materials, 7.*

3.4.14 Stream anchors may use the chain cables with stud or without them as well as wire ropes, which shall meet the requirements of 3.4.11 and 3.4.12.

Table 3.4.4-1 Breaking loads and proof loads of stud link chain cables

Grade	Breaking load (BL), [kN]	Proof load (PL), [kN]
CRS-L1	$BL_1 = 9,80665 \cdot 10^{-3} \cdot [d^2 \cdot (44 - 0,08 \cdot d)]$	$PL_1 = 0,7 \cdot BL_1$
CRS-L2	$BL_2 = 1,4 \cdot BL_1$	$PL_2 = BL_1$
CRS-L3	$BL_3 = 2 \cdot BL_1$	$PL_3 = 1,4 \cdot BL_1$

Table 3.4.4-2 Test load values for stud link chain cables

Chain cable diameter, [mm]	Grade CRS-L1		Grade CRS-L2		Grade CRS-L3	
	Proof load, [kN]	Breaking load, [kN]	Proof load, [kN]	Breaking load, [kN]	Proof load, [kN]	Breaking load, [kN]
1	2	3	4	5	6	7
11	35.8	51	51	71.7	71.7	102
12.5	46	65.7	65.7	92	92	132
14	57.9	82	82	116	116	165
16	75.5	107	107	150	150	216
17.5	89	127	127	179	179	256
19	105	150	150	211	211	301
20.5	123	175	175	244	244	349
22	140	200	200	280	280	401
24	167	237	237	332	332	476
26	194	278	278	389	389	556
28	225	321	321	449	449	642
30	257	368	368	514	514	735
32	291	417	417	583	583	833
34	328	468	468	655	655	937
36	366	523	523	732	732	1050
38	406	581	581	812	812	1160
40	448	640	640	896	896	1280
42	492	703	703	981	981	1400
44	538	769	769	1080	1080	1540
46	585	837	837	1170	1170	1680
48	635	908	908	1270	1270	1810
50	686	981	981	1370	1370	1960
52	739	1060	1060	1480	1480	2110
54	794	1140	1140	1590	1590	2270
56	851	1220	1220	1710	1710	2430
58	909	1290	1290	1810	1810	2600
60	969	1380	1380	1940	1940	2770
62	1030	1470	1470	2060	2060	2940
64	1100	1560	1560	2190	2190	3130
66	1160	1660	1660	2310	2310	3300
68	1230	1750	1750	2450	2450	3500
70	1290	1840	1840	2580	2580	3690
73	1390	1990	1990	2790	2790	3990
76	1500	2150	2150	3010	3010	4300
78	1580	2260	2260	3160	3160	4500
81	1690	2410	2410	3380	3380	4820
84	1800	2580	2580	3610	3610	5160
87	1920	2750	2750	3850	3850	5500

Chain cable diameter, [mm]	Grade CRS-L1		Grade CRS-L2		Grade CRS-L3	
	Proof load, [kN]	Breaking load, [kN]	Proof load, [kN]	Breaking load, [kN]	Proof load, [kN]	Breaking load, [kN]
1	2	3	4	5	6	7
90	2050	2920	2920	4090	4090	5840
92	2130	3040	3040	4260	4260	6080
95	2260	3230	3230	4510	4510	6440
97	2340	3340	3340	4680	4680	6690
100	2470	3530	3530	4940	4940	7060
102	2560	3660	3660	5120	5120	7320
105	2700	3850	3850	5390	5390	7700
107	2790	3980	3980	5570	5570	7960
111	2970	4250	4250	5940	5940	8480
114	3110	4440	4440	6230	6230	8890
117	3260	4650	4650	6510	6510	9300
120	3400	4850	4850	6810	6810	9720
122	3500	5000	5000	7000	7000	9990
124	3600	5140	5140	7200	7200	10280
127	3750	5350	5350	7490	7490	10710
130	3900	5570	5570	7800	7800	11140
132	4000	5720	5720	8000	8000	11420
137	4260	6080	6080	8510	8510	12160
142	4520	6450	6450	9030	9030	12910
147	4790	6840	6840	9560	9560	13660
152	5050	7220	7220	10100	10100	14430
157	5320	7600	7600	10640	10640	15200
162	5590	7990	7990	11170	11170	15970

3.5 ANCHOR APPLIANCES

3.5.1 Stoppers

3.5.1.1 Each bower anchor chain cable or rope is to be provided with stopper holding the anchor in the hawse pipe when stowed for sea or, in addition, intended for holding the ship at anchor.

In ships having no anchor machinery or having the anchor machinery, which is not in compliance with the *Rules for the classification of ships, Part 9 - Machines*, 6.3 stoppers must be installed for holding the ship at anchor.

3.5.1.2 Where the stopper is intended only for securing the anchor in the hawse pipe, its parts are to be calculated to withstand the chain cable strain to twice the weight of the anchor, the stresses in the stopper parts not exceeding 0,4 times the yield point of their material.

Where the stopper comprises a chain cable or rope, this is to have safety factor 5 in relation to the breaking load of the chain cable or actual breaking strength of the rope under the action of a force equal to twice the weight of the anchor.

3.5.1.3 Where the stopper is intended for riding the ship at anchor, its parts are to be calculated on assumption that the stopper is to be subjected to a force in the chain cable equal to 0,8 times its breaking load. The stresses in the stopper parts are to not exceed 0,95 times the yield point of their material. Where the stopper comprises a chain cable or rope, they are to be of strength equal to that of the chain cable for which they are intended.

3.5.2 Device for securing and releasing the inboard end of the chain cables

3.5.2.1 The inboard ends of the chain cables are to be secured to the structures by fastening able to withstand a force not less than 15% nor more than 30% of the breaking load of the chain cable.

3.5.2.2 The fastening is to be provided with means suitable to permit, in case of emergency, an easy slipping of the chain cables to sea, operable from an accessible position outside the chain locker.

3.5.3 Laying of chain cables

3.5.3.1 Laying of chain cables shall provide for their run when dropping or hoisting the anchors.

3.5.3.2 The anchor shank shall easily enter the hawse pipe under the mere action of the chain cable tension and shall readily take off the hawse pipe when the chain cable is released.

3.5.3.3 It is recommended that thickness of the hawse pipe is not to be less than 0,4 times the diameter of chain cable passing through the hawse pipe.

3.5.4 Chain lockers

3.5.4.1 For stowage of each bower anchor chain lockers are to be provided.

When one chain locker is designed for two chains, it is to be provided with an internal division so that separate stowage of each chain is ensured.

For specific requirements relating to chain lockers of passenger ships in domestic service class "D" operating exclusively in the area of navigation 6 and 7, in the period from April 1 to October 31, see Section A.11.

3.5.4.2 The chain locker is to be of capacity and depth adequate to provide an easy direct lead of the cables through the chain pipes and self-stowing of the cables.

The minimum required stowage capacity without mud box for the two bow anchor chains is as follows:

$$S = 1,1d^2 \frac{l}{100000}, \quad [\text{m}^3]$$

where:

- d = chain diameter, [mm], according to Tables 3.1.2-1 and 3.1.2-2
- l = total length of stud link chain cable according to Tables 3.1.2-1 and 3.1.2-2

The total stowage capacity is to be distributed on two chain lockers of equal size for the port and starboard chain cables. The shape of the base areas is to as far as possible be quadratic with a maximum edge length of $33 \cdot d$. As an alternative, circular base areas may be selected, the diameter of which is not to exceed $30 - 35 \cdot d$.

Above the stowage of each chain locker in addition a free depth of $h = 1500$ mm is to be provided.

3.5.4.3 The chain locker design and covers of the access openings are to be watertight as necessary to prevent accidental flooding of the chain locker which could damage essential auxiliaries or equipment (located outside the chain locker) or could affect the proper operation of the ship.

3.5.4.4 The drainage facilities for chain locker shall meet the requirements of the *Rules for the classification of ships, Part 8 - Piping*, 2.11, and the lighting with the requirements of the *Rules for the classification of ships, Part 12 - Electrical equipment*, 6.7.

3.5.4.5 Closure of chain lockers

3.5.4.5.1 This requirement is applicable to ships with a length of 24 m and above built in accordance with the *1966 Load Line Convention* or the *1988 Protocol to the Load Line Convention* and the keels of which are laid or which are at a similar stage of construction on or after 1 July 2003.

3.5.4.5.2 Spurling pipes and cable lockers are to be watertight up to the weather deck. Bulkheads between separate cable lockers (see Fig. 3.5.4.5.2-1), or which form a common boundary of cable lockers (see Fig. 3.5.4.5.2-2), need not however be watertight.

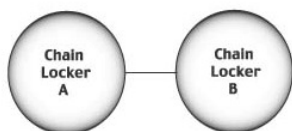


Figure 3.5.4.5.2-1

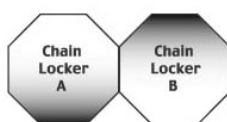


Figure 3.5.4.5.2-2

3.5.4.5.3 Where means of access is provided, it is to be closed by a substantial cover and secured by closely spaced bolts.

3.5.4.5.4 Where a means of access to spurling pipes or cable lockers is located below the weather deck, the access cover

and its securing arrangements are to be in accordance with recognized standards* or equivalent for watertight manhole covers. Butterfly nuts and/or hinged bolts are prohibited as the securing mechanism for the access cover.

3.5.4.5.5 Spurling pipes through which anchor cables are led are to be provided with permanently attached closing appliances** to minimize water ingress.

* Examples of the recognized standards are such as:

- i) ISO 5894-1999
- ii) China: CB/T4392-2014 "Marine manhole cover"
- iii) India: IS 15876-2009 "Ships and Marine Technology manholes with bolted covers"
- iv) Japan: JIS F2304:2015, "Ship's Manholes" and JIS F2329:1975, "Marine Small Size Manhole"
- v) Korea: KS V ISO 5894:2012
- vi) Norway: NS 6260:1985 "Manhole cover - overview"
- vii) Russia: GOST 2021-90 "Ship's steel manholes. Specifications"

** Examples of acceptable arrangements are such as:

- i) steel plates with cutouts to accommodate chain links, or
- ii) canvas hoods with a lashing arrangement that maintains the cover in the secured position.

3.5.5 Anchor machinery

3.5.5.1 A windlass used for handling anchors, suitable for the size of chain cable and complying with the design, construction and testing criteria given in the *Rules for the classification of ships, Part 9 - Machines*, 6.3 is to be fitted to the ship.

An anchor windlass must be provided if the anchor mass exceeds 35 kg.

3.5.5.2 On ships with an equipment number of 205 or less, a hand-operated anchor windlass may be installed, or other deck machinery may be used to release or hoist the anchor.

3.5.5.3 Unless located at least 2.4 m above the cargo deck the windlass and the openings of chain pipes leading into the chain locker are to be fitted at distance of not less than 3 m from cargo tank boundaries, if liquids having a flashpoint not exceeding 60°C are intended to be carried.

3.5.5.4 On ships intended to carry in bulk flammable liquids having the flash point below 60°C no deck machinery is to be fitted directly on the decks being the top of cargo tanks and bunkers.

In this case, the deck machinery is to be fitted on special foundations, the construction of which provides for free circulation of air underneath the machinery.

3.5.6 Spare parts

3.5.6.1 Every ship whose anchor arrangement includes a spare bower anchor and cable chains must have three spare joining links and one end shackle of the corresponding dimensions. If the ship has no spare bower anchor the shackle is not mandatory.

3.5.6.2 Every ship whose anchor arrangement includes a spare anchor and cable chains must have all the parts needed for connecting the wire rope to the anchor shackle.

3.5.7 Permissible wear-down of chain cables

3.5.7.1 When a length of chain cable is so worn that the mean diameter of a link, at its most worn part, is reduced by 12% or more from its required nominal diameter it is to be renewed.

3.5.7.2 The mean diameter is half the value of the sum of the minimum diameter found in one cross-section of the link and of the diameter measured in a perpendicular direction in the same cross-section.

3.5.7.3 For the guidelines for maximum wear down of anchor cable fittings, joining shackles, the looseness of studs within anchor cable and the securing by welding of studs found loose during survey of chain cables links in service, see *IACS Rec. 79*.

3.5.8 Supporting hull structures of anchor windlass and chain stopper

3.5.8.1 The supporting hull structure of anchor windlass and chain stopper is to be sufficient to accommodate the design and sea loads.

3.5.8.2 The design loads are to be taken not less than:

1. for chain stoppers, 80% of the chain cable breaking load,
2. for windlasses, where no chain stopper is fitted or the chain stopper is attached to the windlass, 80% of the chain cable breaking load,
3. for windlasses, where chain stoppers are fitted but not attached to the windlass, 45% of the chain cable breaking load.

The design loads are to be applied in the direction of the chain cable.

3.5.8.3 The sea loads are to be taken according to 7.14.3.2.

3.5.8.4 The stresses acting on the supporting hull structures of windlass and chain stopper, based on net thickness obtained by deducting the corrosion addition, t_k , given in 3.5.8.5, are not to be greater than the following permissible values:

(a) For strength assessment by means of beam theory or grillage analysis:

$$\text{Normal stress: } 1,0 R_{eH}$$

$$\text{Shear stress: } 0,6 R_{eH}$$

The normal stress is the sum of bending stress and axial stress. The shear stress to be considered corresponds to the shear stress acting perpendicular to the normal stress. No stress concentration factors are to be taken into account.

(b) For strength assessment by means of finite element analysis:

$$\text{Von Mises stress: } 1,0 R_{eH}$$

For strength assessment by means of finite element analysis the mesh is to be fine enough to represent the

geometry as realistically as possible. The aspect ratios of elements are not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges may be modelled by beam or truss elements. The element height of girder webs must not exceed one-third of the web height. In way of small openings in girder webs, the web thickness is to be reduced to a mean thickness over the web height as per *Register's Rules*. Large openings are to be modelled. Stiffeners may be modelled using shell, plane stress, or beam elements. The mesh size of stiffeners is to be fine enough to obtain proper bending stress. If flat bars are modeled using shell or plane stress elements, dummy rod elements are to be modelled at the free edge of the flat bars and the stresses of the dummy elements are to be evaluated. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element.

3.5.8.5 The total corrosion addition, t_k , is not to be less than the following values:

(a) Ships covered by Common structural rules for bulk carriers and oil tankers:

t_k : total corrosion addition as defined in these Rules.

(b) Other ships:

For the supporting hull structure, the total corrosion addition, t_k , is defined according to the *Register's Rules* for all considered structural members used in the model (e.g. deck structures).

3.6 EQUIPMENT FOR SHIPS IN RESTRICTED AREA OF NAVIGATION

3.6.1 All vessels, except fishing vessels

3.6.1.1 Provisions for equipment for vessels with restricted service, except fishing vessels, are based on equipment number in accordance with 3.2 and given in Table 3.6.1.1-1.

Table 3.6.1.1-1

Sailing area	Requirements for equipment
2	No reduction
3,4	According equipment number reduced by 15%
5, 6	According equipment number reduced by 25% taking in to account 3.6.1.2
7, 8	According to 3.6.1.3

3.6.1.2 Ship mentioned in 3.6.1.1 with equipment number 35 and less and of restricted navigation area 6, if they are not passenger ships may have only one bower anchor and one chain cable the length of which is two times less than that required in Table 3.1.2-1.

3.6.1.3 Provisions for equipment of ships of restricted navigation area 7 and 8 are to be determined according to Table 3.1.2-1. The anchor weight may be reduced up to 40% and chain diameter may be determined according to the reduced anchor mass.

If an anchor mass of less than 80 kg has been determined, only one anchor is required and half length of chain cable required by Table 3.1.2-1.

3.6.1.4 For ships of restricted area of navigation 5, 6, 7 and 8 stream anchor is not required.

3.6.1.5 For specific requirements relating to attestation of the anchoring equipment of passenger ships in domestic service class "D" operating exclusively in the area of navigation 6 and 7, in the period from April 1 to October 31, see Sections A.10 and A.12.

3.6.2 Fishing vessels of restricted navigation area 3, 4 and 5

3.6.2.1 Provisions for equipment of ships with length $20 < L \leq 40$, are to be determined according to Table 3.6.2.1-1 based on equipment number obtained as follows:

$$E_{nf} = L(B + D) + \Sigma 0.5 \cdot l \cdot h,$$

where:

- l = length of individual superstructure and deckhouse, m;
- h = height of individual superstructure and deckhouse at centreline, m.

Deckhouse having a breadth of less than B/4 may be ignored.

For vessels having a length of 20 m and less the equipment is to be determined for the length L in accordance with Table 3.6.2.1-1.

3.6.2.2 Provisions stated in 3.3, 3.4 and 3.5 are to also be observed.

3.6.2.3 The second anchor is considered as spare one on condition that provision is made for its quick getting ready for use.

3.6.2.4 For ships with length less than 20 m the weight of spare anchor may be 70% of the value required by Table 3.6.2.1-1.

3.6.2.5 Stream anchor is not required.

3.6.3 Fishing vessels of restricted navigation area 6, 7 and 8

3.6.3.1 Fishing vessels of this sailing area, with length less than 16 m may have only one anchor and chain cable with length two times less than in Table 3.6.2.1-1.

Table 3.6.2.1-1 Equipment for vessels with restricted service (except fishing vessels)

Length L [m]	Equipment number E_{nf}	Bower anchors		Stud link chain cables			Mooring ropes		
		No.	Weight per anchors [kg]	Total length [m]	Diameter		Total length [m]	Diameter	
					d_1 [mm]	d_2 [mm]		d_3 [mm]	d_4 [mm]
to 14	-	2	60	95	11.0	-	80	-	20
14-16	-	2	75	105	11.0		90	10	20
16-18	-	2	85	110	11.0		100	10	20
18-20	-	2	95	110	12.5	12.5	120	10	20
$L = 20 - 40$	to 270	2	110	137.5	12.5	12.5	150	10	22
	270-300	2	140	165	14.0	12.5	180	10	22
	300-330	2	180	165	14.0	12.5	200	10	22
	330-360	2	210	220	16.0	14.0	225	10	24
	360-400	2	250	220	16.0	14.0	225	10	24
	400-450	2	300	247.5	17.5	16.0	225	10	24
	450-500	2	370	247.5	19.0	17.5	250	12	26
over 500	2	440	275.0	22.0	19.0	250	12	26	

Remarks:
- Short link cable of same proof load may be taken in lieu of stud link chain cables for ships with E_{nf} less than 330.
Explanatory notes:
 d_1 Chain diameter grade CRS-L1
 d_2 Chain diameter grade CRS-L2
 d_3 Diameter of wire rope 6 x 24, breaking strength 1570 N/mm².
 d_4 Diameter of polyamide ropes and manila ropes.

4 MOORING ARRANGEMENT

4.1 GENERAL PROVISIONS

4.1.1 The number, length and ship design minimum breaking load of mooring ropes are to be determined for all ships according to Table 3.1.2-1 and for fishing vessels according to Table 3.1.2-2, and Table 3.6.2.1-1. The ship design minimum breaking loads specified in tables are valid for wire ropes and ropes of natural fibre (manila) only. See also *IACS Rec. No.10*.

4.1.2 For ships with a ratio A/E_n exceeding 0,9, an increased number of mooring ropes compared to those specified in Table 3.1.2-1 must be provided as follows:

- 1 rope -when

$$0,9 < \frac{A}{E_n} \leq 1,1,$$
- 2 ropes - when

$$1,1 < \frac{A}{E_n} \leq 1,2,$$
- 3 ropes-when

$$\frac{A}{E_n} > 1,2,$$

where:

E_n and A - equipment number and area exposed to wind according to 3.2.

4.1.3 On ships with individual mooring ropes having ship design minimum breaking load exceeding 490 kN according to Table 3.1.2-1, the following ropes may be used:

- with reduced ship design minimum breaking load and an increased number of ropes,
- or
- with increased ship design minimum breaking load and a reduced number of ropes.

In such cases the total ship design minimum breaking load of all the mooring ropes is not to be less than the total rope ship design minimum breaking load foreseen according to Table 3.1.2-1. The number of ropes is not to be less than 6, and ship design minimum breaking load of a single rope is not to be lower than 490 kN.

4.1.4 The length of the individual mooring ropes may be up to 7% less than that given in the Table 3.1.2-1 provided that the total length of all wires and ropes is not less than the sum of the individual lengths.

4.1.5 If synthetic-fibre ropes are used, the breaking strength of a rope F_c is not to be less than:

$$F_c = 0,0742 \cdot \delta_n \cdot F_t^{8/9}, \quad [\text{kN}]$$

where:

δ_n = the mean relative elongation to the breaking point of a synthetic rope, in percentages but not less than 30%,

F_t = actual breaking strength of a mooring rope, given in Table 3.1.2-1 or 3.1.2-2, in [kN].

4.1.6 Provisions for mooring ropes of non-propelled unmanned barges are as follow:

- $L < 65$ m : 2 ropes
- $L \geq 65$ m : 3 ropes

Length of the mooring ropes is to be two times of length or 80 m, whichever is greater.

4.1.7 As an alternative to the prescriptive approach, direct mooring analysis may be performed to determine the necessary mooring restraint, i.e. number and strength of mooring lines. Direct analyses allow to optimize mooring equipment and arrangement for the individual ship and the port mooring facilities typical for the considered ship type and size. The requirements of direct analysis are shown in the *IACS Rec. No. 10*, Appendix A.

4.2 MOORING ROPES

4.2.1 Mooring ropes may be made of steel wire, or of natural or synthetic fibres except on ships carrying in bulk flammable liquids with a flash point under 60°.

Operations with steel wire ropes are allowed only on those superstructure decks which are not the top of the cargo tanks and which have no cargo pipelines led over them.

Regardless of the ship design minimum breaking load as specified in Tables 3.1.2-1, 3.1.2-2 or 3.6.2.1-1, fibre ropes with a diameter less than 20 mm are not acceptable.

For polyamide ropes the ship design minimum breaking load should be increased by 20% and for other synthetic ropes by 10% to account for strength loss due to, among others, aging and wear.

4.2.2 Wire ropes are to be of a flexible construction composed according to Table 4.2.2

Table 4.2.2-1

Breaking load (BL) [kN]	Composition
$BL \leq 216$	72 wires in 6 strands with 7 fibre cores
$216 < BL \leq 490$	144 wires in 6 strands with 7 fibre cores
$BL > 490$	216 wires in 6 strands with 1 fibre core

4.2.3 Wire ropes for use in association with mooring winches where the rope is to be stored on the drum may be constructed with on independent wire rope core instead of fibre core. The number of wires in such ropes is not to be less than 216.

In all other respects these ropes shall meet the requirements of the *Rules for the classification of ships, Part 25 - Metallic materials*, Section 8.

4.2.4 Natural fibre ropes are to be either manila or sisal. The ships having equipment number 205 and less are permitted to use hemp ropes. The use of hemp ropes in ships with equipment number over 205 is subject to special consideration in each particular case.

In all other respects these ropes shall meet the requirements of the *Rules for the classification of ships, Part 25 - Metallic materials*, Section 2.

4.2.5 The synthetic fibre ropes may contain capron, nylon, polypropylene and other approved synthetic materials as well as combinations of fibres of different approved materials.

In all other respects, the ropes of synthetic fibre material shall meet the requirements of the *Rules for the classification of ships, Part 24 - Non-metallic materials*, Section 2.

4.3 MOORING APPLIANCES

4.3.1 The number and position of mooring bollards, fairleads and other mooring appliances depend on the construction particulars, purpose and general arrangement of the ship.

4.3.2 Bollards may be of steel or cast iron. Small ships equipped only with natural fibre or synthetic fibre ropes are permitted to use the bollards made of light alloys. As to the method of manufacture, the bollards may be welded or cast.

4.3.3 The outside diameter of the bollard column is to be not less than 10 times the diameter of the steel rope and 5,5 times the diameter of the synthetic-fibre rope; nor is to be less than one circumference of the fibre rope to be used with the bollard. The distance between the axis of the bollard column is not to be less than 25 times the diameter of the steel rope, or 3 circumferences of the fibre rope are to be used with the bollard.

4.3.4 Bollards, fairleads and other parts of mooring appliances, with the exception of rope stoppers, are to be so designed that the stresses in their parts do not exceed 0,95 times the yield point of the material.

The breaking strength of a rope stopper is to be not less than 0,15 of the breaking strength of the whole rope for which it is intended.

4.3.5 For the requirements applicable to design and construction of shipboard fittings and supporting structures used for the mooring operations, see 5.6.

4.3.6 For specific requirements relating to attestation of the mooring equipment of passenger ships in domestic service class "D" operating exclusively in the area of navigation 6 and 7, in the period from April 1 to October 31, see Section A.9.

4.4 MOORING MACHINERY

4.4.1 Specially fitted appliances, such as drums, capstans etc. may be provided for winding up mooring ropes, and as well other existing deck arrangements such as anchor windlass, cargo winches etc. provided with drums for rope coiling.

4.4.2 Decisions as to the number and type of mooring machinery are to the owner and designer's discretion, on condition that the rated forced of the machinery does not exceed 1/3 of the breaking strength of the mooring ropes to be used on the ship and that the requirements of the *Rules for the classification of ships, Part 9 - Machines*, 6.4 are satisfied.

5 TOWING ARRANGEMENT

5.1 GENERAL PROVISIONS

5.1.1 Each ship is to be provided with towing arrangement, which meets the requirements of 5.2, 5.3 and 5.6.

5.1.2 All oil tankers over 20000 tons deadweight, including combination carriers, chemical tankers and liquefied gas carriers shall comply with requirements of 5.4.

5.1.3 Tugs shall comply with requirements of 5.5.

5.2 TOWING LINE

5.2.1 Lengths and breaking loads of a towing lines specified in the Table 3.1.2-1 are recommendations only.

5.2.2 For shipborn barges the breaking strength of the towing line is determined by the formula:

$$F_p = 16 \cdot n \cdot B \cdot d, \text{ in [kN]},$$

where:

- n = number of barges towed,
- B = width of barges, in [m],
- d = draught of the barges, in [m].

The breaking strength of the rope is used in calculations of equipment strength for shipborn barges. The lines for towing barges may be stored on the barges if the shipowner so desires, or they may be kept on tugboats and not be included as part of the barge equipment.

5.2.3 Towing lines may be made of steel wire or of natural or synthetic fibres. The requirements for mooring rope as provided in 4.2 are also applicable to towing lines.

5.3 TOWING APPLIANCES

5.3.1 The number and location of towing bollards and chocks depend on the construction particulars, purpose and general arrangement of the ship.

5.3.2 The requirements for mooring bollards and chocks as provided in 4.3.2, 4.3.3 and 4.3.4 are also applicable to towing bollards and chocks.

5.4 EMERGENCY TOWING ARRANGEMENTS ON TANKERS

5.4.1 General requirements

5.4.1.1 Emergency towing arrangements shall be fitted at both ends on board every tanker listed in 5.1.2.

5.4.1.2 For tankers constructed on or after 1 July 2002:

- .1 the arrangements shall, at all times, be capable of rapid deployment in the absence of main power on the ship to be towed and easy connection to the towing ship. At least one of the emergency towing arrangements shall be pre-rigged ready for rapid deployment; and
- .2 emergency towing arrangements at both ends shall be of adequate strength taking into account the size and deadweight of the ship, and the expected forces during bad weather conditions. The design and construction and prototype testing of emergency towing arrangements shall be approved by the Administration, based on the Guidelines developed by the Organization*.

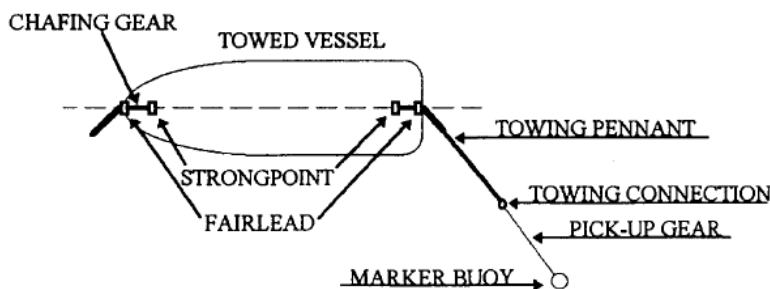


Figure 5.4.1.2 Typical emergency towing arrangement

5.4.1.3 For tankers constructed before 1 July 2002, the design and construction of emergency towing arrangements shall be approved by the Administration, based on the Guidelines developed by the Organization*.

* Refer to the Guidelines on emergency towing arrangements for tankers, adopted by the Maritime Safety Committee by resolution MSC.35(63), as amended.

5.4.1.4 Towing arrangements may be (1) a packaged self contained unit, or (2) a unit comprised of individually tested components assembled onboard the vessel. Both arrangements should meet the specified strength requirements and undergo a deployment test on board the vessel as required by MSC.35(36). See also *IACS UISC 113*.

Fixed gear such as strongpoints, fairleads, foundations and associated vessel supporting structure are to be demonstrated as adequate for the loads specified in 5.4.2.2 by means of analysis or calculations submitted to the *Register*. If such analysis is deemed not appropriate depending on structural configuration, proof test may be required.

Articles of loose gear such as chains, towing pennants and associated end fittings, and shackles or other connecting links are to be tested to the requirements of the *Rules for the classification of ships, Part 25 - Metallic materials, Section 2*.

5.4.1.5 Where a manufacturer requests a certificate of type approval for a complete packaged towing arrangement, one assembled unit to undergo prototype test to 2 x SWL (safe working load).

5.4.1.6 Existing emergency towing arrangements fitted in accordance with IMO Resolution A.535(13) and approved by the *Register* may retain at forward location.

Table 5.4.2.1-1 Towing components

	Forward of ship	Aft of ship	Strength requirements
Pick-up gear	Optional	Yes	'
Towing pennant	Optional	Yes	Yes
Chafing gear	Yes	Depending on design	Yes
Fairlead	Yes	Yes	Yes
Strongpoint	Yes	Yes	Yes
Roller pedestal	Yes	Depending on design	-

5.4.2 Towing components, strength and technical characteristics

5.4.2.1 The towing arrangements generally shall consist of the major components specified in Table 5.4.2.1-1.

5.4.2.2 Towing components as specified in 5.4.2.1 for strength are to be designed with a working strength of at least 1000 kN for tankers of 20000 tonnes deadweight and over but less than 50000 tonnes deadweight, and at least 2000 kN for tankers of 50000 tonnes deadweight and over (working strength is defined as one half ultimate strength). The strength is to be sufficient for all relevant angels of towing line, i.e. up to 90° from the ship's centreline to port and starboard and 30° vertical downwards.

Other components are to be designed with a working strength sufficient to withstand the load to which such components may be subjected during the towing operation.

5.4.2.3 Length of the towing pennant is to be at least twice the lightest seagoing ballast freeboard at the fairlead plus 50 m.

5.4.2.4 The bow and stern strongpoint and fairleads are to be located so as to facilitate towing from either side of the bow and stern and minimise the stress on the towing system.

5.4.2.5 Fairleads opening are to be large enough to pass the largest portion of the chafing gear, towing pennant or towing line.

The fairlead has to give adequate support for the towing pennant during towing operation, which means bending 90° to port, and to starboard side and 30° vertical downwards. The bending ratio (towing pennant bearing surface diameter to towing pennant diameter) is not to be less than 7 : 1.

5.4.2.6 If a chafing chain is to be used on design of chafing gear, the following characteristics are to be provided:

- .1 The chafing chain is to be stud link chain.
- .2 The chafing chain is to be long enough to ensure that the towing pennant remains outside the fairlead during the towing operation. A chain extending from the strongpoint to a point at least 3 m beyond the fairlead should meet this criterion.
- .3 One end of the chafing chain is to be suitable for connection to the strongpoint. The other end is to be fitted with a standard pear-shaped open link (see Fig. 5.4.2.6) allowing connection to a standard bow shackle.
- .4 The chafing chain is to be stowed in such a way that it can be rapidly connected to the strongpoint.

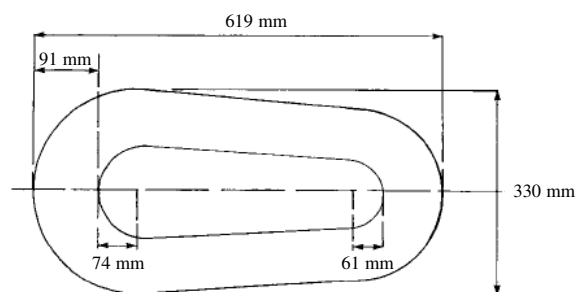


Figure 5.4.2.6 Standardised pear-shaped link

5.4.2.7 A termination of the towing pennant is to be a hard eye-formed allowing connection to a standard bow shackle.

5.4.2.8 To ensure ready availability and rapid deployment, emergency towing arrangements shall comply with the following criteria:

- .1 The aft emergency towing arrangements are to be pre-rigged and be capable of being deployed in a controlled manner in harbour conditions not more than 15 min.
- .2 The pick-up gear for the aft towing pennant is to be designed at least for manual operation by one person taking into account the absence of power and the potential for adverse environmental conditions that may prevail during such emergency towing operations. The pick-up gear is to be protected against the weather and other adverse conditions that may prevail.
- .3 The forward emergency towing arrangement is to be capable of being deployed in harbour conditions in not more than 60 min.
- .4 The forward emergency towing arrangements is to be designed at last with a means of securing a towing line to the chafing gear using a suitably positioned pedestal roller to facilitate connection of the towing pennant.
- .5 Forward emergency towing arrangements which comply with the requirements for aft emergency towing arrangements may be accepted.
- .6 All emergency towing arrangements are to be clearly marked to facilitate safe and effective use even in darkness and poor visibility.

5.4.2.9 All emergency towing components are to be inspected by ship personnel at regular intervals and maintained in good working order.

5.5 SPECIAL ARRANGEMENT FOR TUGS

5.5.1 Towing hook or equivalent is normally to be located 5 to 10% of the ship's length abaft amidships, but in no circumstances is to be sited forward of the longitudinal centre of gravity of the tug in any anticipated condition of loading.

5.5.2 Towing hooks should have reliable slip arrangement i.e. quick release device which facilitate towing line release regardless of angle of heel and of direction of towing line.

The towing hook has to be equipped with a mechanical, hydraulic or pneumatic slip device. The slip device is to be designed such as to guarantee that unintentional slipping is avoided.

The releasing device is to be operable from the bridge as well as in the vicinity of hook itself.

Towrope protection sleeves or other adequate means are to be provided to prevent the directly pulled towropes from being damaged by chafing / abrasion.

5.5.3 The number and type of equipment and outfit forming special arrangement for tugs which ensures towing operations under different service conditions are determined by the shipowner considering that such equipment and outfit shall satisfy the requirements of the present chapter.

5.5.4 The main determining factor in providing the tugs with a special arrangement is the rated towing pull (F). The numerical value of F is within the owner's and designer's discretion, and all calculations pertaining to the determination of this value are not subject to approval by the Register.

If, however, during mooring and sea trials of the tug, the towing force is found to exceed the value F , Register may require strengthening of the towing arrangements units or a restriction of power during towing operations.

The bollard pull of the vessel may be verified by a bollard pull test approved by Register. The results of test are to be shown in diagram bollard pull/time (see Fig. 5.5.4.).

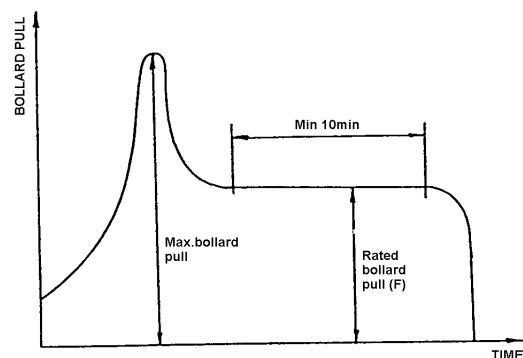


Figure 5.5.4

5.5.5 The required minimum breaking force F_{min} of the tow-rope is to be determined by the following formula:

where:

$$F_{min} = k \cdot F, \text{ [kN];}$$

k = utility factor, defined as:

$$k = 2,5 \text{ for } F \leq 200 \text{ kN;}$$

$$k = 2,0 \text{ for } F \geq 1000 \text{ kN;}$$

$$F = \text{towing pull, [kN].}$$

For F between 200 and 1000 kN, k may be interpolated linearly.

The requirements of 4.2 for mooring ropes are also applicable to the towing line.

The length of the towrope is to be chosen according to the tow formation (masses of tug and towed object), the water depth and the nautical conditions. Regulations of flag state authorities have to be observed.

The length of towing line for towing operations is to be at least 150 m.

5.5.6 All stressed parts of the towing arrangement (such as the towing hook, towing rails, etc.) as well as the fastenings for securing these parts to the ship's hull are to be designed to take a test force F_t .

where:

$$F_t = 2 \cdot F, \text{ for } F \leq 500 \text{ kN;}$$

$$F_t = F + 500, \text{ for } 500 < F \leq 1500 \text{ kN;}$$

$$F_t = 1.33 \cdot F, \text{ for } F > 1500 \text{ kN;}$$

The equivalent permissible stresses in these parts are not to exceed 0,85 times the upper yield stress of their material.

For the towing hook foundation it has to be additionally proven that these permissible stresses are not exceeded assuming a load equal to the minimum breaking force F_{min} of the towrope.

5.5.7 The device for protection of the hook from overloading must be adjusted to a breaking strength three times the nominal towing force.

5.5.8 Prior to installation on board the ship the towing hooks are to be tested by application of a test force F_t .

5.5.9 The towing beams are to be made of pipes or other suitable sections. Wide and high beams are to be supported by (A) type tubular struts, which are to be arranged in the centreline of the ship or symmetrically in relation to it. On the bulwark, the beams are to be connected with brackets whose free edges are to be framed with a bar section or pipe.

5.5.10 The section modulus of the towing beam is not to be less than:

$$W = 0,343 \cdot 10^{-2} \frac{d^2 L l}{R_{eH}}, \quad [\text{cm}^3],$$

where:

- d = diameter of the towing line, in [mm],
- L = the length of the towing line, in [m], not to be less than 300 m,
- l = distance between the struts or between one strut and the bulwark, in [m],
- R_{eH} = yield point of the beam material, in [N/mm²].

5.5.11 The cross-sectional area of each branch of a A-shaped strut is not to be less than:

$$f = 0,03 \frac{d^2 L}{R_{eH}}, \quad [\text{cm}^2],$$

where:

- R_{eH} = yield point of the strut material, in [N/mm²].

5.5.12 The wire stopper and its fastenings are to be such that their breaking load is not less than 1,5 times the towing force.

5.5.13 A robust and efficient fendering system is to be fitted in areas intended for pushing. The fendering system purpose is to distribute the pushing force and limit its dynamic component on the hull structure of both the tug (and the assisted ship).

5.5.14 The requirements for the design of towing winches are specified in the *Rules for the classification of ships, Part 9 - Machines*, 6.5.

5.5.15 The length of towing line on winch is not to be less than 400 m.

5.6 SHIPBOARD FITTINGS AND SUPPORTING HULL STRUCTURES ASSOCIATED WITH TOWING AND MOORING ON CONVENTIONAL VESSELS

5.6.1 Application and definitions

Conventional ships are to be provided with arrangements, equipment and fittings of sufficient safe working load to enable the safe conduct of all towing and mooring operations associated with the normal operations of the ship.

This requirement is to apply to design and construction of shipboard fittings and supporting structures used for the normal towing and mooring operations. Normal towing means towing operations necessary for manoeuvring in ports and sheltered waters associated with the normal operations of the ship.

For ships, not subject to SOLAS Regulation II-1/3-4, Paragraph 1, but intended to be fitted with equipment for towing by another ship or a tug, e.g. such as to assist the ship in case of emergency as given in SOLAS Regulation II-1/3-4, Paragraph 2, the requirements designated as 'other towing' in this requirement are to be applied to design and construction of those shipboard fittings and supporting hull structures.

This requirement is not applicable to design and construction of shipboard fittings and supporting hull structures used for special towing services defined as:

- **Escort towing:** Towing service, in particular, for laden oil tankers or LNG carriers, required in specific estuaries. Its main purpose is to control the ship in case of failures of the propulsion or steering system. It should be referred to local escort requirements and guidance given by, e.g., the *Oil Companies International Marine Forum (OCIMF)*.
- **Canal transit towing:** Towing service for ships transiting canals, e.g. the Panama Canal. It should be referred to local canal transit requirements.
- **Emergency towing for tankers:** Towing service to assist tankers in case of emergency. For the emergency towing arrangements, ships subject to SOLAS regulation II-1/3-4, Paragraph 1 are to comply with that regulation and resolution *MSC.35(63)* as may be amended.

IACS Recommendation No. 10 "Anchoring, Mooring and Towing Equipment" may be referred to for recommendations concerning mooring and towing.

For the requirements of SOLAS regulation II-1/3-8 relating to towing and mooring equipment, see IACS Unified Interpretation SC212.

The net minimum scantlings of the supporting hull structure are to comply with the requirements given in 5.6.2.5 and 5.6.3.5. The net thicknesses, t_{net} , are the member thicknesses necessary to obtain the above required minimum net scantlings. The required gross thicknesses are obtained by adding the corrosion addition, t_k , given in 5.6.5, to t_{net} .

Shipboard fittings are to comply with the requirements given in 5.6.2.4 and 5.6.3.4. For shipboard fittings not selected from an accepted industry standard the corrosion addition, tk, and the wear allowance, tw, given in 5.6.5 and 5.6.6, respectively, are to be considered.

For the purpose of this requirement:

- **Conventional ships** means new displacement-type ships of 500 GT and above, excluding high speed craft, special purpose ships, and offshore units of all types. As per MSC.266(84), 'Special purpose ship' means a mechanically self-propelled ship which by reason of its function carries on board more than 12 special personnel.
- **Shipboard fittings** mean those components limited to the following: bollards and bits, fairleads, stand rollers, chocks used for the normal mooring of the vessel and the similar components used for the normal towing of the ship. Other components such as capstans, winches, etc. are not covered by the requirements of this Section. Any weld or bolt or equivalent device connecting the shipboard fitting to the supporting structure is part of the shipboard fitting and if selected from an industry standard subject to that standard.
- **Supporting hull structures** means that part of the ship structure on/in which the shipboard fitting is placed and which is directly submitted to the forces exerted on the shipboard fitting. The supporting hull structure of capstans, winches, etc. used for the normal towing and mooring operations mentioned above is also subject to the requirements of this Section.
- **Industry standard** means international standard (ISO, etc.) or standards issued by national association which are recognised in the country where the ship is built.
- The nominal **capacity condition** is defined as the theoretical condition where the maximum possible deck cargoes are included in the ship arrangement in their respective positions. For container ships the nominal capacity condition represents the theoretical condition where the maximum possible number of containers is included in the ship arrangement in their respective positions.
- **Ship Design Minimum Breaking Load (MBL_{SD})** means the minimum breaking load of new, dry mooring lines or tow line for which shipboard fittings and supporting hull structures are designed in order to meet mooring restraint requirements or the towing requirements of other towing service.
- **Line Design Break Force (LDBF)** means the minimum force that a new, dry, spliced, mooring line will break at. This is for all synthetic cordage materials.

5.6.2 Towing

5.6.2.1 Strength

The strength of shipboard fittings used for normal towing operations at bow, sides and stern and their supporting hull structures are to comply with the requirements of this Section.

Where a ship is equipped with shipboard fittings intended to be used for other towing services, the strength of these fittings and their supporting hull structures are to comply with the requirements of this Section.

For fittings intended to be used for, both, towing and mooring, 5.6.3 applies to mooring.

5.6.2.2 Arrangement

Shipboard fittings for towing are to be located on stiffeners and/or girders, which are part of the deck construction so as to facilitate efficient distribution of the towing load.

Other arrangements may be accepted (for chocks in bulwarks, etc.) provided the strength is confirmed adequate for the intended service.

5.6.2.3 Load considerations

The minimum design load applied to supporting hull structures for shipboard fittings is to be:

- (1) for normal towing operations, 1.25 times the intended maximum towing load (e.g. static bollard pull) as indicated on the towing and mooring arrangements plan.
- (2) for other towing service, the ship design minimum breaking load according to IACS Recommendation No. 10 (see Notes),
- (3) for fittings intended to be used for, both, normal and other towing operations, the greater of the design loads according to (1) and (2).

Notes:

1. *Side projected area including that of deck cargoes as given by the ship nominal capacity condition is to be taken into account for selection of towing lines and the loads applied to shipboard fittings and supporting hull structure. The nominal capacity condition is defined in 5.6.1.*

2. *The increase of the line design break force for synthetic ropes according to IACS Recommendation No. 10 needs not to be taken into account for the loads applied to shipboard fittings and supporting hull structure.*

When a safe towing load TOW greater than that determined according to 5.6.2.6 is requested by the applicant, then the design load is to be increased in accordance with the appropriate TOW/design load relationship given by 5.6.2.3 and 5.6.2.6.

The design load is to be applied to fittings in all directions that may occur by taking into account the arrangement shown on the towing and mooring arrangements plan.

Where the towing line takes a turn at a fitting the total design load applied to the fitting is equal to the resultant of the design loads acting on the line, see Fig. 5.6.2.3.

However, in no case does the design load applied to the fitting need to be greater than twice the design load on the line.

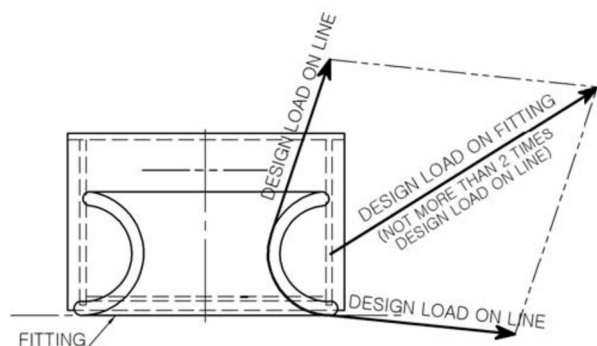


Figure 5.6.2.3

5.6.2.4 Shipboard fittings

Shipboard fittings may be selected from an industry standard accepted by the *Register* and at least based on the following loads.

- (1) For normal towing operations, the intended maximum towing load (e.g. static bollard pull) as indicated on the towing and mooring arrangements plan,
- (2) For other towing service, the ship design minimum breaking load of the tow line according to IACS Recommendation No. 10 (see Notes in 5.6.2.3),
- (3) For fittings intended to be used for, both, normal and other towing operations, the greater of the loads according to (1) and (2).

Towing bits (double bollards) may be chosen for the towing line attached with eye splice if the industry standard distinguishes between different methods to attach the line, i.e. figure-of-eight or eye splice attachment.

When the shipboard fitting is not selected from an accepted industry standard, the strength of the fitting and of its attachment to the ship is to be in accordance with 5.6.2.3 and 5.6.2.5. Towing bits (double bollards) are required to resist the loads caused by the towing line attached with eye splice. For strength assessment beam theory or finite element analysis using net scantlings is to be applied, as appropriate. Corrosion additions are to be as defined in 5.6.5. A wear down allowance is to be included as defined in 5.6.6. At the discretion of the *Register*, load tests may be accepted as alternative to strength assessment by calculations.

5.6.2.5 Supporting hull structure

5.6.2.5.1 Arrangement

The reinforced members beneath shipboard fittings are to be effectively arranged for any variation of direction (horizontally and vertically) of the towing forces acting upon the shipboard fittings, see Fig. 5.6.2.5.1 for a sample

arrangement. Proper alignment of fitting and supporting hull structure is to be ensured.

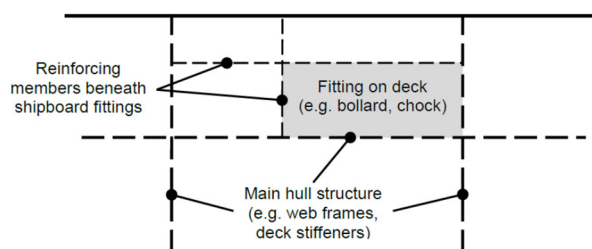


Figure 5.6.2.5.1

5.6.2.5.2 Acting point of towing force

The design load applied to supporting hull structure is to be in accordance with 5.6.2.3.

The acting point of the towing force on shipboard fittings is to be taken at the attachment point of a towing line or at a change in its direction. For bollards and bits the attachment point of the towing line is to be taken not less than 4/5 of the tube height above the base, see Fig. 5.6.2.5.2.

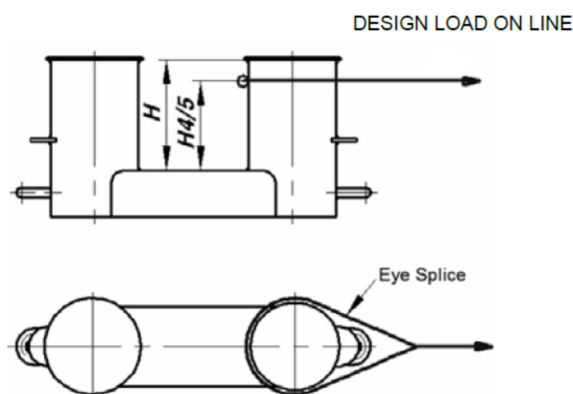


Figure 5.6.2.5.2

5.6.2.5.3 Allowable stresses

Allowable stresses under the design load conditions as specified in 5.6.2.3 are as follows:

- (1) for strength assessment by means of beam theory or grillage analysis:

normal stress: 1,0 ReH;

shearing stress: 0,6 ReH.

Normal stress is the sum of bending stress and axial stress with the corresponding shearing stress acting perpendicular to the normal stress. No stress concentration factors being taken into account.

- (2) for strength assessment by means of finite element analysis:

Von Mises stress: $1,0 R_{eH}$.

For strength assessment by means of finite element analysis the mesh is to be fine enough to represent the geometry as realistically as possible. The aspect ratios of elements are not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges may be modelled by beam or truss elements. The element height of girder webs must not exceed one-third of the web height. In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height as per *Register's* Rules. Large openings are to be modelled. Stiffeners may be modelled by using shell, plane stress, or beam elements. The mesh size of stiffeners is to be fine enough to obtain proper bending stress. If flat bars are modeled using shell or plane stress elements, dummy rod elements are to be modelled at the free edge of the flat bars and the stresses of the dummy elements are to be evaluated. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element.

R_{eH} is the specified minimum yield stress of the material.

5.6.2.6 Safe towing load (TOW)

5.6.2.6.1 The safe towing load (TOW) is the safe load limit of shipboard fittings for towing purpose.

5.6.2.6.2 TOW used for normal towing operations is not to exceed 80% of the design load per 5.6.2.3 (1).

5.6.2.6.3 TOW used for other towing operations is not to exceed 80% of the design load according to 5.6.2.3 (2).

5.6.2.6.4 For fittings used for both normal and other towing operations, the greater of the safe towing loads according to 5.6.2.6.2 and 5.6.2.6.3 is to be used.

5.6.2.6.5 For fittings intended to be used for, both, towing and mooring, 5.6.3 applies to mooring.

5.6.2.6.6 TOW, in [t], of each shipboard fitting is to be marked (by weld bead or equivalent) on the deck fittings used for towing. For fittings intended to be used for, both, towing and mooring, SWL, in [t], according to 5.6.3.6 is to be marked in addition to TOW.

5.6.2.6.7 The above requirements on TOW apply for the use with no more than one line. If not otherwise chosen, for towing bits (double bollards) TOW is the load limit for a towing line attached with eye-splice.

5.6.2.6.7 The towing and mooring arrangements plan mentioned in 5.6.4 is to define the method of use of towing lines.

5.6.3 Mooring**5.6.3.1 Strength**

The strength of shipboard fittings used for mooring operations and their supporting hull structures as well as the strength of supporting hull structures of winches and capstans is to comply with the requirements of this Section.

For fittings intended to be used for, both, towing and mooring, 5.6.2 applies to towing.

5.6.3.2 Arrangement

Shipboard fittings, winches and capstans for mooring are to be located on stiffeners and/or girders, which are part of the deck construction so as to facilitate efficient distribution of the mooring load.

Other arrangements may be accepted (for chocks in bulwarks, etc.) provided the strength is confirmed adequate for the service.

5.6.3.3 Load considerations

5.6.3.3.1 The minimum design load applied to supporting hull structures for shipboard fittings is to be 1.15 times the ship design minimum breaking load according to the Tables 3.1.2-1 and 3.1.2-2 (see Notes). See also IACS Recommendation No. 10.

5.6.3.3.2 The minimum design load applied to supporting hull structures for winches is to be 1.25 times the intended maximum brake holding load, where the maximum brake holding load is to be assumed not less than 80% of the the ship design minimum breaking load according to the Tables 3.1.2-1 and 3.1.2-2, see Notes. See also IACS Recommendation No. 10. For supporting hull structures of capstans, 1.25 times the maximum hauling-in force is to be taken as the minimum design load.

5.6.3.3.3 When a safe working load SWL greater than that determined according to 5.6.3.6 is requested by the applicant, then the design load is to be increased in accordance with the appropriate SWL/design load relationship given by 5.6.3.3 and 5.6.3.6.

5.6.3.3.4 The design load is to be applied to fittings in all directions that may occur by taking into account the arrangement shown on the towing and mooring arrangements plan. Where the mooring line takes a turn at a fitting the total design load applied to the fitting is equal to the resultant of the design loads acting on the line, refer to the Fig. 5.6.2.3. However, in no case does the design load applied to the fitting need to be greater than twice the design load on the line.

Notes:

1. Side projected area including that of deck cargoes as given by the ship nominal capacity condition is to be taken into account for selection of towing lines and the loads applied to shipboard fittings and supporting hull structure. The nominal capacity condition is defined in 5.6.1. See also IACS Recommendation No. 10.

2. The increase of the line design break force for synthetic ropes according to 4.2 needs not to be taken into account for the loads applied to shipboard fittings and supporting hull structure. See also IACS Recommendation No. 10.

5.6.3.4 Shipboard fittings

Shipboard fittings may be selected from an industry standard accepted by the *Register* and at least based on the ship design minimum breaking load according to the Tables 3.1.2-1 and 3.1.2-2 (see Notes in 5.6.3.3). See also IACS Recommendation No. 10.

Mooring bits (double bollards) are to be chosen for the mooring line attached in figure-of-eight fashion if the industry standard distinguishes between different methods to attach the line, i.e. figure-of-eight or eye splice attachment.

When the shipboard fitting is not selected from an accepted industry standard, the strength of the fitting and of its attachment to the ship is to be in accordance with 5.6.3.3 and 5.6.3.5. Mooring bitts (double bollards) are required to resist the loads caused by the mooring line attached in figure-of-eight fashion, see Note. For strength assessment beam theory or finite element analysis using net scantlings is to be applied, as appropriate. Corrosion additions are to be as defined in 5.6.5. A wear down allowance is to be included as defined in 5.6.6. At the discretion of the *Register*, load tests may be accepted as alternative to strength assessment by calculations.

Note:

With the line attached to a mooring bitt in the usual way (figure-of-eight fashion), either of the two posts of the mooring bitt can be subjected to a force twice as large as that acting on the mooring line. Disregarding this effect, depending on the applied industry standard and fitting size, overload may occur.

5.6.3.5 Supporting hull structure

5.6.3.5.1 Arrangement

The arrangement of reinforced members beneath shipboard fittings, winches and capstans is to consider any variation of direction (horizontally and vertically) of the mooring forces acting upon the shipboard fittings, see Fig. 5.6.2.5.1 for a sample arrangement. Proper alignment of fitting and supporting hull structure is to be ensured.

5.6.3.5.2 Acting point of mooring force

The design load applied to supporting hull structure is to be in accordance with 5.6.3.3.

The acting point of the mooring force on shipboard fittings is to be taken at the attachment point of a mooring line or at a change in its direction.

For bollards and bitts the attachment point of the mooring line is to be taken not less than 4/5 of the tube height above the base, see a) in Fig. 5.6.3.5.2. However, if fins are fitted to the bollard tubes to keep the mooring line as low as possible, the attachment point of the mooring line may be taken at the location of the fins, see b) in Fig. 5.6.3.5.2.

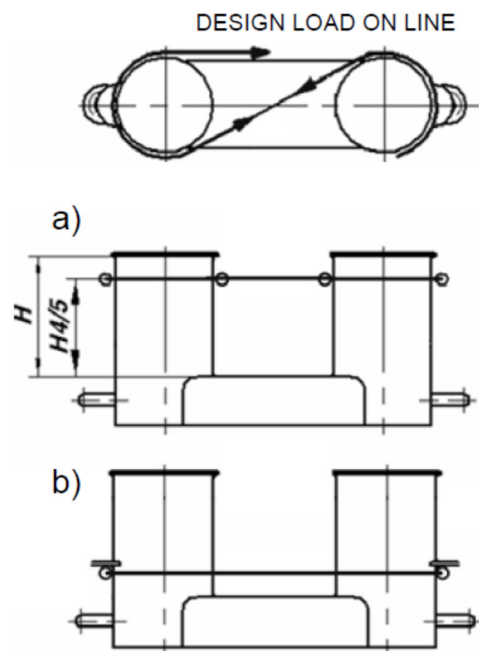


Figure 5.6.3.5.2

5.6.3.5.3 Allowable stresses

Allowable stresses under the design load conditions as specified in 5.6.3.3 are as follows:

- (1) for strength assessment by means of beam theory or grillage analysis:

normal stress: $1,0 R_{eH}$;

shearing stress: $0,6 R_{eH}$.

Normal stress is the sum of bending stress and axial stress. No stress concentration factors being taken into account.

- (2) for strength assessment by means of finite element analysis:

Von Mises stress: $1,0 R_{eH}$.

For strength assessment by means of finite element analysis the mesh is to be fine enough to represent the geometry as realistically as possible. The aspect ratios of elements are not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges may be modelled by beam or truss elements. The element height of girder webs must not exceed one-third of the web height. In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height as per Register's Rules. Large openings are to be modelled. Stiffeners may be modelled by using shell, plane stress, or beam elements. The mesh size of stiffeners is to be fine enough to obtain proper bending stress. If flat bars are modeled using shell or plane stress elements, dummy rod elements are to be modelled at the free edge of the flat bars and the stresses of the dummy elements are to be evaluated. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element.

ReH is the specified minimum yield stress of the material.

5.6.3.6 Safe working load (SWL)

5.6.3.6.1 The Safe Working Load (SWL) is the safe load limit of shipboard fittings used for mooring purpose.

5.6.3.2 Unless a greater SWL is requested by the applicant according to 5.6.3.3, the SWL is not to exceed the ship design minimum breaking load of the Tables 3.1.2-1 and 3.1.2-2, see Notes in 5.6.3.3. See also IACS Recommendation No. 10.

5.6.3.3 The SWL, in [t], of each shipboard fitting is to be marked (by weld bead or equivalent) on the deck fittings used for mooring. For fittings intended to be used for, both, mooring and towing, TOW, in [t], according to 5.6.2.6 is to be marked in addition to SWL.

5.6.3.4 The above requirements on SWL apply for the use with no more than one mooring line.

5.6.3.5 The towing and mooring arrangements plan mentioned in 5.6.4 is to define the method of use of mooring lines.

5.6.4 Towing and mooring arrangements plan

5.6.4.1 The SWL and TOW for the intended use for each shipboard fitting is to be noted in the towing and mooring arrangements plan available on board for the guidance of the Master.

It is to be noted that TOW is the load limit for towing purpose and SWL that for mooring purpose. If not otherwise chosen, for towing bitts it is to be noted that TOW is the load limit for a towing line attached with eye-splice.

5.6.4.2 Information provided on the plan is to include in respect of each shipboard fitting:

1. location on the ship;
2. fitting type;
3. SWL/TOW;
4. purpose (mooring/harbour towing/other towing);
5. manner of applying towing or mooring line load including limiting fleet angles i.e. angle of change in direction of a line at the fittings.

Item 3 with respect to items 4 and 5, is subject to approval by the *Register*.

Furthermore, information provided on the plan is to include:

1. the arrangement of mooring lines showing number of lines (N),
2. the ship design minimum breaking load (MBL_{SD}),
3. the acceptable environmental conditions (refer for minimum conditions to IACS Recommendation No. 10 for the recommended ship design minimum breaking load for ships with equipment number $E_n > 2000$):

- 30 second mean wind speed from any direction (v_w or v_w^* according to IACS Recommendation No. 10).

- maximum current speed acting on bow or stern ($\pm 10^\circ$).

5.6.4.3 The information as given in 5.6.4.2 is to be incorporated into the pilot card in order to provide the pilot proper information on harbour and other towing operations.

5.6.5 Corrosion addition

The total corrosion addition, t_k , in [mm], is not to be less than the following values:

1. Ships covered by IACS Common Structural Rules for Bulk Carriers and Oil Tankers: t_k , total corrosion addition defined in these rules
2. Other ships: 2.0 mm.
 - for the supporting hull structure, according to the *Register's* Rules for the surrounding structure (e.g. deck structures, bulwark structures).
 - for pedestals and foundations on deck which are not part of a fitting according to an accepted industry standard, 2.0 mm.
 - for shipboard fittings not selected from an accepted industry standard, 2.0 mm.

5.6.6 Wear allowance

In addition to the corrosion addition given in 5.6.5 the wear allowance, t_w , for shipboard fittings not selected from an accepted industry standard is not to be less than 1.0 mm, added to surfaces which are intended to regularly contact the line.

5.6.7 Survey after construction

Upon request from the owner, *Register* is prepared to certify that the vessel is specially fitted for compliance with Section 4.3 of "Mooring Equipment Guidelines (MEG 4)", published by the *Oil Companies International Marine Forum* (OCIMF), 2018, as amended.

5.7 EQUIPMENT FOR MOORING AT SINGLE POINT MOORINGS

5.7.1 Upon request from the owner, *Register* is prepared to certify that the vessel is specially fitted for compliance with Section 4.3 of "Mooring Equipment Guidelines (MEG 4)", published by the *Oil Companies International Marine Forum*, 2018, as amended. See also IACS Rec. No. 13.

5.7.2 Plans showing the arrangement should be submitted to the *Register* for review.

The safety factor on yield load for bow chain stoppers and bow fairleads should be a minimum of 2 when the specified safe working load (SWL) is applied as given in Section 4.3 of the Guidelines.

Their foundations and supporting structures should be adequate to withstand $2 \times$ SWL of bow chain stoppers and bow fairleads.

Smit type towing bracket fittings should not be used as bow chain stoppers.

Calculations to demonstrate this capability should be submitted.

The chain bearing surface of the bow fairleads described in 4.3 should have a diameter at least seven times that of the associated chain.

The installation on board the ship should be confirmed by a *Register's* surveyor.

Compliance with the foregoing should be suitably documented.

5.8 EMERGENCY TOWING PROCEDURES ON SHIPS

5.8.1 This paragraph applies to:

- .1 all passenger ships, not later than 1 January 2010;
- .2 cargo ships constructed on or after 1 January 2010; and
- .3 cargo ships constructed before 1 January 2010, not later than 1 January 2012.

5.8.2 Ships shall be provided with a ship-specific emergency towing procedure. Such a procedure shall be carried aboard the ship for use in emergency situations and shall be based on existing arrangements and equipment available on board the ship.

5.8.3 The procedure** shall include:

- .1 drawings of fore and aft deck showing possible emergency towing arrangements;
- .2 inventory of equipment on board that can be used for emergency towing;
- .3 means and methods of communication; and
- .4 sample procedures to facilitate the preparation for and conducting of emergency towing operations.

** Refer to the Guidelines for owners/operators on preparing emergency towing procedures (MSC.1/Circ.1255).

5.9 TOWING AND MOORING EQUIPMENT (SOLAS REG.II-1/3-8)

5.9.1 For new ships:

- .1 for which the building contract is placed on or after 1 January 2024; or
- .2 in the absence of a building contract, the keel of which is laid, or which is at a similar stage of construction on or after 1 July 2024; or
- .3 the delivery of which is on or after 1 January 2027;

requirements for towing and mooring equipment under SOLAS Reg. II-1/3-8, and as adopted by IMO Res. MSC.474(102) shall apply, and compliance to MSC.1/Circ.1175/Rev.1, MSC.1/Circ.1619 and **MSC.1/Circ.1362/Rev.2** required.

5.9.2 While applying the requirements of SOLAS regulation II-1/3-8.4 to regulation II-1/3-8.6 and SOLAS regulation II-1/3-8.8, for ships of less than 3,000 gross tonnage, the following shall be confirmed:

- .1 the "Towing and mooring arrangements plan" shall be provided for information, where the maximum brake holding load shall be included in addition to the information provided in section 5 (Towing and mooring arrangements plan) of the annex to MSC.1/Circ.1175/Rev.1. A technical specification document of the mooring lines supplied with the ship shall be provided for information. The manufacturers' recommended minimum diameter D of each fitting in contact with the mooring lines and the Line Design Break Force (LDBF) of the mooring lines shall be included in the document;
- .2 for confirmation of the appropriate selection of mooring line, the properties of mooring lines related to LDBF and bend radius (D/d ratio) shall be submitted to the Administration or the *Register*. A warning shall be provided that the wear rate of lines may be higher for lower diameter (paragraph 5.6 of MSC.1/Circ.1620); and
- .3 at delivery of the ship, the Administration or the *Register* shall confirm that the towing and mooring arrangements plan is provided on board.

5.9.3 While applying the requirements of SOLAS regulation II-1/3-8.4 to regulation II-1/3-8.6 and the SOLAS regulation II-1/3-8.7, for ships of 3,000 gross tonnage and above, the following shall be confirmed in addition to those specified under paragraph 2 of this interpretation:

- .1 a document shall be provided by the designer for information and as a supplement to the towing and mooring arrangements plan, confirming that MSC.1/Circ.1619 has been considered. The document shall explicitly state that the deviations, if any, were unavoidable;
- .2 deviations shall be recorded (paragraph 6.1 of MSC.1/Circ.1619), justification and suitable safety measures shall be provided (paragraph 6.2 of MSC.1/Circ.1619) in the supplement to the towing and mooring arrangements plan. A reference to the supplement shall be included in the towing and mooring arrangements plan (paragraph 6.3 of MSC.1/Circ.1619);
- .3 if deviations are not found necessary, and the supplement is not needed, then this shall be mentioned explicitly in the towing and mooring arrangements plan;
- .4 the mooring maximum brake holding load shall be less than 100% of the Ship Design Minimum Breaking Load (MBLSD) (paragraphs 5.2.3.3 and 5.2.4 of MSC.1/Circ.1619). The winches shall be fitted with brakes that allow for the reliable setting of the brake rendering load; and
- .5 at delivery of the ship, the Administration or the *Register* shall confirm that the towing and mooring arrangements plan and the supplement describing deviations and suitable safety measures is provided on board.

6 SIGNAL MASTS

6.1 GENERAL PROVISIONS

6.1.1 The requirements given in the present section refer only to the signal masts, i.e. the masts which are intended for carrying the signal means: navigation lights, day signals, antennae, etc.

6.1.2 Arrangement, height and equipment of the signal masts shall comply with the requirements of the *Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs)*.

6.1.3 The vibration calculation is recommended to be carried out.

6.2 STAYED MASTS

6.2.1 The outside diameter and the plate thickness at the heel of the masts made of steel having yield point from 215 up to 255 N/mm² and stayed by two shrouds on each side of the ship, are not to be less than:

$$\begin{aligned} d &= 22 l, \text{ [mm]}, \\ t &= 0,2 l + 3, \text{ [mm]}, \end{aligned}$$

where:

- d - outside diameter of the mast at the heel, in [mm],
- t - plate thickness at the heel, in [mm],
- l - mast length, in [m], from the heel to the shroud eyeplates.

The diameter of the mast may be gradually decreased upwards to a value of $0,75 \cdot d$ at the shroud eyeplates, while the thickness of the mast plates is maintained constant throughout the length l . The mast length from the shroud eyeplates to the top is not to exceed one third of l .

The mast is to be stayed by the shrouds as follows:

- 1 horizontal distance (a) from the deck (or bulwark) stay eyeplate to the transverse plane through the mast stay eyeplate is not to be less than:

$$a = 0,15 h, \text{ in [m]},$$

where:

- h - vertical distance, in [m], from the mast stay eyeplate to the deck (or bulwark) stay eyeplate,
- 2 horizontal distance (b) from the deck (or bulwark) stay eyeplate to the longitudinal plane through the mast stay eyeplate is not to be less than:

$$b = 0,30 h, \text{ in [m]},$$
- 3 the value of a is not to exceed the value of b .

6.2.2 The breaking strength of the whole ropes used for the mast shrouds as specified in 6.2.1 is not to be less than:

$$F = 0,49 (l^2 + 10l + 25), \text{ in [kN]}$$

The loose gear of shrouds (shackles, turnbuckles, etc.) is to be such that their safe working load is not to be less than 0,25 times the actual breaking strength of the ropes referred to above.

In all other respects the ropes for the mast shrouds shall meet the requirements of the *Rules for the classification of ships, Part 25 - Metallic materials*, Section 8.

6.2.3 Where:

- the mast is made of high-tensile steel, light alloys, fibreglass or wood (1st grade wood must be used),
 - the mast is stayed in some way other than that specified in 6.2.1,
 - in addition to a yard arm, lights, and day signals, the mast is fitted with other equipment of considerable weight, such as radar reflectors with platforms for their servicing, "crow's nests", etc.,
- proceed as specified in 6.4.

6.2.4 The wire of the shrouds must have a standard quality zinc coating.

6.3 UNSTAYED MASTS

6.3.1 The outer diameter, d , and thickness of the plates t at the base of the masts, which are to be made of steel with a yield point between 215 and 255 N/mm² inclusive, is not to be less than:

$$d = 3l^2 \frac{\left(1 + \sqrt{1 + \frac{51,5 \cdot 10^4}{l^2 \cdot (0,674l + a + 13)^2}} \right)}{100 \cdot (0,674l + a + 13)^{-1}}, \text{ [mm]};$$

$$t = \frac{1}{70} d, \text{ [mm]},$$

where:

- l - length of the mast from bottom to top, in [m],
- a - vertical distance from the base of the mast to the centre of gravity of the ship, in [m].

The outer diameter of a mast may decrease so that at $0,75 l$ from the base is $0,5 d$. The thickness of the mast plates is not to be less than 4 mm. The heel of the mast must be rigidly fixed to the deck from all directions.

6.3.2 Where:

- the mast is made of high-tensile steel, light alloys, fibreglass or wood (1st grade wood must be used),
- in addition to a yard arm, lights, and day signals, the mast is fitted with other equipment of considerable weight, such as radar reflectors with platforms for their servicing, etc.,

proceed as specified in 6.4.

6.4 MASTS OF SPECIAL CONSTRUCTION

6.4.1 In the cases specified in 6.2.3 and 6.3.2 as well as where bipod, tripod and other similar masts are installed, detailed strength calculations of these masts are to be carried out. These calculations are to be submitted for the approval.

6.4.2 The calculations are to be performed on the assumption that each part of the mast is affected by a horizontal force:

$$F_i = \left[m_i \frac{4\pi^2}{T^2} (\theta z_i + r \sin \theta) + m_i g \sin \theta + p A_i \cos \theta \right] \cdot 10^{-3}, \text{ [kN]}$$

where:

- m_i = mass of part (i), in [kg],
- z_i = elevation of the centre of gravity of part (i) above that of the ship, in [m],
- A_i = projected lateral area of part (i), in [m²],
- T = rolling or pitching period, in sec.,
- θ = amplitude of roll or pitch, maximum, in radians,
- r = wave half height, in [m],
- p = specified wind pressure, in [N/m²]
- p = 1960 N/m².

The calculations are to be carried out both for rolling and pitching of the ship; r being taken as equal to $L/40$, where L is the ship's length, in [m], and θ , in radians, as corresponding angle of 40° at roll and of 5° at pitch.

6.4.3 Under load specified in 6.4.2 the stresses in parts of the mast are not to exceed 0,7 times the yield stress of the material if made of metal and are not to exceed 12 N/mm² if made of wood.

The safety factor of the standing rope under the same load is not to be less than 3.

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

7.1 GENERAL PROVISIONS

7.1.1 The requirements of the present section apply to ships of unrestricted service as well as to ships of restricted areas of navigation 2 and 3. The requirements for ships of restricted areas of navigation 4, 5, 6, 7 and 8 may be relaxed, the extent of relaxation is to be specially considered by the *Register* in each case depending upon the type of ship, navigation area, strength, freeboard and stability of ship.

For specific requirements relating to the windows and external doors of the passenger ships in domestic service class "D" operating exclusively in the area of navigation 6 and 7, in the period from April 1 to October 31, and carrying passengers on a daily trips or carrying not more than 36 cabin passengers, see requirements in Sections A.1 to A.8 of these *Rules*.

7.1.2 Departures from these requirements may be permitted for the ships to which a greater than minimum freeboard is assigned on condition that the *Register* is satisfied with safety conditions provided.

7.1.3 The arrangement of openings and their closing appliances in the hull, superstructures and deckhouses shall also comply with the requirements of the *Rules for the classification of ships*, the *Rules for the classification of ships, Part 17 - Fire protection*, the *Rules for the classification of ships, Part 12 - Electrical equipment, ICLL, 1966* and the *Rules for the classification of ships, Part 24 - Non-metallic materials*.

7.1.4 As far as deck openings are considered, the following two positions are distinguished in the present section:

- .1 Position 1:
 - .1 upon exposed freeboard and raised quarter decks;
 - .2 upon exposed superstructure decks situated forward of a point located a quarter of the ship's length from the forward perpendicular;
- .2 Position 2:
 - .1 upon exposed superstructure decks situated abaft a quarter of the ship's length from the forward perpendicular and located at least one standard height of superstructure above the freeboard deck;
 - .2 upon exposed superstructure decks situated forward of a point located a quarter of the ship's length from the forward perpendicular and located at least two standard heights of superstructure above the freeboard deck.

7.1.5 The heights of coamings in ships of restricted area of navigation are to be approved by the Administration.

7.1.6 The height of coamings specified in the present section is measured from the upper surface of the steel deck

plating or from the upper surface of the wood or other sheathing, if fitted.

7.1.7 In supply vessels the access to the spaces situated below the open cargo deck shall preferably be provided from the location inside the enclosed superstructure or deckhouse or from the location above the superstructure deck or deckhouse top.

7.1.8 For the ships indicated in 7.1.7 the arrangement of companion or other hatches on the open cargo deck leading to the spaces below this deck is subject to special consideration, taking account of the degree of protection of these hatches from possible damage during cargo handling operations as well as the volume of spaces flooded in case of damage to the hatch.

7.1.9 All external openings leading to compartments assumed intact in the damage stability calculation, which are bellow the final damage water line, are required to be watertight. The closing appliances of these openings are to be of sufficient strength and, except for cargo hatch covers, are to be fitted with indicators (open-closed) on the bridge.

7.1.10 Openings in the shell plating bellow the bulkhead deck are to be kept permanently closed while at sea. If any of these openings are accessible during the voyage, they are to be fitted with a device which prevents unauthorised opening.

7.1.11 Notwithstanding the requirements of 7.1.10, the *Register* may authorise that particular doors may be opened at the discretion of the master, if necessary for the operation of the ship and provided that the ship safety is not impaired.

Other closing appliances which are kept permanently closed at sea to ensure the watertight integrity of external openings are to be provided with a notice affixed to each appliance to the effect that it is to be kept closed. Manholes fitted with closely bolted covers need not to be so marked.

7.1.12 The number of openings in the shell plating of the passenger ships is to be reduced to the minimum compatible with the design and proper working of the ship.

7.1.13 The arrangement and efficiency of the means for closing any opening in the shell plating are to be consistent with its intended purpose and the position in which it is fitted and generally to the satisfaction of the *Register*.

7.1.14 The number of scuppers, sanitary discharges and other similar openings in the shell plating is to be reduced to the minimum either by making each discharge serve for as many as possible of the sanitary and other pipes, or in any other satisfactory manner.

7.1.15 All inlets and discharges in the shell plating are to be fitted with efficient and accessible arrangements for preventing the accidental admission of water into the ship.

7.1.16 Subject to the requirements of the *ICLL, 1996*, and except as provided in 7.1.18, each separate discharge led through the shell plating from spaces below the bulkhead deck of passenger ships and the freeboard deck of cargo ships is to be provided with either one automatic non-return valve fitted with a positive means of closing it from above the bulkhead deck or with two automatic non-return valves without positive means of closing, provided that the inboard valve is situated above the deepest subdivision draught and is always accessible for examination under service conditions. Where a valve with positive means of closing is fitted, the operating position above the bulkhead deck is to always be readily accessible and means

are to be provided for indicating whether the valve is open or closed.

7.1.17 The requirements of the *ICLL, 1996*, shall apply to discharges led through the shell plating from spaces above the bulkhead deck of passenger ships and the freeboard deck of cargo ships.

7.1.18 Machinery space, main and auxiliary sea inlets and discharges in connection with the operation of machinery are to be fitted with readily accessible valves between the pipes and the shell plating or between the pipes and fabricated boxes attached to the shell plating. In manned machinery spaces the valves may be controlled locally and are to be provided with indicators showing whether they are open or closed.

7.1.19 Moving parts penetrating the shell plating below the deepest subdivision draught are to be fitted with a watertight sealing arrangement acceptable to the *Register*. The inboard gland is to be located within a watertight space of such volume that, if flooded, the bulkhead deck is not to be submerged. The Register may require that if such compartment is flooded, essential or emergency power and lighting, internal communication, signals or other emergency devices must remain available in other parts of the ship.

7.1.20 All shell fittings and valves required by these requirements are to be of steel, bronze or other approved ductile material. Valves of ordinary cast iron or similar material are not acceptable. All pipes to which this regulation refers are to be of steel or other equivalent material to the satisfaction of the *Register*.

7.1.21 Gangway, cargo and fuelling ports fitted below the bulkhead deck of passenger ships and the freeboard deck of cargo ships are to be watertight and in no case be so fitted as to have their lowest point below the deepest subdivision draught.

7.1.22 The inboard opening of each ash-chute, rubbish-chute, etc., is to be fitted with an efficient cover.

7.1.23 If the inboard opening is situated below the bulkhead deck of passenger ships and the freeboard deck of cargo ships, the cover is to be watertight and, in addition, an automatic non-return valve is to be fitted in the chute in an easily accessible position above the deepest subdivision draught.

7.1.24 It is recommended that cargo ports or similar openings below the uppermost load specified in *Regulation 21(2) of ICCL, 1996* may be accepted submerged provided the safety of the ship is in no way impaired. It is considered that the fitting of a second door of equivalent strength and watertightness is one acceptable arrangement. In that case leakage detection device should be provided in the compartment between the two doors. Further, drainage of this compartment to the bilges controlled by an easily accessible screw down valve, should be arranged. The outer door should preferably open outwards. See *IACS Unified Interpretation LL21*.

7.2 SIDESCUTTLES AND WINDOWS

7.2.1 General

7.2.1.1 The requirements in 7.2.1 to 7.2.4 apply to sidescuttles and rectangular windows providing light and air, located in positions which are exposed to the action of sea and/or bad weather.

7.2.1.2 **Sidescuttles** are round or oval openings with an area not exceeding 0.16 m². Round or oval openings having area exceeding 0.16 m² are to be treated as windows.

7.2.1.3 **Windows** are rectangular openings generally, having a radius at each corner relative to window size in accordance with recognised national or international standards, and round or oval openings with an area exceeding 0.16 m².

7.2.1.4 The number of sidescuttles in the shell plating below the freeboard deck is to be reduced to a minimum compatible with the design and proper working of the ship.

Fishing vessels mooring alongside each other or other ships at sea are not to have sidescuttles under freeboard deck in the mooring zone, wherever possible. If in this zone sidecuttles are fitted in the shell plating, they are to be so positioned that the possibility of their damage during mooring operations is excluded.

No sidescuttles are permitted within the boundaries of the ice belt of the shell plating specified in the *Rules for the classification of ships, Part 2 - Hull*, Section 14, in icebreakers and ships with ice strengthening.

7.2.1.5 Sidescuttles and windows together with their glasses, **deadlights**¹ and storm covers, if fitted, are to be of approved design and substantial construction in accordance with, or equivalent to, recognised national or international standards.

Non-metallic frames are not acceptable. The use of ordinary cast iron is not allowed for sidescuttles below the freeboard deck.

7.2.1.6 All sidescuttles the sills of which are below the bulkhead deck of passenger ships and the freeboard deck of cargo ships, as permitted by paragraph 7.2.2.1, are to be of such construction as will effectively prevent any person opening them without the consent of the master of the ship.

Sidescuttles and their deadlights which are not accessible during navigation are to be closed and secured before ship leaves the port.

7.2.1.7 Side scuttles to the following spaces shall be fitted with efficient hinged inside deadlights:

- (a) spaces below freeboard deck
- (b) spaces within the first tier of enclosed superstructures
- (c) first tier deckhouses on the freeboard deck protecting openings leading below or considered buoyant in stability calculations.

¹⁾ „Deadlights“, in accordance with recognised standards, are fitted to the inside of windows and side scuttles while „storm covers“, of comparable specifications to deadlights, are fitted to the outside of windows, where accessible, and may be hinged or portable.

The deadlights shall be capable of being effectively closed and secured watertight if fitted below freeboard deck and weathertight if fitted above.

Efficient hinged inside deadlights so arranged that they can be easily and effectively closed and secured watertight, are to be fitted to all sidescuttles except that abaft one eighth of the ship's length from the forward perpendicular and above a line drawn parallel to the bulkhead deck at side and having its lowest point at a height of 3.7 m plus 2.5% of the breadth of the ship above the deepest subdivision draught, the deadlights may be portable in passenger accommodation other than that for steerage passengers, unless the deadlights are required by the *ICLL, 1996*, to be permanently attached in their proper positions. Such portable deadlights are to be stowed adjacent to the sidescuttles they serve.

7.2.2 Position and opening arrangement

7.2.2.1 No sidescuttle is to be fitted in such position that its sill is below a line drawn parallel to the bulkhead deck at side and having its lowest point 0.025·*B* above the summer load waterline (or timber summer load waterline if assigned), or 0.5 m, whichever is the greater.

If the length of the ship is less than 24 m, the specified distance may be reduced to 0.3 m for ships of navigation area 4 and 5 and to 0.15 m for ships of navigation area 6, 7 and 8.

7.2.2.2 No sidescuttles is to be fitted in any spaces which are appropriated exclusively for carriage of cargo or coal.

Sidescuttles may, however, be fitted in spaces appropriated alternatively for carriage of cargo or passengers, but they are to be of such construction as will effectively prevent any person opening them or their deadlights without the consent of the master.

If cargo is carried in such spaces, the sidescuttles and their deadlights are to be closed watertight and locked before the cargo is shipped.

7.2.2.3 Side scuttles shall be of the non-opening type in ships subject to damage stability regulations, if calculations indicate that they would become immersed by any intermediate stage of flooding or the final equilibrium waterplane in any required damage case.

7.2.2.4 In ships having several decks above the bulkhead deck, such as passenger ships, the arrangement of sidescuttles and rectangular windows is to be specially considered by the *Register* in each case. Special consideration is to be given to the ship side up to the upper deck and the front bulkhead of the superstructure.

7.2.2.5 Automatic ventilating sidescuttles are not to be fitted in the shell plating below the bulkhead deck without the special sanction of the *Register*.

7.2.2.6 Windows are not to be fitted below the freeboard deck, in first tier end bulkheads or sides of enclosed superstructures and in first tier deckhouses considered as being buoyant in the stability calculations or protecting openings leading below.

In the front bulkhead of a superstructure situated on the upper deck, in case of substantially increased freeboard, rectangular windows with permanently fitted storm covers are acceptable.

7.2.2.7 Side scuttles and windows at the side shell in the second tier, protecting direct access below or considered buoyant in the stability calculations, shall be provided with efficient hinged inside deadlights capable of being effectively closed and secured weathertight.

7.2.2.8 Side scuttles and windows set inboard from the side shell in the second tier, protecting direct access below to spaces listed in 7.2.1.7, shall be provided with either efficient hinged inside deadlights or, where they are accessible, permanently attached external storm covers of approved design and of substantial construction and capable of being effectively closed and secured weathertight.

7.2.2.9 Cabin bulkheads and doors in the second tier separating side scuttles and windows from a direct access leading below may be accepted in place of deadlights or storm covers fitted to the side scuttles and windows.

7.2.2.10 Deckhouses situated on a raised quarter deck or on the deck of a superstructure of less than standard height or on the deck of a deckhouse of less than standard height, may be regarded as being in the second tier as far as the provision of deadlights is concerned, provided the height of the raised quarter deck, superstructure or deckhouse is equal to, or greater than, the standard quarter deck height.

7.2.2.11 Fixed or opening skylights shall have glass thickness appropriate to their size and position as required for side scuttles and windows. Skylight glasses in any position shall be protected from mechanical damage and where fitted in positions 1 or 2, shall be provided with robust deadlights or storm covers permanently attached. See also *IASC Unified Interpretation LL62*.

7.2.3 Glasses

7.2.3.1 In general, toughened glasses with frames of special type are to be used in compliance with, or equivalent to, recognised national or international standards, see the *Rules for the classification of ships, Part 24 - Non-metallic materials, 3.7*.

The use of clear plate glasses is to be specially considered by the *Register* in each case.

7.2.3.2 The thickness of toughened glasses in sidescuttles is not to be less than that obtained from Table 7.2.3.2-1.

Table 7.2.3.2-1

Clear light diameter of sidescuttle [mm]	Thickness [mm]		
	Type A Heavy series	Type B Medium series	Type C Light series
200	10	8	6
250	12	8	6
300	15	10	8
350	15	12	8
400	19	12	10
450	Not applicable	15	10

Type A, B or C sidescuttles are to be adopted according to the requirements of Table 7.2.3.2-2, where:

- zone 1 is the zone comprised between a line, parallel to the sheer profile, with its lowest points at a distance above the summer load waterline equal to $0.025 B$, or 0.5 m, whichever is the greater, and a line parallel to the previous one located 1.4 m above it;
- zone 2 is the zone located above zone 1 and bounded at the top by the freeboard deck;
- zone 4 is the second tier of superstructures or deckhouses;
- zone 5 is the third and higher tiers of superstructures or deckhouses;
- exposed zones are the boundaries of superstructures or deckhouses set in from the ship's side at a distance less than or equal to $0.04 B$;

- unexposed zones are the boundaries of superstructures or deckhouses set in from the ship's side at a distance greater than $0.04 B$.

7.2.3.3 Ships of navigation area 4 and 5, having length less than 24 m, may be fitted with sidescuttles type B and type C instead of those type A and type B required in Table 7.2.3.2-2.

Ships of navigation area 6 and 7 may be fitted with sidescuttles type B and type C instead of those type A and type B required in Table 7.2.3.2-2.

In ships of navigation area 8 all fitted sidescuttles may be type C.

Table 7.2.3.2-2

Zone	Aft of $0.875 L$ from the aft end		Forward of $0.875 L$ from the aft end
5	Type C		Type B
4	Protecting openings giving direct access to spaces below the freeboard deck: Type B		Type B
	Not protecting openings giving direct access to spaces below the freeboard deck: Type C		
3	Exposed zones	Type B	Type B
	Unexposed zones	Protecting openings giving direct access to spaces below the freeboard deck: Type B	
		Not protecting openings giving direct access to spaces below the freeboard deck: Type C	
2	Type B		Type A
1	Type A		Type A

7.2.3.4. The thickness of toughened glasses in rectangular windows is not to be less than that obtained from Table 7.2.3.4-1.

Dimensions of rectangular windows other than those in Table 7.2.3.4-1 is to be specially considered by the *Register* in each case.

7.2.3.5 The thickness of glasses forming screen bulkheads on the side of enclosed promenade spaces and that for rectangular windows in the boundaries of deckhouses, which are protected by such screen bulkheads, is to be specially considered by the *Register* in each case.

The *Register* may require both limitations on size of rectangular windows and use of glasses of increased thickness in way of front bulkheads, which are exposed to heavy sea.

Table 7.2.3.4-1

Nominal size (clear light) of rectangular window [mm]	Thickness, [mm]			Minimum number of closing appliances of opening type rectangular windows
	Unexposed zone of first tier, exposed zone of second tier	Unexposed zone of second tier, exposed zone of third tier and above	Windows not exposed to the action of sea located more than $5 \times H_{1/3}$ above scantling draught of ship (d_{sc}) where $H_{1/3}$ is the significant wave height for ship navigation area	
300 x 425	10	8	6	4
355 x 500	10	8	6	4
400 x 560	12	8	6	4
450 x 630	12	8	6	4
500 x 710	15	10	6	6
560 x 800	15	10	6	6
900 x 630	19	12	8	6
1000 x 710	19	12	8	8
1100 x 800	Not applicable	15	8	8
Windows with area (clear light) of 1 m ² but less than 2 m ²	Not applicable	Not applicable	10	8
Windows with area (clear light) of 2 m ² or more	Not applicable	Not applicable	To be specially considered by the Register in each case	To be specially considered by the Register in each case

7.2.4 Deadlights arrangement

7.2.4.1 Sidescuttles in the following positions are to be fitted with efficient, hinged inside deadlights so arranged that they can be easily and effectively closed and secured watertight:

- in the shell plating below freeboard deck;
- in front bulkheads of enclosed superstructures and deckhouses of the first tier;
- in front bulkheads of enclosed superstructures and deckhouses of the second tier within $0.25 L$ from the forward perpendicular;
- in the first tier of enclosed superstructures and deckhouses on freeboard deck protecting openings leading below or considered buoyant in stability calculations.

Table 7.2.3.4-1

Nominal size (clear light) of rectangular window [mm ²]	Thickness, [mm]		Minimum number of closing appliances of opening type rectangular windows
	Unexposed zone of first tier, exposed zone of second tier	Unexposed zone of second tier, exposed zone of third tier and above	
300 x 425	10	8	4
355 x 500	10	8	4
400 x 560	12	8	4
450 x 630	12	8	4
500 x 710	15	10	6
560 x 800	15	10	6
900 x 630	19	12	6
1000 x 710	19	12	8
1100 x 800	Not applicable	15	8

7.3 FLUSH SCUTTLES

7.3.1 Flush scuttles in positions 1 or 2 are to be closed by substantial covers capable of being made watertight. Unless secured by closely spaced bolts, the covers are to be permanently attached.

7.3.2 The largest of clear dimensions of the flush scuttles is not to be over 200 mm, with the glass being at least 15 mm in thickness. The flush scuttles are to be fastened to the metal deck plating by means of frames.

7.4 SHELL DOORS

7.4.1 Bow doors and inner doors

7.4.1.1 General

7.4.1.1.1 The requirements of this head of the *Rules* apply to the arrangement, strength and securing of bow doors and inner doors leading to a complete or long forward enclosed superstructure, or to a long non-enclosed superstructure, where fitted to attain minimum bow height equivalence.

The requirements apply to all ro-ro passenger ships and ro-ro cargo ships engaged on international voyages and also to ro-ro passenger ships and ro-ro cargo ships engaged only in domestic (non-international) voyages, except where specifically indicated otherwise herein.

The requirements are not applicable to high speed, light displacement craft as defined in the IMO Code of Safety for High Speed Craft.

Two types of bow door are provided for:

Visor doors opened by rotating upwards and outwards about a horizontal axis through two or more hinges located near the top of the door and connected to the primary structure of the door by longitudinally arranged lifting arms,

Side-opening doors either by rotating outwards about a vertical axis through two or more hinges located near the outboard edges or by horizontal translation by means of linking arms arranged with pivoted attachments to the door and the ship.

Other types of bow doors are to be specially considered by the *Register*.

7.4.1.1.2 Bow doors are to be situated above the freeboard deck. A watertight recess in the freeboard deck located forward of the collision bulkhead and above the deepest waterline fitted for arrangement of ramps or other related mechanical devices may be regarded as a part of the freeboard deck for the purpose of this requirement.

7.4.1.1.3 Inner doors are to be fitted. The inner door is to be part of the collision bulkhead. The inner door need not be fitted directly above the bulkhead below, provided that it is located within the limits specified for the position of the collision bulkhead, refer to *Regulation II-1/12 of the SOLAS Convention*. A vehicle ramp may be arranged for this purpose, provided its position complies with *Regulation II-1/12 of the SOLAS Convention*. If this is not possible a separate inner weathertight door are to be installed, as far as practicable within the limits specified for the position of the collision bulkhead.

7.4.1.1.4 Bow doors are to be so fitted as to ensure tightness consistent with operational conditions and to give effective

protection to inner doors. Inner doors forming of the collision bulkhead are to be weathertight over the full height of the cargo space and arranged with fixed sealing supports on the aft side of the doors.

7.4.1.1.5 Bow doors and inner doors are to be arranged so as to preclude the possibility of the bow door causing structural damage to the inner door or to the collision bulkhead in the case of damage to or detachment of the bow door. If this is not possible, a separate inner weathertight door is to be installed, as indicated in 7.4.1.1.3.

7.4.1.1.6 For the purpose of satisfaction of the requirements for inner doors, vehicles are to be effectively lashed and secured against movement in stowed position.

7.4.1.1.7 Definitions

Securing device: device used to keep the door closed by preventing it from rotating about its hinges.

Supporting device: a device used to transmit external or internal loads from the door to a securing device and from the securing device to the ship's structure, or a device other than a securing device, such as a hinge, stopper or other fixed device, transmits loads from the door to the ship's structure.

Locking device: a device that locks a securing device in the closed position.

Ro-ro passenger ship: a passenger ship with ro-ro spaces or special category spaces.

Ro-ro spaces: are spaces not normally subdivided in any way and normally extending to either a substantial length or the entire length of the ship, in which motor vehicles with fuel in their tanks for their own propulsion and/or goods (packaged or in bulk, in or on rail or road cars, vehicles (including road or rail tankers), trailers, containers, pallets, demountable tanks or in or on similar stowage units or, other receptacles) can be loaded and unloaded normally in a horizontal direction.

Special category spaces: are those enclosed vehicle spaces above or below the bulkhead deck, into and from which vehicles can be driven and to which passengers have access. Special category spaces may be accommodated on more than one deck provided that the total overall clear height for vehicles does not exceed 10m.

7.4.1.2 Strength criteria

7.4.1.2.1 Scantlings of the primary member, securing and supporting devices of bow doors and inner doors are to be determined to withstand the design loads defined in 7.4.1.3, using the following permissible stresses:

- shear stress: $\tau = 80/k$ [N/mm²]
- bending stress: $\sigma = 120/k$ [N/mm²]

- equivalent stress:

$$\sigma_e = \sqrt{\sigma^2 + 3\tau^2} = 150/k \quad [\text{N/mm}^2]$$

where k is the material factor as given in the Rules, Part 2 - Hull, 1.4, but is not to be taken less than 0,72.

7.4.1.2.2 The buckling strength of primary members is to be verified as being adequate.

7.4.1.2.3 For steel to steel bearings in securing and supporting devices, the nominal bearing pressure calculated by dividing the design force by the projected bearing area is not to exceed $0,8 \cdot R_{eH}$, where R_{eH} is the yield stress of the bearing material. For other bearing materials, the permissible bearing pressure is to be determined according to the manufacturer's specification.

7.4.1.2.4 The arrangement of securing and supporting devices is to be such that threaded bolts do not carry support forces. The maximum tension in way of threads of bolts not carrying support forces is not to exceed $125/k$ [N/mm^2].

7.4.1.3 Design loads

7.4.1.3.1 The design external pressure, in [kN/m^2], to be considered for the scantlings of primary members, securing and supporting devices of bow doors is not to be less than:

$$p_e = 2,75 \cdot \lambda \cdot C_H \cdot (0,22 + 0,15 \cdot \tan \alpha) (0,4 \cdot v \cdot \sin \beta + 0,6 \cdot \sqrt{L})^2$$

where:

v = contractual ship's speed, in [knots];

L = ship's length, in [m], but need not be taken greater than 200 metres;

λ = coefficient depending on the area where the ship is intended to be operated:

$\lambda = 1$ for sailing area 1 and 2;

$\lambda = 0,8$ for sailing area 3 and 4;

$\lambda = 0,5$ for sailing area 5, 6, 7 and 8.

$C_H = 0,0125 L$, for $L < 80$ m

1,00, for $L \geq 80$ m

α = flare angle at the point to be considered, defined as the angle between a vertical line and the tangent to the side shell plating, measured in a vertical plane normal to the horizontal tangent to the shell plating (see Figure 7.4.1.3.2);

β = entry angle at the point to be considered, defined as the angle between a longitudinal line parallel to the centreline and the tangent to the shell plating in a horizontal plane (see Figure 7.4.1.3.2).

7.4.1.3.2 The design external forces, in [kN], considered for the scantlings of securing and supporting devices of bow doors is not to be less than:

$$F_x = p_e \cdot A_x$$

$$F_y = p_e \cdot A_y$$

$$F_z = p_e \cdot A_z$$

where:

A_x = area, in [m^2], of the transverse vertical projection of the door between the levels of the bottom of the door and the top of the upper deck bulwark, or between the bottom of the door and the top of the door,

including the bulwark, where it is part of the door, whichever is the lesser. Where the flare angle of the bulwark is at least 15° less than the flare angle of the adjacent shell plating, the height from the bottom of the door may be measured to the upper deck or to the top of the door, whichever is lesser. In determining the height from the bottom of the door to the upper deck or to the top of the door, the bulwark is to be excluded.;

A_y = area, in [m], of the longitudinal vertical projection of the door between the levels of the bottom of the door and the top of the upper deck bulwark, or between the bottom of the door and the top of the door, including the bulwark, where it is part of the door, whichever is the lesser. Where the flare angle of the bulwark is at least 15° less than the flare angle of the adjacent shell plating, the height from the bottom of the door may be measured to the upper deck or to the top of the door, whichever is lesser.

A_z = area, in [m^2], of the horizontal projection of the door between the levels of the bottom of the door and the top of the upper deck bulwark, or between the bottom of the door and the top of the door, including the bulwark, where it is part of the door, whichever is the lesser. Where the flare angle of the bulwark is at least 15° less than the flare angle of the adjacent shell plating, the height from the bottom of the door may be measured to the upper deck or to the top of the door, whichever is lesser.

h = height, in [m], of the door between the levels of the bottom of the door and the upper deck or between the bottom of the door and the top of the door, whichever is the lesser;

l = length, in [m], of the door at a height $h/2$ above the bottom of the door;

w = breadth, in [m], of the door at a height $h/2$ above the bottom of the door;

p_e = external pressure, in [kN/m^2], as given in 7.4.1.3.1 with angles α and β defined as follows:

α = flare angle measure at the point on the bow door, $l/2$ aft of the stem line on the plane $h/2$ above the bottom of the door, as shown in Figure 7.4.1.3.2;

β = entry angle measured at the same point as α .

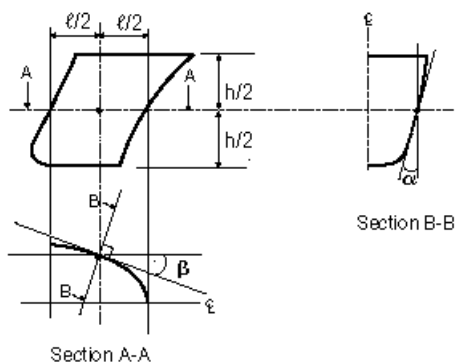


Figure 7.4.1.3.2 Definition of α and β

For bow doors, including bulwark, of unusual form or proportions, e.g. ships with a rounded nose and large stem angles, the areas and angles used for determination of the design values of external forces may require to be specially considered.

7.4.1.3.3 For visor doors the closing moment M_y under external loads, in [kNm], is to be taken as:

$$M_y = F_x \cdot a + 10 \cdot W \cdot c - F_z \cdot b$$

where:

- W = mass of the visor door, in [t];
- a = vertical distance, in [m], from visor pivot to the centroid of the transverse vertical projected area of the visor door, as shown in Figure 7.4.1.3.3;
- b = horizontal distance, in [m], from visor pivot to the centroid of the horizontal projected area of the visor door, as shown in Figure 7.4.1.3.3;
- c = horizontal distance, in [m], from visor pivot to the centre of gravity of visor mass, as shown in Figure 7.4.1.3.3.

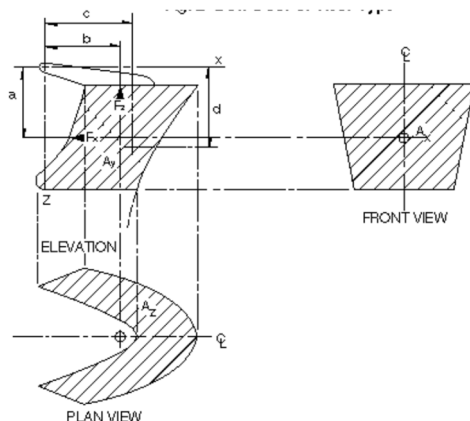


Figure 7.4.1.3.3 Bow door of visor type

7.4.1.3.4 The lifting arms of a visor door and its supports are to be dimensioned for the static and dynamic forces applied during the lifting and lowering operations, and a minimum wind pressure of 1,5 kN/m² is to be taken into account.

7.4.1.3.5 The design external pressure p_e , in [kN/m²], considered for the scantlings of primary members, securing and supporting devices and surrounding structure of inner doors is to be taken as the greater of the following:

- $p_e = 0,45 \cdot L$;
- hydrostatic pressure $p_h = 10 \cdot h$, where h is the distance, in [m], from the load point to the top of the cargo space;

where L is the ship's length, as defined in 7.4.1.3.1.

7.4.1.3.6 The design internal pressure p_i , in [kN/m²], considered for the scantlings of securing devices of inner doors is not to be less than 25.

7.4.1.4 Scantlings of bow and inner doors

7.4.1.4.1 The strength of bow doors is to be commensurate with that of the surrounding structure.

7.4.1.4.2 Bow doors are to be adequately stiffened and means are to be provided to prevent lateral or vertical movement of the doors when closed. For visor doors adequate strength for the opening and closing operations is to be provided in the connections of the lifting arms to the door structure and to the ship structure.

7.4.1.4.3 The thickness of the bow door plating is not to be less than required for the side shell plating, using bow door stiffener spacing, but in no case less than the minimum required thickness of fore end shell plating.

7.4.1.4.4 The section modulus of horizontal or vertical stiffeners of bow doors is not to be less than that required for fore end framing. Consideration is to be given, where necessary, to differences in fixity between ship's frames and bow door stiffeners.

7.4.1.4.5 The stiffener webs of bow doors are to have a net sectional area, in [cm²], not less than:

$$A = \frac{Q \cdot k}{10}$$

where:

- Q = shear force, in [kN], in the stiffener calculated by using uniformly distributed external pressure p_e as given in 7.4.1.3.1.

7.4.1.4.6 The bow door secondary stiffeners are to be supported by primary members constituting the main stiffening of the door.

The primary members of the bow door and the hull structure in way are to have sufficient stiffness to ensure integrity of the boundary support of the door.

Scantlings of the primary members of the bow and inner doors are generally to be supported by direct strength calculations in association with the external pressure given in 7.4.1.3.1 and 7.4.1.3.5, respectively, and permissible stress given in 7.4.1.2.1. Normally, formulae for simple beam theory may be applied to determine the bending stress. Members are to be considered to have simply supported end connections.

7.4.1.4.7 Where inner doors also serve as a vehicle ramp, the scantlings are not to be less than those required for vehicle decks.

7.4.1.4.8 The distribution of the forces acting on the securing and supporting devices of inner doors is generally to be

supported by direct calculations taking into account the flexibility of the structure and the actual position and stiffness of the supports.

7.4.1.5 Securing and supporting of bow doors

7.4.1.5.1 Bow doors are to be fitted with adequate means of securing and supporting so as to be commensurate with the strength and stiffness of the surrounding structure. The hull supporting structure in way of the bow doors is to be suitable for the same design loads and design stress as the securing and supporting devices. Where packing is required, the packing material is to be of a comparatively soft type, and the supporting forces are to be carried by the steel structure only. Maximum design clearance between securing and supporting devices is not generally to exceed 3 mm.

A means are to be provided for mechanically fixing the door in the open position.

7.4.1.5.2 Only the active supporting and securing devices having an effective stiffness in the relevant direction are to be included and considered to calculate the reaction forces acting on the devices. Small and/or flexible devices such as cleats intended to provide load compression of the packing material are not generally to be included in the calculations called for in 7.4.1.5.8. The number of securing and supporting devices is generally to be the minimum practical whilst taking into account the requirements for redundant provision given in 7.4.1.5.9 and 7.4.1.5.10 and the available space for adequate support in the hull structure.

7.4.1.5.3 For opening outwards visor doors, the pivot arrangement is generally to be such that the visor is self closing under external loads, that is $M_y > 0$. Moreover, the closing moment M_y as given in 7.4.1.3.3 is not to be less than:

$$M_{y0} = 10 \cdot W \cdot c + 0,1 \cdot \sqrt{(a^2 + b^2)(F_x^2 + F_z^2)}$$

7.4.1.5.4 Securing and supporting devices are to be adequately designed so that they can withstand the reaction forces within the permissible stresses given in 7.4.1.3.1.

7.4.1.5.5 For visor doors the reaction forces applied on the effective securing and supporting devices assuming the door as a rigid body are determined for the following combination of external loads acting simultaneously together with the self weight of the door:

- a) case 1 F_x and F_z ;
- b) case 2 $0,7 \cdot F_y$ acting on each side separately together with $0,7 \cdot F_x$ and $0,7 \cdot F_z$;

where F_x , F_y and F_z are determined as indicated in 7.4.1.3.2 and applied at the centroid of projected areas.

7.4.1.5.6 For side-opening doors the reaction forces applied on the effective securing and supporting devices assuming the door as a rigid body are determined for the following combination of external loads acting simultaneously together with the self weight of the door:

- a) case 1 F_x , F_y and F_z acting on both doors;

- b) case 2 $0,7 \cdot F_x$ and $0,7 \cdot F_z$ acting on both doors and $0,7 \cdot F_y$ acting on each door separately;

where F_x , F_y and F_z are determined as indicated in 7.4.1.3.2 and applied at the centroid of projected areas.

7.4.1.5.7 The support forces as determined according to 7.4.1.5.5 a) and b) shall generally give rise to a zero moment about the transverse axis through the centroid of the area A_x . For visor doors, longitudinal reaction forces of pin and/or wedge supports at the door base contributing to this moment are not to be of the forward direction.

7.4.1.5.8 The distribution of the reaction forces acting on the securing and supporting devices may require to be supported by direct calculations taking into account the flexibility of the hull structure and the actual position and stiffness of the supports.

7.4.1.5.9 The arrangement of securing and supporting devices in way of these securing devices is to be designed with redundancy so that in the event of failure of any single securing or supporting device the remaining devices are capable to withstand the reaction forces without exceeding by more than 20 percent the permissible stresses as given in 7.4.1.2.1.

7.4.1.5.10 For visor doors, two securing devices are to be provided at the lower part of the door, each capable of providing the full reaction force required to prevent opening of the door within the permissible stresses given in 7.4.1.2.1. The opening moment M_o , in [kNm], to be balanced by this reaction force, is not to be taken less than:

$$M_o = 10 \cdot W \cdot d + 5 \cdot A_x \cdot a$$

where:

d = vertical distance, in [m], from the hinge axis to the centre of gravity of the door, as shown in Figure 7.4.1.3.3;

a = as defined in 7.4.1.3.3.

7.4.1.5.11 For visor doors, the securing and supporting devices excluding the hinges are to be capable of resisting the vertical design force ($F_z - 10 \cdot W$), in [kN], within the permissible stresses given in 7.4.1.2.1.

7.4.1.5.12 All load transmitting elements in the design load path, from door through securing and supporting devices into the ship structure, including welded connections, are to be to the same strength standard as required for the securing and supporting devices. These elements include pins, supporting brackets and back-up brackets.

7.4.1.5.13 For side-opening doors, thrust bearing has to be provided in way of girder ends at the closing of the two leaves to prevent one leaf to shift towards the other one under effect of unsymmetrical pressure (see example of Figure 7.4.1.5.13). Each part of the thrust bearing has to be kept secured on the other part by means of securing devices. Any other arrangement serving the same purpose may be proposed.

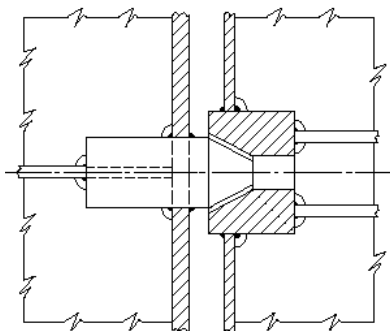


Figure 7.4.1.5.13 Thrust bearing

7.4.1.6 Securing and locking arrangement

7.4.1.6.1 Securing devices are to be simple to operate and easily accessible. Securing devices are to be equipped with mechanical locking arrangement (self locking or separate arrangement), or be of the gravity type. The opening and closing systems as well as securing and locking devices are to be interlocked in such a way that can only operate in the proper sequence.

7.4.1.6.2 Bow doors and inner doors giving access to vehicle decks are to be provided with an arrangement for remote control, from a position above the freeboard deck, of:

- the closing and opening of the doors, and
- associated securing and locking devices for every door.

Indication of the open/closed position of every securing and locking device is to be provided at the remote control stations. The operating panels for operation of doors are to be inaccessible to unauthorised persons. A notice plate, giving instructions to the effect that all securing devices are to be closed and locked before leaving harbour, is to be placed at each operating panel and is to be supplemented by warning indicator lights.

7.4.1.6.3 Where hydraulic devices are applied, the system is to be mechanically lockable in closed position. This means that, in the event of loss of the hydraulic fluid, the securing devices remain locked.

The hydraulic system for securing and locking devices is to be isolated from other hydraulic circuits, when in closed position.

7.4.1.6.4 Separate indicator lights and audible alarms are to be provided on the navigation bridge and on the operating panel to show that the bow door and inner door are closed and that their securing and locking devices are properly positioned.

The indication panel is to be provided with a lamp test function. It is not to be possible to turn off the indicator light.

7.4.1.6.5 The indicator system is to be designed on the fail safe principle and is to show by visual alarms if the door is not fully closed and not fully locked and by audible alarms if securing devices become open or locking devices become unsecured. The power supply for the indicator system for operating and closing doors is to be independent of the power supply for operating and closing the door and is to be provided with a back-up power supply from the emergency source of power or other

secure power supply. The sensor of indicator system is to be protected from water, ice formation, and mechanical damages.

Note: The indicator system is considered designed on the fail - safe principal when:

- 1) The indication panel is provided with:
 - a power failure alarm
 - an earth failure alarm
 - a lamp test
 - separate indication for door closed, door locked, door not closed and door not locked.
- 2) Limit switches electrically closed when the door is closed (when more limit switches are provided they may be connected in series).
- 3) Limit switches electrically closed when securing arrangements are in place (when more limit switches are provided they may be connected in series).
- 4) Two electrical circuits (also in one multi-core cable), one for the indication of door closed / not closed and the other for door locked / not locked.
- 5) In case of dislocation of limit switches, indication to show : not closed / not locked / securing arrangement not in place - as appropriate.

7.4.1.6.6 The indication panel on the navigation bridge is to be equipped with a mode selection function "harbour/sea voyage", so arranged that audible alarm is given on the navigation bridge if the vessel leaves harbour with the bow door or inner door not closed or with any of the securing devices not in the correct position.

7.4.1.6.7 A water leakage detection system with audible alarm and television surveillance is to be arranged to provide an indication to the navigation bridge and to the engine control room of leakage through the inner door.

See Note in item 7.4.1.6.5.

7.4.1.6.8 Between the bow door and the inner door a television surveillance system is to be fitted with a monitor on the navigation bridge and in the engine control room. The system must monitor the position of doors and a sufficient number of their securing devices. Special consideration is to be given for lighting and contrasting colour of objects under surveillance.

See Note in item 7.4.1.6.5.

7.4.1.6.9 A drainage system is to be arranged in the area between bow door and ramp, as well as in the area between the ramp and inner door where fitted. The system is to be equipped with an audible alarm function to the navigation bridge for water level in these areas exceeding 0,5 [m] above the car deck level.

See Note in item 7.4.1.6.5.

7.4.1.6.10 For ro-ro passenger ships on international voyages, the special category spaces and ro-ro spaces are to be continuously patrolled or monitored by effective means, such as television surveillance, so that any movement of vehicles in adverse weather conditions or unauthorised access by passengers thereto, can be detected whilst the ship is underway.

7.4.1.7 Operating and maintenance manual

7.4.1.7.1 An operating and maintenance manual for the bow door and inner door is to be provided on board and is to contain necessary information on:

- main particulars and design drawings; special safety precautions details of vessel equipment and design loading (for ramps) key plan of equipment (doors and ramps) manufacturer's recommended testing for equipment description of equipment for bow doors inner bow doors bow ramp/doors side doors stern doors central power pack bridge panel engine control room panel
- service conditions limiting heel and trim of ship for loading/unloading limiting heel and trim for door operations doors/ramps operating instructions doors/ramps emergency operating instructions
- maintenance schedule and extent of maintenance trouble shooting and acceptable clearances manufacturer's maintenance procedures
- register of inspections and repairs, including inspection of locking, securing and supporting devices, and repairs and renewals.

This manual is to be submitted to the *Register* for approval that the above mentioned items are contained in the OMM and that the maintenance part includes the necessary information with regard to inspections, trouble-shooting and acceptance / rejection criteria.

Note: It is recommended that recorded inspections of the door supporting and securing devices be carried out by the ship's staff at monthly intervals or following incidents that could result in damage, including heavy weather or contact in the region of the shell doors.

Any damages recorded during inspections of the door supporting and securing devices, carried out by the ship's staff, are to be reported to the *Register*.

7.4.1.7.2 Documented operating procedures for closing and securing the bow door and inner door are to be kept on board and posted at appropriate place.

7.4.1.8 Requirements for bow doors and inner doors of existing ro-ro passenger ships

7.4.1.8.1 The structural condition of bow doors and inner doors, especially the primary structure, the securing and supporting arrangements and the hull structure alongside and above the doors, are to be specially examined and any defects rectified.

7.4.1.8.2 The requirements of 7.4.1.7 concerning operating procedures of the bow door and inner door are to be complied with.

7.4.1.8.3 The following measures are to be complied with by all existing ro-ro passenger ships with the date of building before the 30th of June 1996, including, when not differently deliberated by the competent flag Administrations, ships only engaged on domestic sea voyages.

- a) The location and arrangement of inner doors are to comply with the applicable requirements of the *SOLAS Convention* and with 7.4.1.1.5.
- b) Ships with visor door are to comply with 7.4.1.5.10 requiring redundant provision of securing devices preventing the upward opening of the bow door. In addition, where the visor door is not self-closing under external loads (i.e. the closing moment M_y calculated in accordance with 7.4.1.3.3 is less than zero) then the opening moment M_o is not to be taken less than $-M_y$. If drainage arrangements in the space between the inner and bow doors are not fitted, the value of M_o is to be specially considered. Where available space above the tank-top does not enable the full application of 7.4.1.5.10, equivalent measures are to be taken to ensure that the door has positive means for being kept closed during seagoing operation.
- c) Ships with visor door are to comply with 7.4.1.5.11 requiring securing and supporting devices excluding hinges to be capable of bearing the vertical design force ($F_z - IOW$) without exceeding the permissible stresses given in 7.4.1.2.1.
- d) For side-opening doors, the structural arrangements for supporting vertical loads, including securing devices, supporting devices and, where applicable, hull structure above the door, are to be re-assessed in accordance with the applicable requirements of 7.4.1.5 and modified accordingly.
- e) The securing and locking arrangements for bow doors and inner doors which may lead to the flooding of a special category space or ro-ro space as defined in the 7.4.1.1.7 are to comply with the following requirements:
 - Separate indicator lights and audible alarms are to be provided on the navigation bridge and on each panel to indicate that the doors are closed and that their securing and locking devices are properly positioned.
 - The indication panel is to be provided with a lamp test function. It is not to be possible to turn off the indicator light.
 - The indication panel on the navigation bridge is to be equipped with a mode selection function "harbor/sea voyage", so arranged that audible alarm is given if the vessel leaves harbor with the bow doors or inner doors not closed or with

any of the securing devices not in the correct position.

- A water leakage detection system with audible alarm and television surveillance are to be arranged to provide an indication to the navigation bridge and to the engine control station of any leakage through the doors.

7.4.2 Side shell doors and stern doors

7.4.2.1 General

7.4.2.1.1 These requirements are for the arrangement, strength and securing of side shell doors, abaft the collision bulkhead, and stern doors leading to enclosed spaces.

The requirements apply to all ro-ro passenger ships and ro-ro cargo ships engaged on international voyages and also to ro-ro passenger ships and ro-ro cargo ships engaged only in domestic (non-international) voyages, except where specifically indicated otherwise herein.

The requirements are not applicable to high speed craft and light displacement craft as defined in the IMO Code of Safety for High Speed Craft.

7.4.2.1.2 Arrangement of doors

7.4.2.1.2.1 Stern doors for passenger vessels are to be situated above the freeboard deck. Stern doors for Ro-Ro cargo ships and side shell doors may be either below or above the freeboard deck.

7.4.2.1.2.2 Side shell doors and stern doors are to be so fitted as to ensure tightness and structural integrity commensurate with their location and the surrounding structure.

7.4.2.1.2.3 Where the sill of any side shell door is below the uppermost load line, the arrangement is to be specially considered.

7.4.2.1.2.4 Doors should preferably open outwards.

7.4.2.1.3 Definitions

7.4.2.1.3.1 For definitions see item 7.4.1.1.7.

7.4.2.2 Strength criteria

7.4.2.2.1 Primary structure and securing and supporting devices

7.4.2.2.1.1 Scantlings of the primary members, securing and supporting devices of side shell doors and stern doors are to be determined to withstand the design loads defined in 7.4.2.3, using the following permissible stresses:

$$\text{shear stress: } \tau = \frac{80}{k}, \quad [\text{N/mm}^2]$$

$$\text{bending stress: } \sigma = \frac{120}{k}, \quad [\text{N/mm}^2]$$

$$\text{equivalent stress: } \sigma_e = \sqrt{\sigma^2 + 3\tau^2} = \frac{150}{k}, \quad [\text{N/mm}^2]$$

where k is the material factor as given in *Rules, Part 2 - Hull*, 1.4, but is not to be taken less than 0.72 unless a

direct strength analysis with regard to relevant modes of failures is carried out.

7.4.2.2.1.2 The buckling strength of primary members is to be verified as being adequate.

7.4.2.2.1.3 For steel to steel bearings in securing and supporting devices, the nominal bearing pressure calculated by dividing the design force by the projected bearing area is not to exceed $0,8 R_{eH}$, where R_{eH} is the yield stress of the bearing material. For other bearing materials, the permissible bearing pressure is to be determined according to the manufacturer's specification.

7.4.2.2.1.4 The arrangement of securing and supporting devices is to be such that threaded bolts do not carry support forces. The maximum tension in way of threads bolts not carrying support forces is not to exceed $125/k$ [N/mm^2], with k defined in 7.4.2.2.1.1.

7.4.2.2.1.5 The buckling strength of primary members is to be verified as being adequate.

7.4.2.2.1.6 For steel to steel bearings in securing and supporting devices, the nominal bearing pressure calculated by dividing the design force by the projected bearing area is not to exceed $0,8 \sigma_F$, where σ_F is the yield stress of the bearing material. For other bearing materials, the permissible bearing pressure is to be determined according to the manufacturer's specification.

7.4.2.3 Design loads

7.4.2.3.1 The design forces, in [kN], considered for the scantlings of primary members, securing and supporting devices of side shell doors and stern doors are to be not less than:

7.4.2.3.1.1 Design forces for securing or supporting devices of doors opening inwards:

$$\begin{aligned} \text{external force:} & F_e = A p_e + F_p \\ \text{internal force:} & F_i = F_o + 10 W \end{aligned}$$

7.4.2.3.1.2 Design forces for securing or supporting devices of doors opening outwards:

$$\begin{aligned} \text{external force:} & F_e = A p_e \\ \text{internal force:} & F_i = F_o + 10 W + F_p \end{aligned}$$

7.4.2.3.1.3 Design forces for primary structural members:

$$\begin{aligned} \text{external force:} & F_e = A p_e \\ \text{internal force:} & F_i = F_o + 10 W \end{aligned}$$

whichever is the greater,

where:

A = area, in [m^2], of the door opening,

W = mass of the door, in [t],

F_p = total packing force, in [kN], packing line pressure is normally not to be taken less than 5 N/mm,

F_o = the greater of F_c and $5A$, in [kN],

F_c = accidental force, in [kN], due to loose of cargo etc., to be uniformly distributed over the area A and not to be taken less than 300 kN. For small doors such as bunker doors and pilot doors, the value of F_c may be appropriately reduced. However, the value of F_c may be taken as zero, provided an additional structure such as an inner ramp is fitted, which is capable of

protecting the door from accidental forces due to loose cargoes.

p_e = external design pressure, in [kN/m²], determined at the centre of gravity of the door opening and not taken less than:

$$p_e = 10 (T - Z_G) + 25, \text{ in [kN/mm}^2\text{],}$$

for $Z_G < T$

$$p_e = 25 \text{ kN/mm}^2, \text{ for } Z_G \geq T$$

Note:

The external pressure applied on stern doors is derived from the formula considered in 7.4.1.3.1 for bow doors, assuming:

$$\alpha = 0^\circ$$

$$\beta = 90^\circ$$

$$V = 2 \text{ knots}$$

7.4.2.3.2 Moreover, for stern doors of ships fitted with bow doors, P_e is not to be taken less than:

$$P_e = 0,6 \lambda C_H (0,8 + 0,6L^{0,5})^2$$

where:

λ = coefficient depending on the area where the ship is intended to be operated:

= 1, for sea going ships, all navigation areas

= 0,8, for ships operated in coastal waters, navigation areas 5, 6, 7 and 8

= 0,5, for ships operated in sheltered waters, navigation areas 7 and 8.

Navigation area, coastal waters and sheltered waters, are defined in *Rules, Part 1 - General requirements, Chapter 1 - General information, 4.2.*

$$C_H = 0,0125 \cdot L, \quad \text{for } L < 80\text{m}$$

$$= 1, \quad \text{for } L \geq 80\text{m}$$

L = ship's length, in [m], but need not be taken greater than 200 metres,

T = draught, in [m], at the highest subdivision load line,

Z_G = height of the centre of area of the door, in [m], above the baseline.

7.4.2.4 Scantlings of side shell doors and stern doors

7.4.2.4.1 General

7.4.2.4.1.1 The strength of side shell doors and stern doors is to be commensurate with that of the surrounding structure.

7.4.2.4.1.2 Side shell doors and stern doors are to be adequately stiffened and means are to be provided to prevent any lateral or vertical movement of the doors when closed. Adequate strength is to be provided in the connections of the lifting/manoeuvring arms and hinges to the door structure and to the ship's structure.

7.4.2.4.1.3 Where doors also serve as vehicle ramps, the design of the hinges should take into account the ship angle of trim and heel, which may result in uneven loading on the hinges.

7.4.2.4.1.4 Shell door openings are to have well-rounded corners and adequate compensation is to be arranged with web frames at sides and stringers or equivalent above and below.

7.4.2.4.2 Plating and secondary stiffeners

7.4.2.4.2.1 The thickness of the door plating is not to be less than the required thickness for the side shell plating, using the door stiffener spacing, but in no case less than the minimum required thickness of shell plating.

Where doors serve as vehicle ramps, the plating thickness is to be not less than required for vehicle decks.

7.4.2.4.2.2 The section modulus of horizontal or vertical stiffeners is not to be less than that required for side framing. Consideration is to be given, where necessary, to differences in fixity between ship's frames and door stiffeners.

Where doors serve as vehicle ramps, the stiffener scantlings are not to be less than required for vehicle decks.

7.4.2.4.3 Primary structure

7.4.2.4.3.1 The secondary stiffeners are to be supported by primary members constituting the main stiffening of the door.

7.4.2.4.3.2 The primary members and the hull structure in way are to have sufficient stiffness to ensure structural integrity of the boundary of the door.

7.4.2.4.3.3 Scantlings of the primary members are generally to be supported by direct strength calculations in association with the design forces given in 7.4.2.3 and permissible stresses given in 7.4.2.2.1.1.

Normally, formulae for simple beam theory may be applied to determine the bending stresses. Members are to be considered to have simply supported end connections.

7.4.2.5 Securing and supporting of doors

7.4.2.5.1 General

7.4.2.5.1.1 Side shell doors and stern doors are to be fitted with adequate means of securing and supporting so as to be commensurate with the strength and stiffness of the surrounding structure. The hull supporting structure in way of the doors is to be suitable for the same design loads and design stresses as the securing and supporting devices.

Where packing is required, the packing material is to be of a comparatively soft type, and the supporting forces are to be carried by the steel structure only. Other types of packing may be considered.

Maximum design clearance between securing and supporting devices is not generally to exceed 3 mm.

A means is to be provided for mechanically fixing the door in the open position.

7.4.2.5.1.2 Only the active supporting and securing devices having an effective stiffness in the relevant direction are to be included and considered to calculate the reaction forces acting on the devices. Small and/or flexible devices such as cleats intended to provide local compression of the packing material are not generally to be included in the calculations called for in 7.4.2.5.2.2. The number of securing and supporting devices are generally to be the minimum practical whilst taking into account the requirement for redundant provision given in 7.4.2.5.2.3 and the available space for adequate support in the hull structure.

7.4.2.5.2 Scantlings

7.4.2.5.2.1 Securing and supporting devices are to be adequately designed so that they can withstand the reaction forces within the permissible stresses given in 7.4.2.2.1.1.

7.4.2.5.2.2 The distribution of the reaction forces acting on the securing devices and supporting devices may require to be supported by direct calculations taking into account the flexibility of the hull structure and the actual position of the supports.

7.4.2.5.2.3 The arrangement of securing devices and supporting devices in way of these securing devices is to be designed with redundancy so that in the event of failure of any single securing or supporting device the remaining devices are capable to withstand the reaction forces without exceeding by more than 20 per cent the permissible stresses as given in 7.4.2.2.1.1.

7.4.2.5.2.4 All load transmitting elements in the design load path, from the door through securing and supporting devices into the ship's structure, including welded connections, are to be to the same strength standard as required for the securing and supporting devices. These elements include pins, support brackets and back-up brackets.

7.4.2.6 Securing and locking arrangement

7.4.2.6.1 Systems for operation

7.4.2.6.1.1 Securing devices are to be simple to operate and easily accessible. Securing devices are to be equipped with mechanical locking arrangement (self locking or separate arrangement), or are to be of the gravity type. The opening and closing systems as well as securing and locking devices are to be interlocked in such a way that they can only operate in the proper sequence.

7.4.2.6.1.2 Doors which are located partly or totally below the freeboard deck with a clear opening area greater than 6 m² are to be provided with an arrangement for remote control, from a position above the freeboard deck, of:

- the closing and opening of the doors
- associated securing and locking devices.

For doors which are required to be equipped with a remote control arrangement, indication of the open/closed position of the door and the securing and locking device is to be provided at the remote control stations. The operating panels for operation of doors are to be inaccessible to unauthorised persons. A notice plate, giving instructions to the effect that all securing devices are to be closed and locked before leaving harbour, is to be placed at each operating panel and is to be supplemented by warning indicator lights.

7.4.2.6.1.3 Where hydraulic securing devices are applied, the system is to be mechanically lockable in closed position. This means that, in the event of loss of the hydraulic fluid, the securing devices remain locked.

The hydraulic system for securing and locking devices is to be isolated from other hydraulic circuits, when closed position.

7.4.2.6.2 Systems for indication/monitoring

7.4.2.6.2.1 The following requirements apply to doors in the boundary of special category spaces or ro-ro spaces, see the

Rules, Part 17 - Fire protection, 2.2, through which such spaces may be flooded.

For cargo ships, where no part of the door is below the uppermost waterline and the area of the door opening is not greater than 6 m², then the requirements of this section need not be applied.

7.4.2.6.2.2 Separate indicator lights and audible alarms are to be provided on the navigation bridge and on each operating panel to indicate that the doors are closed and that their securing and locking devices are properly positioned.

The indication panel is to be provided with a lamp test function. It is not to be possible to turn off the indicator light.

7.4.2.6.2.3 The indicator system is to be designed on the fail safe principle and is to show by visual alarms if the door is not fully closed and not fully locked and by audible alarms if securing devices become open or locking devices become unsecured. The power supply for the indicator system is to be independent of the power supply for operating and closing the doors and is to be provided with a backup power supply from the emergency source of power or secure power supply.

See 7.4.1.6.5 for fail safe principal design.

The sensors of the indicator system are to be protected from water, ice formation and mechanical damages.

7.4.2.6.2.4 The indication panel on the navigation bridge is to be equipped with a mode selection function "harbour/sea voyage", so arranged that audible alarm is given on the navigation bridge if the vessel leaves harbour with any side shell or stern door not closed or with any of the securing devices not in the correct position.

7.4.2.6.2.5 For passenger ships, a water leakage detection system with audible alarm and television surveillance is to be arranged to provide an indication to the navigation bridge and to the engine control room of any leakage through the doors.

For cargo ships, a water leakage detection system with audible alarm is to be arranged to provide an indication to the navigation bridge.

7.4.2.6.2.6 For ro-ro passenger ships, on international voyages, the special category spaces and ro-ro spaces are to be continuously patrolled or monitored by effective means, such as television surveillance, so that any movement of vehicles in adverse weather conditions and unauthorised access by passengers thereto, can be detected whilst the ship is underway.

7.4.2.7 Operating and maintenance manual

7.4.2.7.1 An operating and maintenance manual for the side shell and stern doors is to be provided on board and contain necessary information (see 7.4.1.7.1).

This manual has to be submitted for approval to the *Register* that the above mentioned items are contained in the OMM and that the maintenance part includes the necessary information with regard to inspections, trouble-shooting and acceptance / rejection criteria.

Note:

It is recommended that recorded inspections of the door supporting and securing devices be carried out by the ship's staff at monthly intervals or following incidents that could result in damage, including heavy weather or contact in the region of

side shell and stern doors. Any damage recorded during such inspections is to be reported to the Register.

7.4.2.7.2 Documented operating procedures for closing and securing side shell and stern doors are to be kept on board and posted at the appropriate places.

7.4.2.8 Requirements for side shell doors and stern doors of existing ro-ro passenger ships

7.4.2.8.1 The structural condition of side shell doors and stern doors, especially the primary structure, the securing and supporting arrangements and the hull structure alongside and above the doors, are to be specially examined and any defects rectified.

7.4.2.8.2 The following measures are to be complied with by all existing ro-ro passenger ships with the date of building before the 30th of June 1996, including, when not differently deliberated by the competent flag Administrations, ships only engaged on domestic sea voyages.

- a) The structural arrangement of securing devices and supporting devices of inwards opening doors in way of these securing devices and, where applicable, of the surrounding hull structure is to be re-assessed in accordance with the applicable requirements of 7.4.2.5 and modified accordingly.
- b) The securing and locking arrangements for side shell doors and stern doors which may lead to the flooding of a special category space or ro-ro spaces as defined in 7.4.2.1.3, are to comply with the following requirements:
 - Separate indicator lights and audible alarms are to be provided on the navigation bridge and on each panel to indicate that the doors are closed and that their securing and locking devices are properly positioned.
 - The indication panel is to be provided with a lamp test function. It is not to be possible to turn off the indicator light.
 - The indication panel on the navigation bridge is to be equipped with a mode selection function "harbor/sea voyage", so arranged that audible alarm is given if the vessel leaves harbor with the bow doors or inner doors not closed or with any of the securing devices not in the correct position.
 - A water leakage detection system with audible alarm and television surveillance are to be arranged to provide an indication to the navigation bridge and to the engine control station of any leakage through the doors.

7.4.2.8.3 Documented operating procedures for closing and securing side shell and stern doors are to be kept on board and posted at the appropriate places.

7.5 SUPERSTRUCTURES AND DECKHOUSES

7.5.1 Construction, openings and closing appliances

7.5.1.1 Openings in the freeboard deck other than those defined in 7.3, 7.6 to 7.11 are to be protected by the enclosed superstructure or enclosed deckhouse.

The similar openings in the deck of enclosed superstructure or enclosed deckhouse are to be protected by enclosed deckhouse of the second tier.

7.5.1.2 Superstructures and deckhouses are considered enclosed if:

- their construction complies with the *Rules, Part 2 - Hull*, 13.
- all access openings comply with the requirements of 7.5.2 and 7.7;
- all other openings in their outside contour comply with requirements of 7.2 to 7.4 and 7.7 to 7.10.

7.5.2 Doors in enclosed superstructures and enclosed deckhouses

7.5.2.1 All access openings in the end bulkheads of enclosed superstructures and outside bulkheads of enclosed deckhouses are to be fitted with doors.

7.5.2.2 The height of the sills to access openings specified in 7.5.2.1 is to be at least 380 mm. However, the bridge or poop is to not be regarded as enclosed unless access is provided for the crew to machinery and other working spaces inside these superstructures from any place in the uppermost continuous open deck or above it by alternative means which are available at all times when bulkhead openings are closed, the height of the sills of the openings in the bulkheads of such bridge or poop is to be at least 600 mm in position 1 and at least 380 mm in position 2.

7.5.2.3 The doors are to be permanently and strongly attached to the bulkhead and fitted with clamping devices or other equivalent means for expeditiously opening, closing and securing them weathertight; such devices are to be so arranged that they can be operated from both sides of the bulkhead.

The doors are to be opening outside, opening of doors inside the superstructure or deckhouse space is to be specially considered by the *Register* in each case.

7.5.2.4 The doors are to be weathertight when secured. The tightness is to be ensured by a rubber or other suitable gasket.

7.5.2.5 The doors are to be made of steel or other material approved by the *Register*.

The strength of the door is to be of equivalent strength to the unpierced bulkhead.

7.6 MACHINERY CASINGS

7.6.1 Machinery space openings in positions 1 and 2 are to be efficiently enclosed by casings of ample strength

raised above the decks as far as is reasonable and practicable, and terminated themselves by a deck, or covers if a skylight is in question. The construction of the casings shall meet the *Rules for the classification of ships, Part 2 - Hull, Section 13*.

7.6.2 Casings are to be made weathertight.

7.6.3 Casings are to be made of steel or other materials approved by *Register*.

7.6.4 The access openings in the casings are to be fitted with permanently attached doors which shall comply with the requirements of 7.5.2.3-7.5.2.5. The height of the sills is to be at least 600 mm in position 1 and at least 380 mm in position 2.

7.6.5 In Type "A" ships and also in Type "B" ships which are permitted to have the tabular freeboard less than that prescribed by *ICLL, 1966*, the engine and boiler casings are to be protected by enclosed poop or bridge of at least standard height, or by a deckhouse of equal height and equivalent strength. However, engine and boiler casings may be exposed if there are no openings giving direct access from the freeboard deck to the machinery space. A door complying with requirements of 7.5.2.3 to 7.5.2.5 may, however, be permitted in the machinery casing provided that it leads to a space or passage-way which is as strongly constructed as the casing and is separated from the stairway to the engine and boiler room by a second similar door. The opening for the outside door is to be provided with a sill at least 600 mm in height, and that for the inside door with a sill of at least 230 mm in height.

7.6.6 In supply vessels the doors in the casings giving access to the engine or boiler rooms are to be located, where possible, inside the enclosed superstructure or deckhouse.

The door in the casing for access to the engine or boiler room may be fitted directly on the open cargo provided that, in addition to the first outside door, the second inside door is fitted; in this case, the outside and inside doors shall satisfy the requirements of 7.5.2.3 to 7.5.2.5, the height of the outside door sill is to be at least 600 mm, and of the inside door sill, at least 230 mm.

7.7 COMPANION HATCHES, SKYLIGHTS AND VENTILATING TRUNKS

7.7.1 Deck openings in positions 1 and 2 intended for stairways to the ship's spaces located below as well as light and air openings to these spaces are to be protected by strong companion hatches, skylights and ventilating trunks.

Where the openings intended for stairways to the ship's spaces located below are protected by superstructures or deckhouse instead of companion hatches, these superstructures or deckhouse shall comply with the requirements of 7.5.

7.7.2 The height of coamings of companion hatches, skylights and ventilating trunks is to be at least 600 mm in position 1 and at least 450 mm in position 2.

The construction of coamings shall comply with requirements of the *Rules for the classification of ships, Part 2 - Hull, 2.6*.

7.7.3 All companion hatches, skylights and ventilating trunks are to be provided with covers made of steel or some other approved material and permanently attached to the coamings.

Where the covers are made of steel, the thickness of their plating is to be equal to at least 0,01 times the spacing of the stiffeners but no less than 6 mm. The minimum specified thickness of 6 mm may be reduced if the cover was formed by pressing, as shown in Figure 7.7.3 and in Table 7.7.3-1.

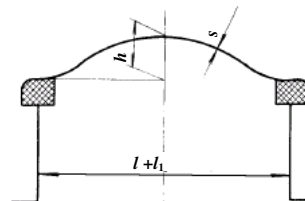


Figure 7.7.3

Table 7.7.3-1

Casing Dimensions <i>l x b</i> , [mm]	Cover Material	Height of Press <i>h</i> , [mm]	Minimum Thickness <i>s</i> , [mm]
450 x 600	steel	25	4
	light alloy		
600 x 600	steel	28	4
	light alloy		
700 x 700	steel	40	4
	light alloy		6
800 x 800	steel	55	4
	light alloy		6
800 x 1200	steel	55	5
	light alloy		6
1000 x 1400	steel	90	5

On small vessels with a deck plating less than 6 mm in thickness, the thickness of the cover may be equal to the thickness of the deck, but not less than 4 mm.

7.7.4 Covers of companion hatches, skylights and ventilating trunks are to have securing devices workable at least from outside of the hatch. However, where the hatches are used as emergency exits in addition to their primary application, the securing devices are to be capable of being operated from each side of the cover.

When secured, the covers are to be weathertight. The tightness is to be provided by a rubber or other suitable gasket.

7.7.5 The glass for windows in the covers of skylights is to be hardened and at least 6 mm thick if the inner diameter is 150 mm and below, and at least 12 mm with the inner diameter of 450 mm.

For intermediate inner diameters, the thickness of glass is to be determined by liner interpolation. However, where wire-reinforced glass is used, its thickness may be 5 mm, and the requirement relating to its hardening is not to be applicable.

Glass is to be efficiently attached to the covers by means of a frame and have on its contour a weathertight gasket of rubber or other equivalent material.

Windows in the covers of skylights fitted in machinery spaces shall comply with the requirements of the *Rules for the classification of ships, Part 17 - Fire protection, 2.1*.

7.7.6 Each window or group of adjacent windows is to be provided with portable shields of the same material as the cover being at least 3 mm in thickness and capable of being

efficiently fastened outside the cover by means of ear-nuts; such portable shields are to be stowed adjacent to the skylights.

7.8 VENTILATORS

7.8.1 Ventilators to spaces below freeboard deck or deck of enclosed superstructures and deckhouses are to be fitted with coamings efficiently connected to the deck. The coamings of ventilators are to be at least 900 mm in height in position 1 and at least 760 mm in position 2.

The thickness of the coaming plates is to be 7,5 mm where the clear opening sectional area of the ventilator coamings is 300 cm² or less, and 10 mm where the clear opening sectional area exceeds 1600 cm². Intermediate values are to be determined by direct interpolation. A thickness of 6 mm is generally to be sufficient within not permanently closed superstructures.

7.8.2 Ventilators in position 1 the coamings of which extend to more than 4500 mm above the deck and in position 2 the coamings of which extend to more than 2300 mm above the deck need not be fitted with closing appliances. In all other cases, each ventilator is to be fitted with a strong cover made of steel or other material approved by the *Register*.

In ships of less than 100 m in length, the covers are to be permanently attached; in ships of 100 m in length and over they may be conveniently stowed near the ventilators to which they are to be fitted.

7.8.3 When secured, the covers of ventilators are to be weathertight. The tightness is to be provided by a rubber or other suitable gasket.

7.8.4 In supply vessels, in order to minimise the possibility of flooding of the spaces situated below, the ventilators are to be positioned in the protected locations where the probability of their damage by cargo is excluded during cargo handling operations. Particular attention is to be given to the arrangement of ventilators of the engine and boiler rooms for which the location is preferable above the deck level of the first tier of superstructures or deckhouses.

7.8.5 The ventilation of machinery spaces shall be according to the principles laid down in *SOLAS Regulation II-1/35* and supplied through suitably protected openings arranged in such a way that they can be used in all weather conditions, taking into account *Reg.17(3)* and *Reg. 19* of the *1966 Load Line Convention* as amended by the *Protocol of 1988*.

The machinery spaces are those defined in *SOLAS Regulation II-1/3.16*.

7.9 MANHOLES

7.9.1 Covers of manholes are to be made of steel or other approved material.

Thickness of the covers is not to be less than that of the plating on which they are fitted. In some cases it may be permitted to decrease the thickness of the covers provided the thickness of plating is greater than 12 mm.

7.9.2 The covers of manholes are to be efficiently attached to the coaming or doubling ring by means of bolts or pins with nuts.

7.9.3 When secured, the covers are to be tight under inner pressure of water or other liquids, for which the tanks are

intended, up to the top of the air pipe. The tightness is to be provided by a rubber or other suitable gasket. The gasket is to be resistant to the liquid cargoes referred to above.

7.10 HATCHWAYS OF DRY CARGO HOLDS

7.10.1 General

7.10.1.1 The deck openings through which cargoes or ship's stores are loaded and unloaded are to be protected by strong hatchways. If these hatchways are situated in positions 1 and 2 (see Section 7.1.4), the hatchway covers are to be weathertight. The tightness is to be provided by one of the following two methods:

- .1 closed by portable covers and secured weathertight by tarpaulins and battening devices;
- .2 by weathertight covers made of steel or other equivalent material fitted with rubber or other suitable gaskets and clamping devices.

7.10.1.2 The strength requirements are applicable to hatch covers and hatch coamings of stiffened plate construction and its closing arrangements.

7.10.1.3 These requirements are applicable to hatch covers and coamings made of steel. In case of alternative materials and innovative designs the approval is subject to special consideration of the *Register*.

7.10.1.4 These requirements don't apply to portable covers secured weathertight by tarpaulins and battening devices, or pontoon covers, as defined in *ICLL Regulation 15*.

7.10.1.5 Hatchways on freeboard and superstructure decks are to have coamings, the minimum height of which above the deck is to be as follows:

- in position 1: 600 mm
- in position 2: 450 mm

7.10.1.6 The height of coamings of the hatchways specified in 7.10.1.1.2 may be decreased in relation to that prescribed by 7.10.1.5 or the coamings may be omitted entirely where the efficiency of the cover tightness and securing means will satisfy the *Register*.

7.10.1.7 Where an increased freeboard is assigned, the height of hatchway coamings according to 7.10.1.5 on the actual freeboard deck may be as required for a superstructure deck, provided the summer freeboard is such that the resulting draught will not be greater than that corresponding to the minimum freeboard calculated from an assumed freeboard deck situated at a distance equal to a standard superstructure height h/N below the actual freeboard deck.

7.10.1.8 Coamings are not to be required for hatchways below the freeboard deck or within weathertight closed superstructure unless they are required for the strength purposes.

7.10.1.9 Coamings which are 600 mm or more in height are to be stiffened by a horizontal stiffener. Where the unsupported height of a coaming exceeds 1,2 m additional stiffeners are to be arranged. Additional stiffeners may be dispensed with

if this is justified by the ship's service and if sufficient strength is verified (e.g. in case of container ships).

7.10.1.10 For hatch way coamings which are designed on the basis of strength calculations as well as for hatch girders, cantilevers and pillars, see the *Rules for the classification of ships, Part 2 - Hull*, Section 9.

For structural members welded to coamings and for cutouts in the top of coaming sufficient fatigue strength according to the *Rules for the classification of ships, Part 2 - Hull*, Section 16 is to be verified.

7.10.1.11 Hatchway coamings are to be adequately supported by stays.

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

Coaming stays are to be supported by appropriate substructures.

Under deck structures are to be designed under consideration of permissible stresses according to 7.10.3.1.

7.10.1.13 Adequate safety against buckling according to Section 4, 4.6 is to be proved for longitudinal coamings which are part of the longitudinal hull structure.

7.10.1.14 The connection of the coamings to the deck at the hatchway corners is to be carried out with special care. For bulk carriers, see also the *Rules for the classification of ships, Part 2 - Hull*, Section 17, 17.2.8.

7.10.1.15 For rounding of hatchway corners, see also the *Rules for the classification of ships, Part 2 - Hull*, 6.1.3.

7.10.1.16 For application of the corrosion margin required by *Regulation 16 (5)(d)* of the *ICLL*, 1996 (*Res. MSC. 143(77)*), see 7.10.7, 7.10.8.6 and *IACS Unified Interpretation LL70*.

7.10.2 Evaluation of scantlings of hatch covers and hatch coamings and closing arrangements of cargo holds of ships

7.10.2.1 Application

These requirements apply to all ships except CSR bulk carriers, and are for all cargo hatch covers and coamings on exposed decks.

As specified in this Section 7.10.2, parts of the requirements are for some specific ship types as categorized below:

1. Type-1 ships, including all ships except bulk carriers, self-unloading bulk carriers, ore carriers and combination carriers, as defined in the *Rules, Part 1 – General Requirements, Chapter 1 – General Information*, 4.2.5.5.
2. Type-2 ships, including all bulk carriers, self-unloading bulk carriers, ore carriers and combination carriers, as defined in the *Rules for the classification of ships, Part 1 – General Requirements, Chapter 1 – General Information*, 4.2.

The strength requirements are applicable to hatch covers and hatch coamings of stiffened plate construction and its closing arrangements.

This Section 7.10.2 is applicable to hatch covers and coamings made of steel. In case of alternative materials and innovative designs the approval is subject to the special consideration by the *Register* in each case.

This Section 7.10.2 does not apply to portable covers secured weathertight by tarpaulins and battening devices, or pontoon covers, as defined in *ICLL Regulation 15*.

These requirements are in addition to the requirements of the *ICLL*.

7.10.2.2 Definition

ICLL Where *ICLL* is referred to in the text, this is to be taken as the *International Convention on Load Lines, 1966* as amended by the 1988 protocol, as amended in 2003.

7.10.2.2.1 Hatch cover types

7.10.2.2.1.1 Single skin cover

A hatch cover made of steel or equivalent material that is designed to comply with *ICLL Regulation 16*. The cover has continuous top and side plating, but is open underneath with the stiffening structure exposed. The cover is weathertight and fitted with gaskets and clamping devices unless such fittings are specifically excluded.

7.10.2.2.1.2 Double skin cover

A hatch cover as above but with continuous bottom plating such that all the stiffening structure and internals are protected from the environment.

7.10.2.2.1.3 Pontoon type cover

A special type of portable cover, secured weathertight by tarpaulins and battening devices. Such covers are to be designed in accordance with *ICLL Regulation 15* and are not covered by these requirements.

Clarification note:

Modern hatch cover designs of lift-away-covers (also called lift-on/lift-off, or just simply LoLo covers) are in many cases called pontoon covers. This definition does not fit to the definition above. Modern lift-away hatch cover designs should belong to one of the two categories single skin covers or double skin cover.

7.10.2.2.2 Positions

The hatchways are classified according to their position as follows:

Position 1 Upon exposed freeboard and raised quarterdecks, and upon exposed superstructure decks situated forward of a point located a quarter of ship's length from forward perpendicular.

Position 2 Upon exposed superstructure decks situated abaft a quarter of the ship's length from the forward perpendicular and located at least one standard height of the superstructure above the freeboard deck.

Upon exposed superstructure decks situated forward of a point located a quarter of the ship's length from the forward perpendicular and located at least two standard height of the superstructure above the freeboard deck.

7.10.2.3 Material

Hatch covers and coamings are to be made of material in accordance with the definitions of the *Rules for the classification of ships, Part 2 – Hull*, 1.4.2. A material class I is to be applied for top plate, bottom plate and primary supporting members.

7.10.2.4 General requirements

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

Generally, the spacing of primary supporting members parallel to the direction of stiffeners is not to exceed 1/3 of the span of primary supporting members. If sufficient strength based on FEM analysis can be verified, this requirement may be waived.

Stiffeners of hatch coamings are to be continuous over the breadth and length of hatch coamings, as far as practical.

7.10.2.5 Net scantling approach

Unless otherwise quoted, the thicknesses t of the following sections are net thicknesses.

The net thicknesses are the member thicknesses necessary to obtain the minimum net scantlings required by 7.10.3 and 7.10.5.

The required gross thicknesses are obtained by adding corrosion additions, t_s , given in Table 7.10.7.1 in 7.10.7.1.

Strength calculations using FEM are to be performed with net scantlings.

7.10.2.6 Hatch cover and coaming load model

Structural assessment of hatch covers and hatch coamings is to be carried out using the design loads, defined in this chapter.

Definitions

L = length of ship, in [m], as defined in 1.2.2.1

L_{LL} = length of ship, in [m], as defined in *ICLL Regulation 3*

x = longitudinal co-ordinate of mid point of assessed structural member measured from aft end of length L or L_{LL} , as applicable

D_{min} = the least moulded depth, in [m], as defined in *ICLL Regulation 3*

h_N = standard superstructure height, in [m]

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

7.10.2.6.1 Vertical weather design load

The pressure p_H , in [kN/m²], on the hatch cover panels is given by *ICLL*. This may be taken from Table 7.10.2.6.1. The vertical weather design load needs not to be combined with cargo loads according to 7.10.2.6.3 and 7.10.2.6.4.

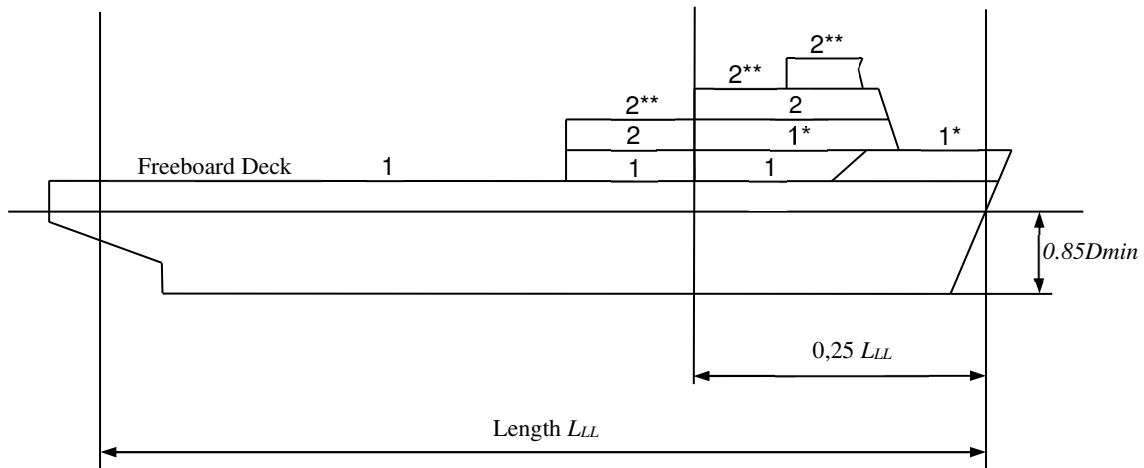
In Fig.7.10.2.6.1-1 the positions 1 and 2 are illustrated for an example ship.

Where an increased freeboard is assigned, the design load for hatch covers according to Tab. 7.10.2.6.1 on the actual freeboard deck may be as required for a superstructure deck, provided the summer freeboard is such that the resulting draught will not be greater than that corresponding to the minimum freeboard calculated from an assumed freeboard deck situated at a distance at least equal to the standard superstructure height h_N below the actual freeboard deck, see Fig.7.10.2.6.1-2.

For hatch covers of cargo holds designed for carriage of ballast or liquid cargo, the internal lateral pressures are also to be considered according to the requirement of *the Rules for the classification of ships, Part 2 – Hull*, 3.4.

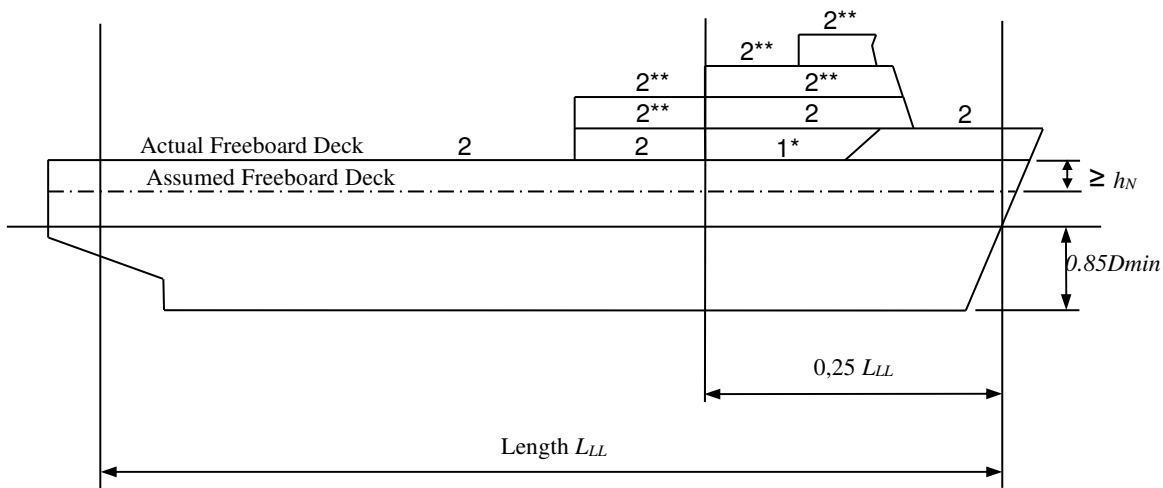
Table 7.10.2.6.1 Design load p_{HC} of weather deck hatches

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



- * reduced load upon exposed superstructure decks located at least one superstructure standard height above the freeboard deck
- ** reduced load upon exposed superstructure decks of vessels with $L_{LL} > 100$ m located at least one superstructure standard height above the lowest Position 2 deck

Figure 7.10.2.6.1-1 Positions 1 and 2



- * reduced load upon exposed superstructure decks located at least one superstructure standard height above the freeboard deck
- ** reduced load upon exposed superstructure decks of vessels with $L_{LL} > 100$ m located at least one superstructure standard height above the lowest Position 2 deck

Figure 7.10.2.6.1-2 Positions 1 and 2 for an increased freeboard

7.10.2.6.2 Horizontal weather design load

7.10.2.6.2.1 General horizontal weather design load

The horizontal weather design load p_A , in [kN/m²], for determining the scantlings of outer edge girders (skirt plates) of weather deck hatch covers and of hatch coamings is:

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

$$\begin{aligned} C_w &= \frac{L}{25} + 4,1, & \text{for } L < 90 \text{ m} \\ &= 10,75 - \left(\frac{300-L}{100} \right)^{1,5}, & \text{for } 90 \text{ m} \leq L < 300 \text{ m} \\ &= 10,75, & \text{for } 300 \text{ m} \leq L < 350 \text{ m} \\ &= 10,75 - \left(\frac{L-350}{150} \right)^{1,5}, & \text{for } 350 \text{ m} \leq L \leq 500 \text{ m} \end{aligned}$$

$$\begin{aligned} c_L &= \sqrt{\frac{L}{90}}, & \text{for } L < 90 \text{ m} \\ &= 1, & \text{for } L \geq 90 \text{ m} \end{aligned}$$

$$f_n = 20 + \frac{L_1}{12}, \text{ for unprotected front coamings and hatch cover skirt plates}$$

$$= 10 + \frac{L_1}{12}, \text{ for unprotected front coamings and hatch cover skirt plates, where the distance from the actual freeboard deck to the summer load line exceeds the minimum non-corrected tabular freeboard according to ICLL by at least one standard superstructure height } h_N.$$

$$= 5 + \frac{L_1}{15}, \text{ for side and protected front coamings and hatch cover skirt plates}$$

$$= 7 + \frac{L_1}{100} - 8 \cdot \frac{x'}{L}, \text{ for aft ends of coamings and aft hatch cover skirt plates abaft amidships}$$

$$= 5 + \frac{L_1}{100} - 4 \cdot \frac{x'}{L}, \text{ for aft ends of coamings and aft hatch cover skirt plates forward of amidships}$$

$$L_1 = L, \text{ need not be taken greater than } 300 \text{ m}$$

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

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

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

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

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

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

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

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

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

The design load p_A is not to be taken less than the minimum values given in Table 7.10.2.6.2.

Table 7.10.2.6.1 Minimum design load p_{Amin}

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

7.10.2.6.2.2 Horizontal weather design load applicable to coamings of Type-2 ships

The pressure P_{Coam} , in [kN/m²], on the No. 1 forward transverse hatch coaming is given by:

$P_{Coam} = 220$, when a forecandle is fitted in accordance with the Rules, Part 2 - Hull, item 17.2.

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

The pressure P_{Coam} , in [kN/m²], on the other coamings is given by:

$$P_{Coam} = 220$$

Note:

The horizontal weather design loads P_A and P_{Coam} need not be included in the direct strength calculation of the hatch cover, unless it is utilized for the design of substructures of horizontal support according to 7.10.6.2.3.

7.10.2.6.3 Cargo loads

7.10.2.6.3.1 Distributed loads

The load on hatch covers due to distributed cargo loads p_L , in [kN/m²], resulting from heave and pitch (i.e. ship in upright condition) is to be determined according to the following formula:

$$p_L = p_{Cargo} \cdot (1 + a_v)$$

where:

p_{Cargo} = uniform cargo load, in [kN/m²],

a_v = vertical acceleration addition as follows:

$$a_v = F \cdot m$$

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

$$m = m_0 - 5(m_0 - 1) \frac{x}{L}, \quad \text{for } 0 \leq \frac{x}{L} \leq 0,2,$$

$$= 1,0, \quad \text{for } 0,2 \leq \frac{x}{L} \leq 0,7$$

$$= 1 + \frac{m_0 + 1}{0,3} \left[\frac{x}{L} - 0,7 \right], \quad \text{for } 0,7 < \frac{x}{L} \leq 1,0,$$

$$m_0 = 1,5 + F,$$

v_0 = maximum speed at summer load line draught, v_0 is not to be taken less than \sqrt{L} , in [knots].

7.10.2.6.3.2 Point loads

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

$$P = P_s (1 + a_v).$$

7.10.2.6.4 Container loads

7.10.2.6.4.1 General

The loads defined in 7.10.2.6.4.2 and 7.10.2.6.4.4 are to be applied where containers are stowed on the hatch cover.

7.10.2.6.4.2 Corner loads for ship in upright condition

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

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

where:

a_v = acceleration addition according to 7.10.2.6.3.1

M = maximum designed mass of container stack, in [t].

7.10.2.6.4.3 Corner loads for ship in heel condition

The loads, in [kN], applied at each corner of a container stack, and resulting from heave, pitch, and the ship's rolling motion (i.e. ship in heel condition) are to be determined as follows, see also Fig 7.10.2.6.4.

$$A_z = 9,81 \frac{M}{2} \cdot (1 + a_v) \cdot \left(0,45 - 0,42 \frac{h_m}{b} \right)$$

$$B_z = 9,81 \frac{M}{2} \cdot (1 + a_v) \cdot \left(0,45 + 0,42 \frac{h_m}{b} \right)$$

$$B_y = 2,4 \cdot M$$

where:

a_v = acceleration addition according to 7.10.2.6.3.1,

M = maximum designed mass of container stack, in [t],

h_m = designed height of centre of gravity of stack above hatch cover top, in [m], may be calculated as weighted mean value of the stack, where the centre of gravity of each tier is assumed to be located at the centre of each container,

$$= \sum (z_i \cdot W_i) / M$$

z_i = distance from hatch cover top to the centre of i th container, in [m],

W_i = weight of i th container, in [t],

b = distance between midpoints of foot points, in [m],

A_z, B_z = support forces in z -direction at the forward and aft stack corners,

B_y = support force in y -direction at the forward and aft stack corners.

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

Note:

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

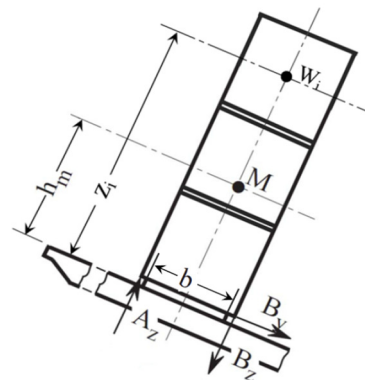


Figure 7.10.2.6.4 Forces due to container loads

7.10.2.6.4.4 Load cases with partial loading

The load cases defined in 7.10.2.6.4.2 and 7.10.2.6.4.3 are also to be considered for partial non homogeneous loading which may occur in practice, e.g. where specified container stack places are empty. For each hatch cover, the heel directions, as shown in Table 7.10.2.6.4.4, are to be considered.

The load case *partial loading of container hatch covers* can be evaluated using a simplified approach, where the hatch cover is loaded without the outermost stacks that are located completely on the hatch cover. If there are additional stacks that are supported partially by the hatch cover and partially by container stanchions then the loads from these stacks are also to be neglected, refer to Table 7.10.2.6.4.4 Partial loading of container hatch covers.

In addition, the case where only the stack places supported partially by the hatch cover and partially by container

stanchions are left empty is to be assessed in order to consider the maximum loads in the vertical hatch cover supports.

It may be necessary to also consider partial load cases where more or different container stack places are left empty. Therefore, the *Register* may require that additional partial load cases be considered.

Table 7.10.2.6.4.4 Partial loading of container hatch covers

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

7.10.2.6.4.5 Mixed stowage of 20' and 40' containers on hatch cover

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

7.10.2.6.5 Loads due to elastic deformations of the ship's hull

Hatch covers, which in addition to the loads according to 7.10.2.6.1 to 7.10.2.6.4 are loaded in the ship's transverse direction by forces due to elastic deformations of the ship's hull, are to be designed such that the sum of stresses does not exceed the permissible values given in 7.10.3.1.1.

7.10.3 Hatch cover strength criteria**7.10.3.1 Permissible stresses and deflections****7.10.3.1.1 Yield strength**

All hatch cover structural members are to comply with the following formulae:

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

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

where:

σ_a : Allowable stress as defined in Tab. 4.

R_{eH} : Specified minimum yield stress, in [N/mm²], of the material.

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

$$\sigma_{vm} = \sqrt{\sigma_x^2 - \sigma_x \sigma_y + \sigma_y^2 + 3\tau_{xy}^2}, \text{ in [N/mm}^2\text{]}$$

σ_x = normal stress, in [N/mm²], in x -direction,

σ_y = normal stress, in [N/mm²], in y -direction,

τ_{xy} = shear stress, in [N/mm²], in the x - y plane.

σ_{axial} = axial stress in rod or beam elements, in [N/mm²],

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

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

For steels with a minimum yield stress of more than 355 N/mm², the value of R_{eH} to be applied throughout this requirement is subject to the *Register* but is not to be more than the minimum yield stress of the material.

Stress concentrations are to be assessed to the satisfaction of the *Register*.

7.10.3.1.1

Allowable stresses

Members of	Subject to	σ_a , in [N/mm ²]
Hatch cover structure	External pressure, as defined in 7.10.2.6.1	0.80 R_{eH}
	Other loads, as defined in 7.10.2.6.1 to 7.10.2.6.5	0.90 R_{eH} for static+dynamic load case 0.72 R_{eH} for static load case

7.10.3.1.2 Deflection

The vertical deflection of primary supporting members due to the vertical weather design load according to 7.10.2.6.1 is to be not more than $0,0056 \cdot l_g$ where l_g is the greatest span of primary supporting members.

Note:

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

7.10.3.2 Local net plate thickness

The local net plate thickness t , in [mm], of the hatch cover top plating is not to be less than:

$$t = F_p \cdot 15,8 \cdot s \sqrt{\frac{p}{0,95 \cdot R_{eH}}}$$

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

F_p = factor for combined membrane and bending response,

$$= 1,5 \text{ in general,}$$

$$= 1,9 \cdot \frac{\sigma}{\sigma_a}, \text{ for } \frac{\sigma}{\sigma_a} \geq 0,8 \text{ for the attached plate flange}$$

of primary supporting members,

where:

s = stiffener spacing, in [m],

p = pressure p_H and p_L , in [kN/m²], as defined in 7.10.2.6,

σ = maximum normal stress, in [N/mm²], of hatch cover top plating, determined according to Fig. 7.10.3.2,

σ_a = as defined in Tab. 7.10.3.1.1

For flange plates under compression sufficient buckling strength according to 7.10.3.6 is to be demonstrated.

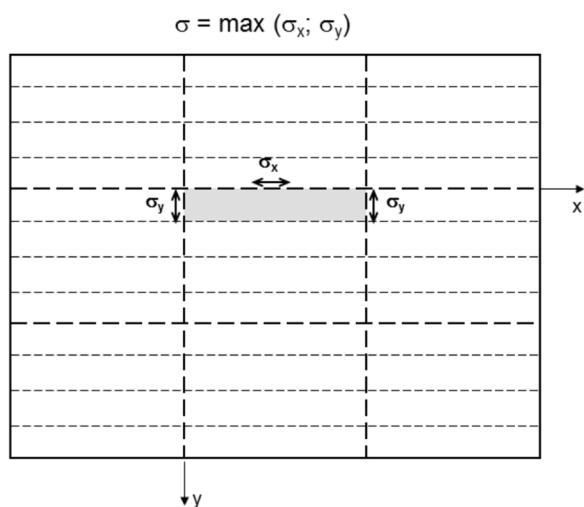


Figure 7.10.3.2 Determination of normal stress of the hatch cover plating

7.10.3.2.1 Local net plate thickness of hatch covers for wheel loading

The local net plate thickness of hatch covers for wheel loading have to be derived from the *Rules for the classification of ships, Part 2 – Hull, Section 6*.

7.10.3.2.2 Lower plating of double skin hatch covers and box girders

The thickness to fulfill the strength requirements is to be obtained from the calculation according to 7.10.3.5 under consideration of permissible stresses according to 7.10.3.1.1. When the lower plating is taken into account as a strength member of the hatch cover, the net thickness, in mm, of lower plating is to be taken not less than 5 mm. When project cargo is intended to be carried on a hatch cover, the net thickness must not be less than:

$$t = 6,5 \cdot s \cdot 10^{-3}, \text{ in [mm]},$$

where:

$$s = \text{stiffener spacing, in [mm]}.$$

Note:

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

When the lower plating is not considered as a strength member of the hatch cover, the thickness of the lower plating should be determined according to the *Rules, Part 2 – Hull*.

7.10.3.3 Net scantling of stiffeners

The net section modulus W and net shear area A_{shr} of uniformly loaded hatch cover stiffeners constraint at both ends must not be less than:

$$W = \frac{p \cdot s \cdot l^2}{f_{bc} \cdot \sigma_a}, \text{ in [cm}^3\text{]},$$

$$A_{shr} = \frac{8,7 \cdot p \cdot s \cdot l}{\sigma_a} \cdot 10^{-3}, \text{ in [cm}^2\text{]},$$

where:

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

s = stiffener spacing, in [mm],

p = pressure p_{HC} and p_L , in [kN/m²], as defined in 7.10.2.

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

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

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

σ_a = allowable stress as defined in Tab. 7.10.3.1.1

For stiffeners of lower plating of double skin hatch covers, requirements mentioned above are not applied due to the absence of lateral loads. For double skin hatch covers of holds designed for ballast or liquid cargo, the stiffeners on lower plating are to be strengthened according to the *Rules for the classification of ships, Part 2 – Hull, Section 9*.

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

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

Stiffeners parallel to primary supporting must be continuous at crossing primary supporting member and may be regarded for calculating the cross-sectional properties of primary supporting members. It is to be verified that the combined stress of those stiffeners induced by the bending of primary supporting members and lateral pressures does not exceed the permissible stresses according to 7.10.3.1.1. The requirements of this paragraph are not applied to stiffeners of lower plating of double skin hatch covers if the lower plating is not considered as strength member.

For hatch cover stiffeners under compression sufficient safety against lateral and torsional buckling according 7.10.3.6.3 is to be verified.

For hatch covers subject to wheel loading or point loads stiffener scantlings are to be determined under consideration of the permissible stresses according to 7.10.3.1.1 or are to be determined according to the *Rules for the classification of ships, Part 2 – Hull, Section 6*.

7.10.3.4 Net scantling of primary supporting members

7.10.3.4.1 Primary supporting members

Scantlings of primary supporting members are obtained from calculations according to 7.10.3.5 under consideration of permissible stresses according to 7.10.3.1.1.

For all components of primary supporting members sufficient safety against buckling must be verified according to 7.10.3.6.

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

$$t = 6,5 \cdot s \cdot 10^{-3}, \text{ in [mm]},$$

where:

$$s = \text{stiffener spacing, in [mm].}$$

7.10.3.4.2 Edge girders (Skirt plates)

Scantlings of edge girders are obtained from the calculations according to 7.10.3.5 under consideration of permissible stresses according to 7.10.3.1.1.

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

$$t = 0.0158 \cdot s \cdot \sqrt{\frac{P_A}{0.95 \cdot R_{eH}}}$$

$$t = 8.5 \cdot s \cdot 10^{-3} \text{ in [mm].}$$

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

where:

P_A = horizontal pressure as defined in 7.10.2.2.1

s = stiffener spacing in [mm].

For the required moment of inertia of edge girders, refer to 7.10.6.1.4.

7.10.3.5 Strength calculations

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

The stress calculation model in this section is to be used for both yielding and buckling strength assessments in accordance with 7.10.3.1 and 7.10.3.6, respectively.

The net scantlings as defined in 7.10.1.5 are to be used.

7.10.3.5.1 General requirements for FEM calculations

For the strength assessments of hatch covers by means of FEM analysis, the hatch cover geometry shall be idealized as realistically as possible. In no case shall element width be larger than stiffener spacing. In way of force transfer points and cutouts the mesh is to be refined where applicable. The ratio of element length to width shall not exceed 3.

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

Hatch covers fitted with U-type stiffeners as shown in Fig.7.10.3.5.1 are to be assessed by means of FEM

analysis. The geometry of the U-type stiffeners is to be accurately modelled using shell/plate elements. Nodal points are to be properly placed on the intersections between the webs of a U-type stiffener and the hatch cover plate, and between the webs and flange of the U-type stiffener.

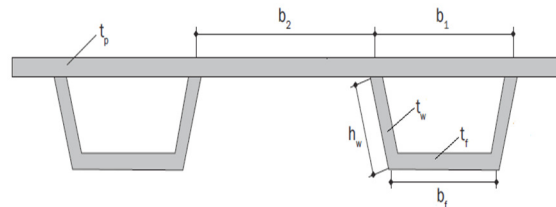


Figure 7.10.3.5.1

Example of hatch cover fitted with U-type stiffeners

Wherever applicable the following boundary conditions are to be applied to the FEM model:

1. Boundary nodes in way of a bearing pad on the hatch coamings are to be fixed against displacement in the direction perpendicular to the pad.
2. Lifting stoppers are to be fixed against displacements in the direction determined by the stoppers.
3. For a folding type hatch cover, the FEM nodes connected through a hinge are to have the same translational displacement in the direction perpendicular to the hatch cover top plating.

7.10.3.6 Buckling strength of hatch cover structures

7.10.3.6.1 General

Buckling strength of all hatch cover structures is to be checked. Buckling assessments are to be performed in compliance with the requirements in the *Rules, Part 2 – Hull, Annex-E* for the conditions specified in 7.10.3.6.2 and 7.10.3.6.3.

The net scantlings as defined in 7.10.1.5 are to be used for buckling check.

7.10.3.6.2 Slenderness requirements

The slenderness requirements are to be in accordance with those specified in the *Rules for the classification of ships, Part 2 – Hull, Annex E*. The slenderness requirements need not be applied to the lower boundary of double skin hatch covers unless the cargo hold is designed for carriage of ballast or liquid cargo.

The breadth of the primary supporting member flange is to be not less than 40% of their depth for laterally unsupported spans greater than 3.0 m. Tripping brackets attached to the flange may be considered as a lateral support for primary supporting members.

7.10.3.6.3 Buckling requirements

7.10.3.6.3.1 Application

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

1. Stiffened and unstiffened panels, including curved panels and panels stiffened with U-type stiffeners.
2. Web panels of primary supporting members in way of opening.

The buckling strength assessment of coaming parts is to be done according to the according to the *Rules, Part 2 - Hull*.

For rule application, the panel types and assessment methods, the applied lateral pressure and stresses, safety factors and buckling check criteria are defined in 7.10.3.6.3.2, 7.10.3.6.3.3, 7.10.3.6.3.4 and 7.20.3.6.3.5, respectively. The procedure and detailed requirements for buckling assessment are given in the *Rules for the classification of ships, Part 2 – Hull*, Annex-E, Section 4, including idealization of irregular plate panels, definition of reference stresses and buckling criteria.

Unless otherwise specified, the symbols used in 7.10.3.6.3 are defined in the *Rules for the classification of ships, Part 2 – Hull*, Annex-E.

7.10.3.6.3.2 Panel types and assessment methods

The plate panel of a hatch cover structure is to be modelled as stiffened panel (SP) or unstiffened panel (UP) as defined in the *Rules for the classification of ships, Part 2 – Hull*, Annex-E, Section 4. Assessment Method A (-A) and Method B (-B) as defined in the *Rules for the classification of ships, Part 2 – Hull*, Annex-E, Section 1, are to be used in accordance with Table 7.10.3.6.1-2, Figure 7.10.3.6.3.1-1 and Figure 7.10.3.6.3.1-2. For a web panel with opening, the procedure for opening should be used for its buckling assessment.

For a hatch cover fitted with U-type stiffeners, the additional buckling assessment requirements specific for panels with U-type stiffeners in the *Rules for the classification of ships, Part 2 – Hull*, Annex-E, Section 5, are also to be followed.

Table 7.10.3.6.1-2
Structural members and assessment methods

Structural elements	Assessment method ⁽¹⁾⁽²⁾	Normal panel definition
Hatch cover top/bottom plating structures, see Fig. 7.10.3.6.3.1-1		
Hatch cover top/bottom plating	SP-A	Length: between transverse girders Width: between longitudinal girders
Irregularly stiffened panels	UP-B	Plate between local stiffeners/PSM
Hatch cover web panels of primary supporting members, see Fig. 7.10.3.6.3.1-2		
Web of transverse/longitudinal girder (single skin type)	UP-B	Plate between local stiffeners/face plate/PSM
Web of transverse/longitudinal girder (double skin type)	SP-B ⁽³⁾	Length: between PSM Width: full web depth
Web panel with opening	Procedure for opening	Plate between local stiffeners/face plate/PSM
Irregularly stiffened panels	UP-B	Plate between local stiffeners/face plate/PSM
Note 1: SP and UP stand for stiffened and unstiffened panel respectively. Note 2: A and B stand for Method A and Method B respectively. Note 3: In case that the buckling carlings/brackets are irregularly arranged in the web of transverse/longitudinal girder, UP-B method may be used.		

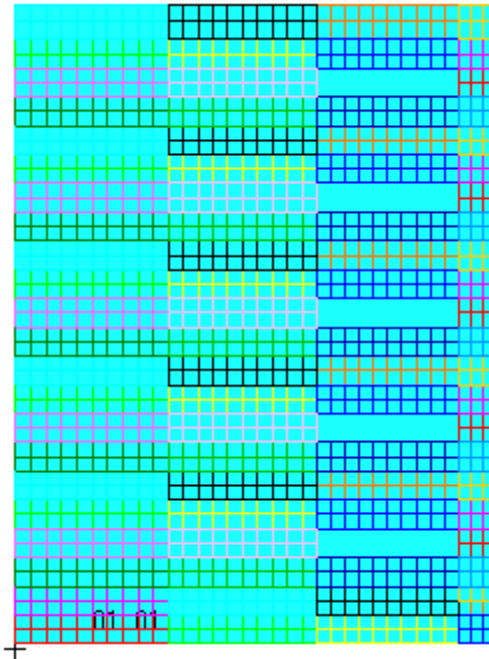


Figure 7.10.3.6.3.1-1 Hatch cover top/bottom plating structures

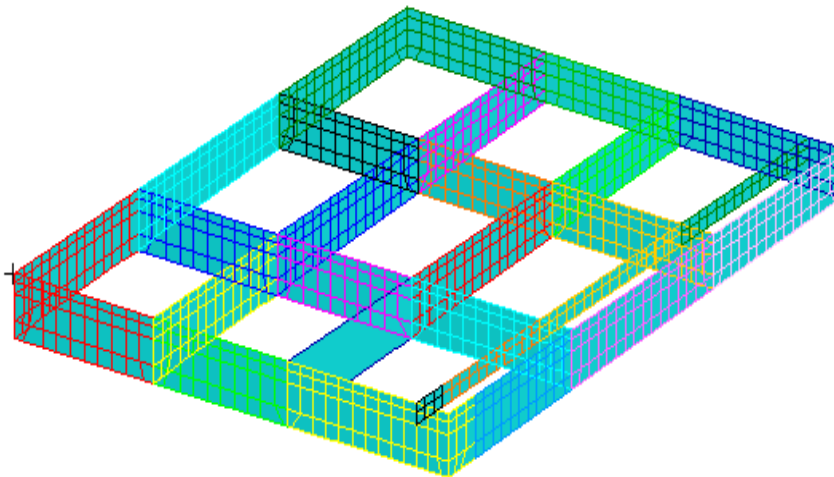


Figure 7.10.3.6.3.1-2 Hatch cover webs of primary supporting members

7.10.3.6.3.3 Applied lateral pressure and stresses

The buckling assessment of hatch covers is based on the lateral pressure as defined in 7.10.2.1 and 7.10.2.1, and stresses obtained from FEM analysis, refer to 7.10.3.5.

7.10.3.6.3.4 Safety factors

For all hatch cover structural members, safety factor $S=1.0$ is to be applied to both of the plating and stiffener buckling capacity formulas as defined in the *Rules for the classification of ships, Part 2 – Hull*, Annex E, Section 2.2 and the *Rules for the classification of ships, Part 2 – Hull*, Annex E, Section 5 and Section 2.3, respectively.

7.10.3.6.3.5 Buckling acceptance criteria

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

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

where:

η_{act} : Buckling utilisation factor based on the applied stress, as defined in the Rules, Part 2 – Hull, Annex E, Section 1 and the Rules, Part 2 – Hull, Annex E, Section 4, and calculated per the Rules, Part 2 – Hull, Annex E, Section 5.

η_{all} : Allowable buckling utilisation factor, taken as given in Tab.7.10.3.6.3.5.

Table 7.10.3.6.3.5
Allowable buckling utilisation factors

Structural component	Subject to	η_{all} , Allowable buckling utilisation factor
Plates and stiffeners Web of PSM	External pressure, as defined in 7.10.2.1	0.80
	Other loads, as defined in 7.10.2.2 to 7.10.2.5	0.90 for static+dynamic load case 0.72 for static load case

7.10.4 Details of hatch covers

7.10.4.1 Container foundations on hatch covers

Container foundations are to be designed to the satisfaction of the *Register*. The substructures of container foundations are to be designed for cargo and container loads according to 7.10.2.6, applying the permissible stresses according to 7.10.3.1.1.

7.10.4.2 Weather tightness

Further to the following requirements *IACS Rec. 14* is applicable to hatch covers.

7.10.4.2.1 Packing material (General)

The packing material is to be suitable for all expected service conditions of the ship and is to be compatible with the cargoes to be transported. The packing material is to be selected with regard to dimensions and elasticity in such a way that expected deformations can be carried. Forces are to be carried by the steel structure only.

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

7.10.4.2.2 Dispensation of weather tight gaskets

For hatch covers of cargo holds solely for the transport of containers, upon request by the owners and subject to compliance with the following conditions the fitting of weather tight gaskets according to 7.10.4.2.1 may be dispensed with:

- The hatchway coamings shall be not less than 600 mm in height.
- The exposed deck on which the hatch covers are located is situated above a depth $H(x)$. $H(x)$ is to be shown to comply with the following criteria:

$$H(x) \geq d_{fb} + f_b + h, \text{ in [m],}$$

d_{fb} = draught, in [m], corresponding to the assigned summer load line,

f_b = minimum required freeboard, in [m], determined in accordance with *ICLL Reg. 28* as modified by further regulations as applicable

$$h = 4,6 \text{ m for } \frac{x}{L_{LL}} \leq 0,75$$

$$= 6,9 \text{ m for } \frac{x}{L_{LL}} > 0,75$$

- Labyrinths, gutter bars or equivalents are to be fitted proximate to the edges of each panel in way of the coamings. The clear profile of these openings is to be kept as small as possible.
- Where a hatch is covered by several hatch cover panels the clear opening of the gap in between the panels shall be not wider than 50 mm.
- The labyrinths and gaps between hatch cover panels shall be considered as unprotected openings with respect to the requirements of intact and damage stability calculations.
- With regard to drainage of cargo holds and the necessary fire-fighting system reference is made to the sections of the *Rules for the classification of ships, Part 8 – Piping* and the *Rules for the classification of ships, Part 17.- Fire protection*.
- Bilge alarms should be provided in each hold fitted with non-weather-tight covers.
- Furthermore, *Chapter 3 of IMO MSC/Circ. 1087* is to be referred to concerning the stowage and segregation of containers containing dangerous goods.

7.10.4.2.3 Drainage arrangements

Cross-joints of multi-panel covers are to be provided with efficient drainage arrangements.

7.10.5 Hatch coaming strength criteria

7.10.5.1 Local net plate thickness of coamings

The net thickness of weather deck hatch coamings shall not be less than the larger of the following values:

1. For Type-1 ships:

$$t = 0.0142 \cdot s \cdot \sqrt{\frac{P_A}{0.95 \cdot R_{eH}}}, \text{ in [mm]},$$

$$t_{\min} = 6 + \frac{L_1}{100}, \text{ in [mm]},$$

2. For Type-2 ships:

$$t = 0.016 \cdot s \cdot \sqrt{\frac{P_{\text{coam}}}{0.95 \cdot R_{eH}}}, \text{ in [mm]},$$

$$t_{\min} = 9.5 \text{ mm}$$

where: P_A = pressure, in [kN/m²], as defined in 7.10.2.2.1

P_{coam} = pressure, in [kN/m²], as defined in 7.10.2.2.2

s = stiffener spacing, in [mm],

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

Longitudinal strength aspects are to be observed.

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

7.10.5.2 Net scantling of stiffeners of coamings

The stiffeners must be continuous at the coaming stays. For stiffeners with both ends constraint the elastic net section modulus W , in [cm³], and net shear area A_{shr} , in [cm²], calculated on the basis of net thickness, must not be less than:

1. For Type-1 ships:

$$W = \frac{P_A \cdot s \cdot l^2}{f_{bc} \cdot R_{eH}}$$

$$A_{shr} = \frac{P_A \cdot s \cdot l}{R_{eH}} \cdot 10^{-2}$$

where: $f_{bc} = 12$ in general

$f_{bc} = 8$ for the end spans of stiffeners sniped at the coaming corners

l = secondary stiffener span, in [m], to be taken as the spacing of coaming stays,

s = stiffener spacing, in [m].

For sniped stiffeners of coaming at hatch corners section modulus and shear area at the fixed support have to be increased by 35 %. The gross thickness of the coaming plate at the sniped stiffener end shall not be less than:

$$t_{gr} = 19.6 \cdot \sqrt{\frac{P_A \cdot s \cdot (l - 0.0005 \cdot s)}{1000 \cdot R_{eH}}}, \text{ in [mm]}$$

2. For Type-2 ships:

$$W = 1.21 \cdot \frac{P_{\text{Coam}} \cdot s \cdot l^2}{f_{bc} \cdot c_p \cdot R_{eH}}$$

where:

$f_{bc} = 16$ in general

$f_{bc} = 12$ for the end spans of stiffeners sniped at the coaming corners

l = span, in [m], of stiffeners

s = spacing, in [mm], of stiffeners

P_A = pressure in [kN/m²], as defined in 7.10.2.2.1

P_{Coam} = pressure in [kN/m²], as defined in 7.10.2.2.2

c_p = ratio of the plastic section modulus to the elastic section modulus of the stiffeners with an attached plate breadth, in [mm], equal to 40 t , where t is the plate net thickness

$c_p = 1.16$ in the absence of more precise evaluation

In addition, for both Type-1 and Type-2 ships horizontal stiffeners on hatch coamings, which are part of the longitudinal hull structure, are to be designed according to the *Rules for the classification of ships, Part 2 - Hull*.

7.10.5.3 Coaming stays

Coaming stays are to be designed for the loads transmitted through them and permissible stresses according to 7.10.3.1.1.

7.10.5.3.1 Coaming stay section modulus and web thickness

At the connection with deck, the net section modulus W , in [cm³], and the gross thickness t_w , in [mm], of the coaming stays designed as beams with flange (examples 1 and 2 are shown in Fig. 7.10.5.3.1) are to be taken not less than:

$$W = \frac{P \cdot s_c \cdot H_c^2}{1.9 \cdot R_{eH}}, \text{ in [cm}^3\text{]}$$

$$t_w = \frac{2 \cdot P \cdot s_c \cdot H_c}{h \cdot R_{eH}}, \text{ in [mm]}$$

where:

HC = stay height, in m

sc = stay spacing, in mm

h = stay depth, in mm, at the connection with the deck

P = pressure on coaming, in [kN/m²], taken as P_A defined in 7.10.2.2.1 in general and as P_{Coam} defined in 7.10.2.2.2 for Type-2 ships.

For other designs of coaming stays, such as those shown in Fig. 7.10.5.3.1, examples 3 and 4, the stresses are to be determined through a grillage analysis or FEM. The calculated stresses are to comply with the permissible stresses according to 7.10.3.1.1.

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

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

For Type-2 ships, toes of stay webs are to be connected to the deck plating with full or partial penetration double bevel welds extending over a distance not less than 15% of the stay width. For other ship types the size of welding for toes of webs at the lower end of coaming stays should be according to the *Rules for the classification of ships, Part 2 - Hull, Section 15*.

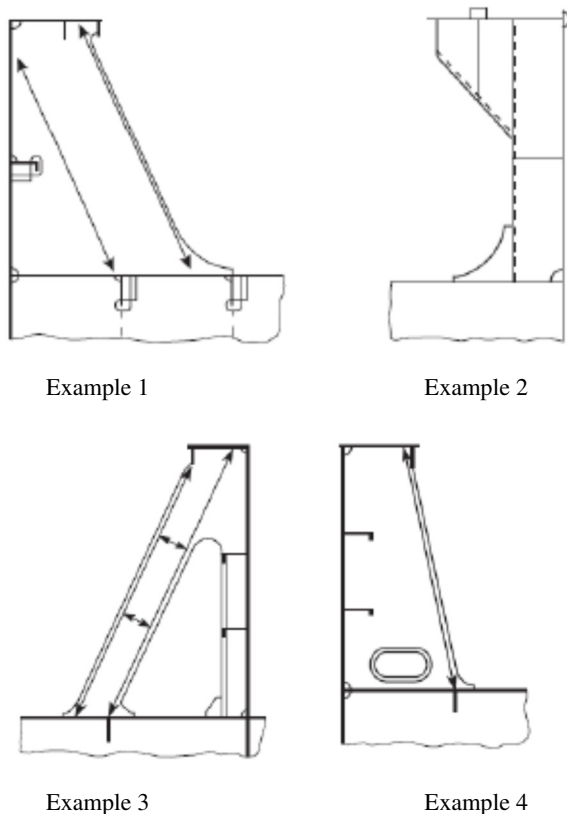


Figure 7.10.5.3.1 Examples of coaming stays

7.10.5.3.2 Coaming stays under friction load

For coaming stays, which transfer friction forces at hatch cover supports, fatigue strength is to be considered according to *Rules for the classification of ships, Part 2 - Hull*, refer to 7.10.6.2.2.

7.10.5.4 Further requirements for hatch coamings

7.10.5.4.1 Longitudinal strength

Hatch coamings which are part of the longitudinal hull structure are to be designed according to the requirements for longitudinal strength of the *Rules for the classification of ships, Part 2 - Hull*, Section 4.

For structural members welded to coamings and for cutouts in the top of coamings sufficient fatigue strength is to be verified according to Section 16.

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

7.10.5.4.2 Local details

If the design of local details is not regulated in 7.10.5, local details are to comply with the *Rules for the classification of ships, Part 2 - Hull* for the purpose of transferring the loads on the hatch covers to the hatch coamings and, through them, to the deck structures below. Hatch coamings and supporting structures are to be adequately stiffened to

accommodate the loading from hatch covers, in longitudinal, transverse and vertical directions.

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

Unless otherwise stated, weld connections and materials are to be dimensioned and selected in accordance with the *Rules for the classification of ships, Part 2 - Hull*.

7.10.5.4.3 Stays

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

7.10.5.4.4 Extend of coaming plates

Coaming plates are to extend to the lower edge of the deck beams; or hatch side girders are to be fitted that extend to the lower edge of the deck beams. Extended coaming plates and hatch side girders are to be flanged or fitted with face bars or half-round bars. Fig. 7.10.5.4.4 gives an example.

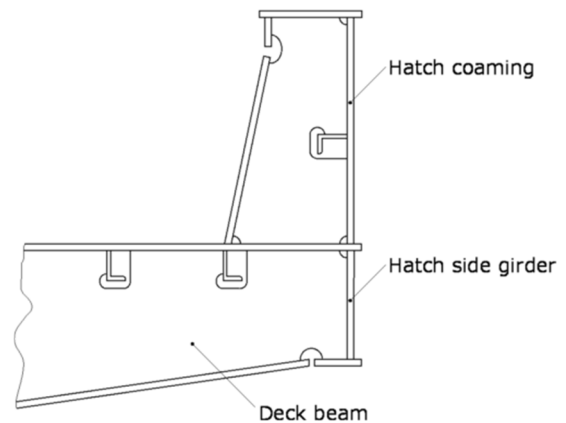


Fig. 7.10.5.4.4 Example for the extend of coaming plates

7.10.5.4.5 Drainage arrangement at the coaming

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

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

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

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

7.10.6 Closing arrangements

7.10.6.1 Securing devices

7.10.6.1.1 General

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

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

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

Sufficient number of securing devices is to be provided at each side of the hatch cover considering the requirements of 7.10.3.4.2. This applies also to hatch covers consisting of several parts.

The materials of stoppers, securing devices and their weldings are to be to the *Register* satisfaction. Specifications of the materials are to be shown in the drawings of the hatch covers.

7.10.6.1.2 Rod cleats

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

7.10.6.1.3 Hydraulic cleats

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

7.10.6.1.4 Cross-sectional area of the securing devices

The gross cross-sectional area, in [cm²], of the securing devices is not to be less than:

$$A = 0,28 \cdot q \cdot s_{SD} \cdot k_1$$

Correspondingly, the stiffness of edge girders is to be sufficient to maintain adequate sealing pressure between securing devices. The moment of inertia, in [cm⁴], of edge girders is not to be less than:

$$I = 6 \cdot q \cdot s_{SD}^4$$

where:

q = packing line pressure, in [N/mm], minimum 5 N/mm,

s_{SD} = spacing between securing devices in [m], not to be taken less than 2 m,

$k_1 = \left(\frac{235}{R_{eH}} \right)^e$, R_{eH} is the minimum yield strength

of the material, in [N/mm²], but is not to be taken greater than $0,7 \cdot R_m$, where R_m is the tensile strength of the material, in [N/mm²].

$e = 0,75$ for $R_{eH} > 235$ N/mm²

$= 1,00$ for $R_{eH} \leq 235$ N/mm².

Rods or bolts are to have a gross diameter not less than 19 mm for hatchways exceeding 5 m² in area.

Securing devices of special design in which significant bending or shear stresses occur may be designed as anti-lifting devices according to 7.10.6.1.5. The packing line pressure q is to be specified, and as load, q multiplied by the spacing between securing devices s_{SD} is to be applied.

7.10.6.1.5 Anti lifting devices

The securing devices of hatch covers, on which cargo is to be lashed, are to be designed for the lifting forces resulting from loads according to 7.10.2.6.4, refer Figure 7.10.6.1.5. Unsymmetrical loadings, which may occur in practice, are to be considered. Under these loadings the equivalent stress in the securing devices is not to exceed:

$$\sigma_v = \frac{150}{k_1}, \text{ in [N/mm}^2\text{]}.$$

Note:

The partial load cases given in Table 7.10.2.6.4.4 may not cover all unsymmetrical loadings, critical for hatch cover lifting.

Section 5.6 of *IACS Rec. 14* should be referred to for the omission of anti lifting devices.

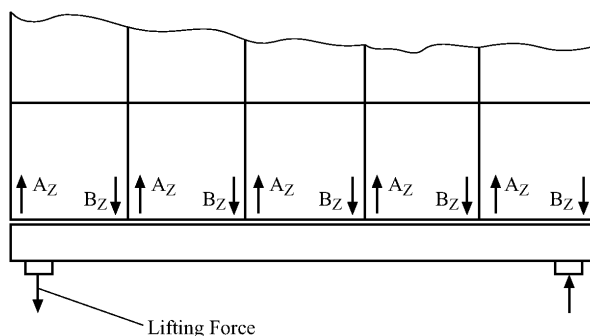


Figure 7.10.6.1.5 Lifting forces at a hatch cover

7.10.6.2 Hatch cover supports, stoppers and supporting structures

7.10.6.2.1 Horizontal mass forces

For the design of hatch cover supports the horizontal mass forces $F_h = m \cdot a$ are to be calculated with the following accelerations:

$a_x = 0,2 \cdot g$ in longitudinal direction,

$a_y = 0,5 \cdot g$ in transverse direction,

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

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

7.10.6.2.2 Hatch cover supports

For the transmission of the support forces resulting from the load cases specified in 7.10.2.6 and of the horizontal mass forces specified in 7.10.6.2.1, supports are to be provided which are to be designed such that the nominal surface pressures in general do not exceed the following values:

$$p_{nmax} = d \cdot p_n, \text{ in [N/mm}^2\text{]}$$

$$d = 3,75 - 0,015 \cdot L$$

$$d_{max} = 3,0$$

$$d_{min} = 1,0 \text{ in general}$$

$$= 2,0 \text{ for partial loading conditions, see 7.10.2.6.4.1}$$

$$p_n = \text{ see Table 7.10.7.2}$$

For metallic supporting surfaces not subjected to relative displacements the nominal surface pressure applies:

$$p_{nmax} = 3 \cdot p_n, \text{ in [N/mm}^2\text{]}$$

Note:

When the maker of vertical hatch cover support material can provide proof that the material is sufficient for the increased surface pressure, not only statically but under dynamic conditions including relative motion for adequate number of cycles, permissible nominal surface pressure may be relaxed at the discretion of the Register. However, realistic long term distribution of spectra for vertical loads and relative horizontal motion should be assumed and agreed with the Register.

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

Tab. 7.10.6.2.2 Permissible nominal surface pressure p_n

Support material	p_n , in [N/mm ²], when loaded by	
	Vertical force	Horizontal force (on stoppers)
Hull structural steel	25	40
Hardened steel	35	50
Lower friction materials	50	-

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

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

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

$$P_h = \mu \cdot \frac{P_v}{\sqrt{d}}$$

where:

$$P_v = \text{ vertical supporting force}$$

$$\mu = \text{ frictional coefficient}$$

$$= 0,5 \text{ in general.}$$

For non-metallic, low-friction support materials on steel, the friction coefficient may be reduced but not to be less than 0,35 and to the satisfaction of the *Rules, Part 24 – Non-Metallic Materials*.

Supports as well as the adjacent structures and substructures are to be designed such that the permissible stresses according to 7.10.3.1.1 are not exceeded.

For substructures and adjacent structures of supports subjected to horizontal forces P_h , a fatigue strength is to be considered according to the *Rules for the classification of ships, Part 2 – Hull*, Section 16.

7.10.6.2.3 Hatch cover stoppers

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

The greater of the loads resulting from 7.10.2.6.2 and 7.10.6.2.1 is to be applied for the dimensioning of the stoppers and their substructures.

The permissible stress in stoppers and their substructures, in the cover, and of the coamings is to be determined according to 7.10.3.1.1. In addition, the provisions in 7.10.6.2.2 are to be observed.

Specifically for Type-2 ships, the following additional requirements are to be complied with:

Hatch covers are to be effectively secured, by means of stoppers, against the transverse forces arising from a pressure of 175 kN/m².

With the exclusion of No.1 hatch cover, hatch covers are to be effectively secured, by means of stoppers, against the longitudinal forces acting on the forward end arising from a pressure of 175 kN/m².

No. 1 hatch cover is to be effectively secured, by means of stoppers, against the longitudinal forces acting on the forward end arising from a pressure of 230 kN/m².

This pressure may be reduced to 175 kN/m² when a forecastle is fitted in accordance with to the *Rules, Part 2 – Hull*, Section 17.

The equivalent stress:

1. in stoppers and their supporting structures, and,
2. calculated in the throat of the stopper welds is not to exceed the allowable value of 0.8ReH.

7.10.7 Corrosion addition and steel renewal

7.10.7.1 Corrosion addition for hatch covers and hatch coamings

The scantling requirements of the above sections imply the following general corrosion additions t_s :

Table 7.10.7.1Corrosion additions t_s for hatch covers and hatch coamings

Application	Structure	t_s [mm]
Weather deck hatches of container ships, car carriers, paper carriers, passenger vessels	Hatch covers	1,0
	Hatch coamings	according to the <i>Rules, Part 2 - Hull</i>
Weather deck cargo hatches of Type-2 ships	Hatch covers in general	2,0
	Top and bottom plating of double skin hatch covers	2,0
	Internal structure of double skin hatch covers	1,5
	Hatch coamings and coaming stays	1,5
Weather deck hatches of all other ship types covered by these requirements	Hatch covers in general	2,0
	Weather exposed plating and bottom plating of double skin hatch covers	1,5
	Internal structure of double skin hatch covers and closed box girders	1,0
	Hatch coamings not part of the longitudinal hull structure	1,5
	Hatch coamings part of the longitudinal hull structure	according to the <i>Rules, Part 2 - Hull</i>
	Coaming stays and stiffeners	1,5

7.10.7.2 Steel renewal

Steel renewal is required where the gauged thickness is less than $t_{net} + 0,5$ mm for:

- single skin hatch covers,
- the plating of double skin hatch covers, and
- coaming structures the corrosion additions t_s of which are provided in Table. 7.10.7.1.

Where the gauged thickness is within the range $t_{net} + 0,5$ mm and $t_{net} + 1,0$ mm, coating (applied in accordance with the coating manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal. Coating is to be maintained in GOOD condition, as defined in the *Rules, Part 1 – General Requirements, Ch.5*.

For the internal structure of double skin hatch covers, thickness gauging is required when hatch cover top or bottom plating renewal is to be carried out or when this is deemed necessary, at the discretion of the *Register's* surveyor, on the

basis of the plating corrosion or deformation condition. In these cases, steel renewal for the internal structures is required where the gauged thickness is less than t_{net} .

For corrosion addition $t_s = 1,0$ mm the thickness for steel renewal is t_{net} and the thickness for coating or annual gauging is when gauged thickness is between t_{net} and $t_{net} + 0,5$ mm.

For coaming structures, the corrosion additions t_s of which are not provided in Table. 7.10.7.1, steel renewal and coating or annual gauging are to be in accordance with the *Register's* requirements.

7.10.8 Construction of portable hatchway covers specified in 7.10.1.1

7.10.8.1 These covers are to be so constructed as to prevent their accidental opening under the effect of sea and weather.

7.10.8.2 Portable beams are to be placed in sockets of the coamings and locked therein. Where portable beams are of sliding type, efficient devices are to be provided for locking them when the hatchway is either closed or open.

7.10.8.3 If the hatchway covers are jointed on the portable beam, a vertical flat bar of at least 60 mm in height is to be attached by welding to the upper flange of the beam.

7.10.8.4 The width of each bearing surface for hatchway covers is to be at least 65 mm.

7.10.8.5 Where the covers are made of wood, their finished thickness is to be at least 60 mm for a load intensity sustained by the cover equal to 17,16 kPa and less. If the load intensity exceeds this value, the above thickness is to be increased by 1,5 mm per 0,981 kPa of overload. In all cases, the portable beams of the hatchway provided with wooden covers are to be spaced not more than 1,5 m apart.

Independently of the provisions of 7.10.1 to 7.10.8, all covers made of steel are to have the thickness of their plating at least 0,01 times the spacing of stiffeners or 6 mm, whichever is the greater.

If the covers are made of light alloy, the minimum thickness of their top plating is to be specially considered by the *Register* in each case.

7.10.8.6 The hatchways in positions 1 and 2 are to be protected by at least two layers of tarpaulins.

Tarpaulins are to be tightly pressed against the hatchway coamings with the aid of battens and wedges, for which purpose the coamings, as well as horizontal stiffeners, if fitted, are to be provided with cleats of at least 65 mm wide and 10 mm thick; edges of the cleats are to be rounded so that the possibility of cutting the wedges is brought to the minimum. Cleats are to be spaced not more than 600 mm centre to centre; the cleats along each side or end are to be not more than 150 mm from hatch corners. The cleats are to be so mounted as to provide setting of wedges in them in the fore to aft direction on the side coamings, and from the sides to centre line direction on the end coamings.

Wedges are to be not less than 200 mm in length and 50 mm in width with a taper of not more than 1:6, and a thickness not less than 13 mm at the thinnest point.

7.10.8.7 Steel bars or other equivalent means are to be provided in order to efficiently and independently secure each section of hatchway covers after the tarpaulins are battened down. Sections of hatchway covers of more than 1,5 m in length are to be secured by at least two such securing appliances.

7.10.9 Hatch beams and cover stiffeners of variable cross section (ICLL Regulation 15 and 16)

7.10.9.1 To avoid stresses and deflections exceeding those given in the above Regulations along construction elements of variable cross section, the required section modulus calculated as for constriction elements of constant cross section is to be increased by a factor C_1 expressed by:

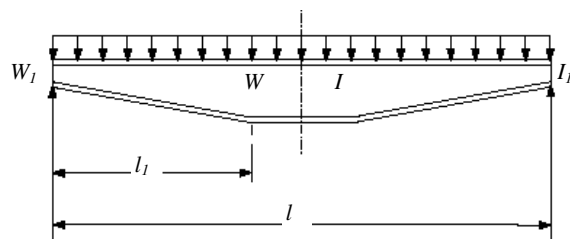


Figure 7.10.9.1

$$C_1 = 1 + \frac{3.2\alpha - \gamma - 0.8}{7\gamma + 0.4};$$

where:

$$\alpha = \frac{l_1}{l}; \gamma = \frac{W_1}{W};$$

The value of factor C_1 obtained by the formula is not to be less than unity.

l_1 , l , W_1 and W are indicated on the Figure 7.10.9.1.

7.10.9.2 The moment of inertia is likewise to be increased by the factor C_2 expressed by:

$$C_2 = 1 + 8\alpha^3 \frac{1 - \beta}{0.2 + 3 \cdot \sqrt{\beta}};$$

The value factor of C obtained by the formula is not to be less than unity.

l_1 and l are indicated on the Figure 7.10.9.1.

The use of the above formulae is limited to the determination of the strength of hatch beams and covers in which abrupt changes in the section of the face material do not occur along the length of the beam or cover.

7.11 HATCHWAYS OF CARGO TANKS IN TYPE "A" SHIPS

7.11.1 Openings for hatchways of the cargo tanks on tankers are to be of round or oval form. Height of the coamings of cargo tank hatchways is not to be regulated by the Register. Construction of the coamings of cargo tank hatchways shall comply with the requirements of the Rules for the classification of ships, Part 2 - Hull, 17.2.8.

7.11.2 Covers of hatches and tank cleaning openings are to be made of steel, bronze or brass. Use of other materials is subject to special consideration by the Register in each case.

In ships carrying flammable liquids in bulk use of light alloys for covers of hatches and tank cleaning openings is not permitted.

7.11.3 Covers of the cargo tank hatchways are to be permanently attached and tight, when secured, under the inner pressure of liquid carried in tanks to a head of at least 2.5 m. Tightness is to be provided by a rubber or other suitable gasket being resistant to the liquids which are carried in the cargo tanks.

7.11.4 The plate of the cargo tank hatchway covers is to be at least 12 mm in thickness if it is of steel. The cover plate is to be reinforced by stiffeners made of flat bars not less than 80 x 12 mm in size, and spaced at every 600 mm of the cover length, or the cover is to be of spherical shape.

7.11.5 The hatchway cover is to be provided with a sighting port having an inner diameter of 150 mm and closed by a cover of similar construction.

7.11.6 Materials and designs of cargo tank hatchway covers in ships intended to carry flammable liquids are to be so selected as to preclude spark formation during opening and closing the covers.

7.12 OPENINGS IN WATERTIGHT SUBDIVISION BULKHEADS AND THEIR CLOSING APPLIANCES

7.12.1 General

7.12.1.1 Unless expressly provided otherwise, the present head covers the ships to which the requirements of the Rules for the classification of ships, Part 5 - Subdivision apply. For other ships the requirements of this chapter apply only to bulkheads provided in accordance with the Rules for the classification of ships, Part 2 - Hull, Section 10. For these ships the requirements may be relaxed, and the degree of relaxation is to be specially considered by the Register in each case.

7.12.2 Openings in watertight bulkheads below the bulkhead deck in passenger ships

7.12.2.1 The number of openings in watertight subdivision bulkheads is to be reduced to the minimum compatible with the design and proper working of the ship, satisfactory means are to be provided for closing these openings.

7.12.2.2 Where pipes, scuppers, electric cables, etc., are carried through watertight bulkheads, arrangements are to be made to ensure the watertight integrity of the bulkheads and the requirements of the Rules for the classification of ships, Part 8 - Piping, 1.6 and the Rules for the classification of ships, Part 12 - Electrical equipment, 16.8 also is to be taken into consideration.

Valves not forming part of a piping system are to not be permitted in watertight bulkheads.

Lead or other heat sensitive materials are to not be used in systems which penetrate watertight bulkheads, where

deterioration of such systems in the event of fire would impair the watertight integrity of the bulkheads.

Any penetration used for the passage of heat-sensitive piping systems through a watertight bulkhead or deck on a passenger ship under provisions of this sub-item, shall be tested with the heat-sensitive piping and shall be type approved for watertight integrity as per paragraphs 4 and 5 of the explanatory notes to regulation II-1/13.2.3 contained in the annex of resolution MSC.429(98)/Rev.2, as applicable, after the fire test.

Provisions of this sub-item shall be applicable to heat-sensitive piping systems and shall not be applied to cable penetrations in watertight bulkheads and decks.

7.12.2.3 No doors, manholes, or access openings are permitted in watertight transverse bulkheads dividing a cargo space from an adjoining cargo space, except as provided in 7.12.2.20 and in the *Rules for the classification of ships, Part 5 – Subdivision, 2.12*.

7.12.2.4 Subject to requirement 7.12.2.22, not more than one door, apart from the doors to shaft tunnels, may be fitted in each watertight bulkhead within spaces containing the main and auxiliary propulsion machinery including boilers serving the needs of propulsion. Where two or more shafts are fitted, the tunnels are to be connected by an intercommunicating passage. There shall be only one door between the machinery space and the tunnel spaces where two shafts are fitted and only two doors where there are more than two shafts. All these doors are to be of the sliding type and are to be so located as to have their sills as high as practicable. The hand gear for operating these doors from above the bulkhead deck is to be situated outside the spaces containing the machinery.

7.12.2.5 Watertight doors, except as provided in 7.12.2.20 or in the *Rules for the classification of ships, Part 5 – Subdivision, 2.12*, are to be power-operated sliding doors complying with the requirements of 7.12.2.9 to 7.12.2.16 capable of being closed simultaneously from the central operating console at the navigation bridge in not more than 60 s with the ship in the upright position.

7.12.2.6 The means of operation whether by power or by hand of any power-operated sliding watertight door are to be capable of closing the door with the ship listed to 15° either way. Consideration is to also be given to the forces which may act on either side of the door as may be experienced when water is flowing through the opening applying a static head equivalent to a water height of at least 1 m above the sill on the centreline of the door.

7.12.2.7 Watertight door controls, including hydraulic piping and electric cables, are to be kept as close as practicable to the bulkhead in which the doors are fitted, in order to minimise the likelihood of them being involved in any damage which the ship may sustain. The positioning of watertight doors and their controls is to be such that if the ship sustains damage within one fifth of the breadth of the ship, such distance being measured at right angles to the centreline at the level of the deepest subdivision draught, the operation of the watertight doors clear of the damaged portion of the ship is not impaired.

7.12.2.8 All power-operated sliding watertight doors are to be provided with means of indication which will show at all remote operating positions whether the doors are open or closed. Remote operating positions are only to be at the navigation bridge as required by paragraph 7.12.2.9.5 and at the

location where hand operation above the bulkhead deck is required by paragraph 7.12.2.9.4.

- 7.12.2.9** Each power-operated sliding watertight door:
- .1 is to have a vertical or horizontal motion;
 - .2 is to, subject to requirement 7.12.2.22, be normally limited to a maximum clear opening width of 1.2 m. The *Register* may permit larger doors only to the extent considered necessary for the effective operation of the ship provided that other safety measures, including the following, are taken into consideration:
 - .1 special consideration is to be given to the strength of the door and its closing appliances in order to prevent leakages; and
 - .2 the door is to be located inboard the damage zone B/5;
 - .3 is to be fitted with the necessary equipment to open and close the door using electric power, hydraulic power, or any other form of power that is acceptable to the *Register*;
 - .4 is to be provided with an individual hand-operated mechanism. It is to be possible to open and close the door by hand at the door itself from either side, and in addition, close the door from an accessible position above the bulkhead deck with an all round crank motion or some other movement providing the same degree of safety acceptable to the *Register*. Direction of rotation or other movement is to be clearly indicated at all operating positions. The time necessary for the complete closure of the door, when operating by hand gear, is not to exceed 90 s with the ship in the upright
 - .5 is to be provided with controls for opening and closing the door by power from both sides of the door and also for closing the door by power from the central operating console at the navigation bridge;
 - .6 is to be provided with an audible alarm, distinct from any other alarm in the area, which will sound whenever the door is closed remotely by power and which shall sound for at least 5 s but no more than 10 s before the door begins to move and shall continue sounding until the door is completely closed. In the case of remote hand operation it is sufficient for the audible alarm to sound only when the door is moving. Additionally, in passenger areas and areas of high ambient noise the *Register* may require the audible alarm to be supplemented by an intermittent visual signal at the door; and
 - .7 is to have an approximately uniform rate of closure under power. The closure time, from the time the door begins to move to the time it reaches the completely closed position shall in no case be less than 20 s or more than 40 s with the ship in the upright position.

7.12.2.10 The electrical power required for power-operated sliding watertight doors is to be supplied from the emergency switchboard either directly or by a dedicated distribution board situated above the bulkhead deck. The associated control, indication and alarm circuits are to be supplied from the emergency switchboard either directly or by a dedicated distribution board situated above the bulkhead deck and be capable of being automatically supplied by the transitional source of emergency electrical power in the event of failure of either the main or emergency source of electrical power.

7.12.2.11 Power-operated sliding watertight doors are to have either:

- .1 a centralised hydraulic system with two independent power sources each consisting of a motor and pump capable of simultaneously closing all doors. In addition, there shall be for the whole installation hydraulic accumulators of sufficient capacity to operate all the doors at least three times, i.e. closed-open-closed, against an adverse list of 15°. This operating cycle is to be capable of being carried out when the accumulator is at the pump cut-in pressure. The fluid used is to be chosen considering the temperatures liable to be encountered by the installation during its service. The power operating system is to be designed to minimise the possibility of having a single failure in the hydraulic piping adversely affect the operation of more than one door. The hydraulic system is to be provided with a low-level alarm for hydraulic fluid reservoirs serving the power-operated system and a low gas pressure alarm or other effective means of monitoring loss of stored energy in hydraulic accumulators. These alarms are to be audible and visual and are to be situated on the central operating console at the navigation bridge; or
- .2 an independent hydraulic system for each door with each power source consisting of a motor and pump capable of opening and closing the door. In addition, there shall be a hydraulic accumulator of sufficient capacity to operate the door at least three times, i.e. closed-open-closed, against an adverse list of 15°. This operating cycle is to be capable of being carried out when the accumulator is at the pump cut-in pressure. The fluid used is to be chosen considering the temperatures liable to be encountered by the installation during its service. A low gas pressure group alarm or other effective means of monitoring loss of stored energy in hydraulic accumulators are to be provided at the central operating console on the navigation bridge. Loss of stored energy indication at each local operating position is also to be provided; or
- .3 an independent electrical system and motor for each door with each power source consisting of a motor capable of opening and closing the door. The power source is to be capable of being automatically supplied by

the transitional source of emergency electrical power in the event of failure of either the main or emergency source of electrical power and with sufficient capacity to operate the door at least three times, i.e. closed-open-closed, against an adverse list of 15°, see also the *Rules, Part 12-Electrical equipment*, 5.10.

For the systems specified in 7.12.2.11.1, 7.12.2.11.2 and 7.12.2.11.3, provision is to be made as follows: Power systems for power-operated watertight sliding doors are to be separate from any other power system. A single failure in the electric or hydraulic power-operated systems excluding the hydraulic actuator is not to prevent the hand operation of any door.

7.12.2.12 Control handles are to be provided at each side of the bulkhead at a minimum height of 1.6 m above the floor and are to be so arranged as to enable persons passing through the doorway to hold both handles in the open position without being able to set the power closing mechanism in operation accidentally. The direction of movement of the handles in opening and closing the door is to be in the direction of door movement and is to be clearly indicated.

7.12.2.13 As far as practicable, electrical equipment and components for watertight doors are to be situated above the bulkhead deck and outside hazardous areas and spaces.

7.12.2.14 The enclosures of electrical components necessarily situated below the bulkhead deck shall provide suitable protection against the ingress of water.*

* Refer to the following IEC publication 529 (1976):

- .1 electrical motors, associated circuits and control components; protected to IPX 7 standard;
- .2 door position indicators and associated circuit components; protected to IPX 8 standard; and
- .3 door movement warning signals; protected to IPX 6 standard.

Other arrangements for the enclosures of electrical components may be fitted provided the Administration is satisfied that an equivalent protection is achieved. The water pressure IPX 8 shall be based on the pressure that may occur at the location of the component during flooding for a period of 36 h.

7.12.2.15 Electric power, control, indication and alarm circuits are to be protected against fault in such a way that a failure in one door circuit will not cause a failure in any other door circuit. Short circuits or other faults in the alarm or indicator circuits of a door are not to result in a loss of power operation of that door. Arrangements are to be such that leakage of water into the electrical equipment located below the bulkhead deck will not cause the door to open.

7.12.2.16 A single electrical failure in the power operating or control system of a power-operated sliding watertight door is not to result in a closed door opening. Availability of the power supply is to be continuously monitored at a point in the electrical circuit as near as practicable to each of the motors required by 7.12.2.11. Loss of any such power supply should activate an audible and visual alarm at the central operating console at the navigation bridge.

7.12.2.17 The central operating console at the navigation bridge is to have a “master mode” switch with two modes of control: a “local control” mode which shall allow any door to be locally opened and locally closed after use without automatic closure, and a “doors closed” mode which shall automatically close any door that is open. The “doors closed” mode shall automatically close any door that is open. The “doors closed” mode shall permit doors to be opened locally and shall automatically re-close the doors upon release of the local control mechanism. The “master mode” switch is normally to be in the “local control” mode. The “doors closed” mode is only to be used in an emergency or for testing purposes. Special consideration is to be given to the reliability of the “master mode” switch.

7.12.2.18 The central operating console at the navigation bridge is to be provided with a diagram showing the location of each door, with visual indicators to show whether each door is open or closed. A red light shall indicate a door is fully open and a green light shall indicate a door is fully closed. When the door is closed remotely the red light shall indicate the intermediate position by flashing. The indicating circuit is to be independent of the control circuit for each door.

7.12.2.19 It is not to be possible to remotely open any door from the central operating console.

7.12.2.20 If the *Register* is satisfied that such doors are essential, watertight doors of satisfactory construction may be fitted in watertight bulkheads dividing cargo between deck spaces. Such doors may be hinged, rolling or sliding doors but are not to be remotely controlled. They are to be fitted at the highest level and as far from the shell plating as practicable, but in no case are to the outboard vertical edges be situated at a distance from the shell plating which is less than one fifth of the breadth of the ship, as defined in regulation 2, such distance being measured at right angles to the centreline at the level of the deepest subdivision draught.

7.12.2.21 Should any such doors be accessible during the voyage, they are to be fitted with a device which prevents unauthorised opening. When it is proposed to fit such doors, the number and arrangements shall receive the special consideration of the *Register*.

7.12.2.22 Portable plates on bulkheads are not to be permitted except in machinery spaces.

The *Register* may permit not more than one power-operated sliding watertight door in each watertight bulkhead larger than those specified in paragraph 7.12.2.9.2 to be substituted for these portable plates, provided these doors are intended to remain closed during navigation except in case of urgent necessity at the discretion of the master. These doors need not meet the requirements of paragraph 7.12.2.9.4 regarding complete closure by hand-operated gear in 90 s.

7.12.2.23 Where trunkways or tunnels for access from crew accommodation to the stokehold, for piping, or for any other purpose are carried through watertight bulkheads, they are to be watertight and in accordance with the requirements of the *Rules, Part 2-Hull*, 11.7. The access to at least one end of each such tunnel or trunkway, if used as a passage at sea, is to be through a trunk extending watertight to a height sufficient to permit access above the bulkhead deck. The access to the other end of the trunkway or tunnel may be through a watertight door of the type required by its location in the ship. Such trunkways or tunnels are not to extend through the first subdivision bulkhead abaft the collision bulkhead.

7.12.2.24 Where it is proposed to fit tunnels piercing watertight bulkheads, these shall receive the special consideration of the *Register*.

7.12.2.25 Where trunkways in connection with refrigerated cargo and ventilation or forced draught trunks are carried through more than one watertight bulkhead, the means of closure at such openings are to be operated by power and be capable of being closed from a central position situated above the bulkhead deck.

7.12.2.26 Doors are to be made of steel. Use of other materials for doors is to be specially considered by the *Register* in each case.

7.12.2.27 Doors shall withstand the pressure of water head of a height measured from the lower edge of the doorway to the underside of the bulkhead deck plating at the centre line, but not less than 5 m of water column.

7.12.2.28 Stresses in the door frame and door plate under the pressure head specified in 7.12.2.27 are not to exceed 0,6 times the upper yield stress of their material.

7.12.2.29 When closed, doors are to be tight under the pressure of water head of the height specified in 7.12.2.27.

7.12.2.30 For doors in watertight bulkheads located in way of the internal watertight subdivision boundaries and the external watertight boundaries necessary to ensure compliance with the relevant subdivision and damage stability regulations *IACS Unified Interpretation SC156/Rev.3, July 2024* is to be applied.

This unified interpretation does not apply to doors located in external boundaries above equilibrium or intermediate waterplanes.

7.12.2.31 For the requirements relating to the accesses that lead to spaces below the bulkhead deck specified in *SOLAS Regulation II-1/17-1, Integrity of the hull and superstructure, damage prevention and control on ro-ro passenger ships*, see also *IACS Unified Interpretation SC220*.

7.12.3 Openings in watertight bulkheads and internal decks in cargo ships

7.12.3.1 The number of openings in watertight subdivisions is to be kept to a minimum compatible with the design and proper working of the ship. Where penetrations of watertight bulkheads and internal decks are necessary for access, piping, ventilation, electrical cables, etc., arrangements are to be made to maintain the watertight integrity. The *Register* may permit relaxation in the watertightness of openings above the freeboard deck, provided that it is demonstrated that any progressive flooding can be easily controlled and that the safety of the ship is not impaired.

7.12.3.2 Doors provided to ensure the watertight integrity of internal openings which are used while at sea are to be sliding watertight doors capable of being remotely closed from the bridge and are also to be operable locally from each side of the bulkhead. Indicators are to be provided at the control position showing whether the doors are open or closed, and an audible alarm is to be provided at the door closure. The power, control and indicators are to be operable in the event of main power failure. Particular attention is to be paid to minimising the effect of control system failure. Each power-operated sliding watertight door is to be provided with an individual hand-operated

mechanism. It is to be possible to open and close the door by hand at the door itself from both sides.

7.12.3.3 Access doors and access hatch covers normally closed at sea, intended to ensure the watertight integrity of internal openings, are to be provided with means of indication locally and on the bridge showing whether these doors or hatch covers are open or closed. A notice is to be affixed to each such door or hatch cover to the effect that it is not to be left open.

7.12.3.4 Watertight doors or ramps of satisfactory construction may be fitted to internally subdivide large cargo spaces, provided that the *Register* is satisfied that such doors or ramps are essential. These doors or ramps may be hinged, rolling or sliding doors or ramps, but are not to be remotely controlled. Should any of the doors or ramps be accessible during the voyage, they are to be fitted with a device which prevents unauthorised opening.

7.12.3.5 Other closing appliances which are kept permanently closed at sea to ensure the watertight integrity of internal openings are to be provided with a notice which is to be affixed to each such closing appliance to the effect that it is to be kept closed. Manholes fitted with closely bolted covers need not be so marked.

7.12.3.6 In all tankers, where there is permanent access from a pipe tunnel to the cargo pump room, a watertight door is to be fitted. A watertight door, in addition to bridge operation, is to be capable of being manually closed from outside the cargo pump-room entrance.

7.12.3.7 For doors in watertight bulkheads located in way of the internal watertight subdivision boundaries and the external watertight boundaries necessary to ensure compliance with the relevant subdivision and damage stability regulations, see [IACS Unified Interpretation SC156/Rev.3, July 2024](#).

7.12.4 Manholes in watertight subdivision bulkheads

7.12.4.1 The requirements of 7.9 relating to the manholes located on the freeboard deck, raised quarter deck or the first tier of superstructures are generally applicable to the manholes fitted in the watertight subdivision bulkheads.

No manholes are permitted:

- .1 in the collision bulkhead below the bulkhead deck for ships having subdivision distinguishing mark in the class notation, and below the freeboard deck for other ships;
- .2 in watertight subdivision bulkheads separating a cargo space from an adjacent cargo space or a fuel oil tank.

7.12.5 Construction and initial tests of watertight doors, sidescuttles, etc.

7.12.5.1 In all ships:

- .1 the design, materials and construction of all watertight doors, sidescuttles, gangway and cargo ports, valves, pipes, ash-chutes and rubbish-chutes referred to in these regulations are to be to the satisfaction of the *Register*;

- .2 such valves, doors and mechanisms are to be suitably marked to ensure that they may be properly used to provide maximum safety; and
- .3 the frames of vertical watertight doors are to have no groove at the bottom in which dirt might lodge and prevent the door closing properly.

7.12.5.2 In passenger ships and cargo ships watertight doors are to be tested by water pressure to a head up to the bulkhead deck or freeboard deck respectively. Where testing of individual doors is not carried out because of possible damage to insulation or outfitting items, testing of individual doors may be replaced by a prototype pressure test of each type and size of door with a test pressure corresponding at least to the head required for the intended location. The prototype test is to be carried out before the door is fitted. The installation method and procedure for fitting the door on board shall correspond to that of the prototype test. When fitted on board, each door is to be checked for proper seating between the bulkhead, the frame and the door.

7.13 STRENGTH AND SECURING OF SMALL HATCHES ON THE EXPOSED FORE DECK

7.13.1 General

7.13.1.1 The strength of, and securing devices for, small hatches fitted on the exposed fore deck are to comply with the requirements of this Section.

7.13.1.2 Small hatches in the context of this Section are hatches designed for access to spaces below the deck and are capable of being closed weather-tight or watertight, as applicable. Their opening is normally 2.5 square meters or less.

7.13.1.3 Hatches designed for use of emergency escape are to comply with the requirements of this Section, excepting 7.13.4.1 (i) and (ii), 7.13.5.3 and 7.13.6.

7.13.1.4 Securing devices of hatches designed for emergency escape are to be of a quick-acting type (e.g., one action wheel handles are provided as central locking devices for latching/unlatching of hatch cover) operable from both sides of the hatch cover.

7.13.2 Application

7.13.2.1 These requirements are applicable to small hatches on the exposed deck over the forward $0.25L$ for:

All ship types of sea going service of length 80 m or more, where the height of the exposed deck in way of the hatch is less than $0.1L$ or 22 m above the summer load waterline, whichever is the lesser.

7.13.2.2 The ship length L is as defined in 1.2.2.1.

7.13.2.3 These requirements do not apply to CSR Bulk Carriers and Oil Tankers.

7.13.2.4 These requirements also do not apply to small hatches on container ship giving access to a cargo hold which comply with UI LL64 except the requirement of clause 4 & 5.

Such hatch covers are considered non-weather-tight regardless of whether it is actually weather-tight or not. However, for scantlings of small hatches, the strength requirements in clause 4 of this requirements could be applied instead of clause 6 of UI LL64.

7.13.3 Strength

7.13.3.1 For small rectangular steel hatch covers, the plate thickness, stiffener arrangement and scantlings are to be in accordance with Table 7.13.3.1, and Figure 7.13.3.1-1. Stiffeners, where fitted, are to be aligned with the metal-to-metal contact points, required in 7.13.5.1, see Figure 7.13.3.1-1. Primary stiffeners are to be continuous. All stiffeners are to be welded to the inner edge stiffener, see Figure 7.13.3.1-2.

7.13.3.2 The upper edge of the hatchway coamings is to be suitably reinforced by a horizontal section, normally not more than 170 to 190 mm from the upper edge of the coamings.

7.13.3.3 For small hatch covers of circular or similar shape, the cover plate thickness and reinforcement is to be according to the requirements of the *Rules*.

7.13.3.4 For small hatch covers constructed of materials other than steel, the required scantlings are to provide equivalent strength.

7.13.4 Primary securing devices

7.13.4.1 Small hatches located on exposed fore deck subject to the application of this Section are to be fitted with primary securing devices such that their hatch covers can be secured in place and weather-tight by means of a mechanism employing any one of the following methods:

- i) Butterfly nuts tightening onto forks (clamps),
- ii) Quick acting cleats, or
- iii) Central locking device.

7.13.4.2 Dogs (twist tightening handles) with wedges are not acceptable.

7.13.5 Requirements for primary securing

7.13.5.1 The hatch cover is to be fitted with a gasket of elastic material. This is to be designed to allow a metal to metal contact at a designed compression and to prevent over compression of the gasket by green sea forces that may cause the securing devices to be loosened or dislodged. The metal-to-metal contacts are to be arranged close to each securing device in accordance with Figure 7.13.3.1-1, and of sufficient capacity to withstand the bearing force.

7.13.5.2 The primary securing method is to be designed and manufactured such that the designed compression pressure is achieved by one person without the need of any tools.

7.13.5.3 For a primary securing method using butterfly nuts, the forks (clamps) are to be of robust design. They are to be designed to minimise the risk of butterfly nuts being dislodged while in use; by means of curving the forks upward, a raised surface on the free end, or a similar method. The plate thickness of unstiffened steel forks is not to be less than 16 mm. An example arrangement is shown in Figure 7.13.3.1-2

7.13.5.4 For small hatch covers located on the exposed deck forward of the fore-most cargo hatch, the hinges are to be fitted such that the predominant direction of green sea will cause the cover to close, which means that the hinges are normally to be located on the fore edge.

7.13.5.5 On small hatches located between the main hatches, for example between Nos. 1 and 2, the hinges are to be placed on the fore edge or outboard edge, whichever is practicable for protection from green water in beam sea and bow quartering conditions.

7.13.6 Secondary securing device

Small hatches on the fore deck are to be fitted with an independent secondary securing device e.g. by means of a sliding bolt, a hasp or a backing bar of slack fit, which is capable of keeping the hatch cover in place, even in the event that the primary securing device became loosened or dislodged. It is to be fitted on the side opposite to the hatch cover hinges.

Table 7.13.3.1 Scantlings for small steel hatch covers on the fore deck

Nominal size [mm x mm]	Cover plate thickness [mm]	Primary stiffeners	Secondary stiffeners
		Flat Bar [mm x mm]; number	
630 x 630	8	-	-
630 x 830	8	100 x 8 ; 1	-
830 x 630	8	100 x 8 ; 1	-
830 x 830	8	100 x 10 ; 1	-
1030 x 1030	8	120 x 12 ; 1	80 x 8 ; 2
1330 x 1330	8	150 x 12 ; 1	100 x 10 ; 2

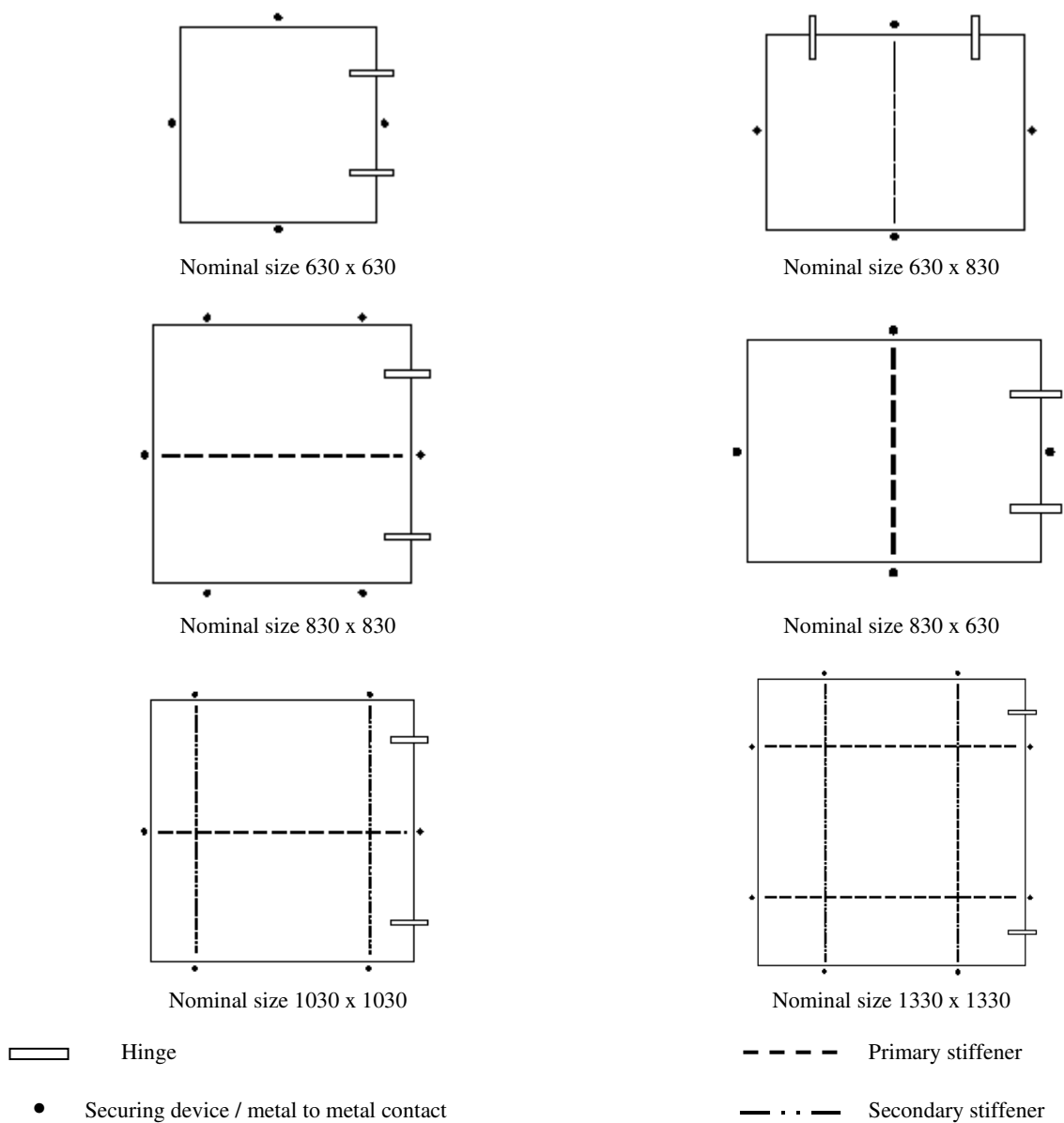
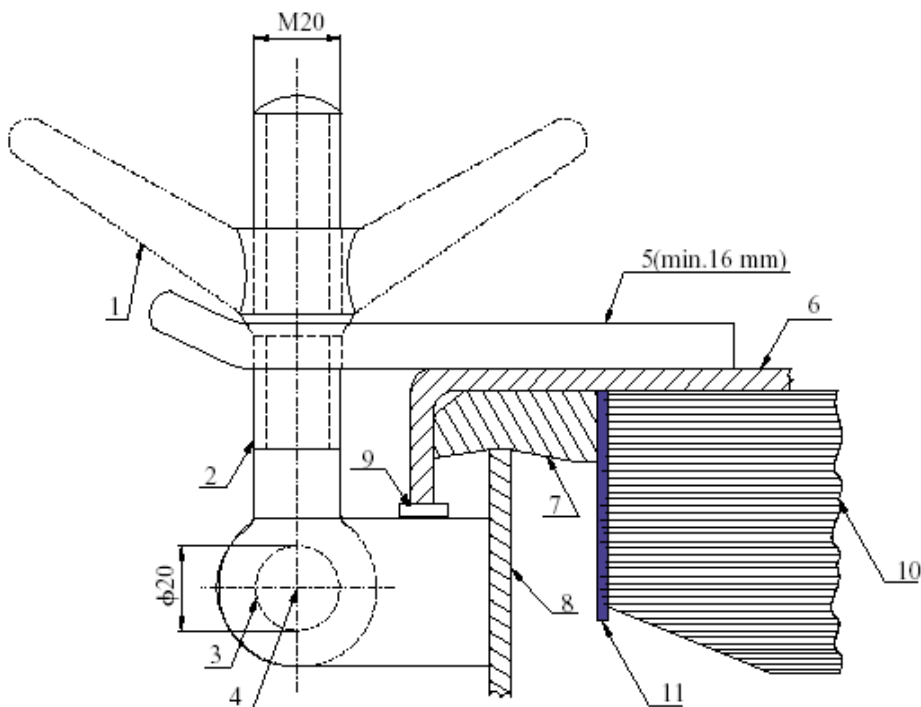


Figure 7.13.3.1-1 Arrangement of stiffeners



(Note: Dimensions in millimetres)

- 1. butterfly nut
- 2. bolt
- 3. pin
- 4. centre of pin
- 5. fork (clamp) plate
- 6. hatch cover
- 7. gasket
- 8. hatch coaming
- 9. bearing pad welded on the bracket of a toggle bolt for metal to metal contact
- 10. stiffener
- 11. inner edge stiffener

Figure 7.13.3.1-2 Example of a primary securing method

7.14 STRENGTH REQUIREMENTS FOR FORE DECK FITTINGS AND EQUIPMENT

7.14.1 General

7.14.1.1 This Section provides strength requirements to resist green sea forces for the following items located within the forward quarter length:

air pipes, ventilator pipes and their closing devices, the securing of windlasses.

7.14.1.2 For windlasses, these requirements are additional to those appertaining to the anchor and chain performance criteria in Section 3.

7.14.1.3 Where mooring winches are integral with the anchor windlass, they are to be considered as part of the windlass.

7.14.2 Application

7.14.2.1 These requirements are applicable to the deck fittings and equipment on the exposed deck over the forward 0.25L for:

All ship types of sea going service of length 80 m or more, where the height of the exposed deck in way of the item is less than 0.1L or 22 m above the summer load waterline, whichever is the lesser.

7.14.2.2 The ship length L is as defined in 1.2.2.1.

7.14.2.3 These requirements do not apply to CSR Oil Tankers. The requirements of this Section concerning windlasses do not apply to CSR Bulk Carriers.

7.14.3 Applied loading

7.14.3.1 Air pipes, ventilator pipes and their closing devices

7.14.3.1.1 The pressures p , in [kN/m²], acting on air pipes, ventilator pipes and their closing devices may be calculated from:

$$p = 0.5 \rho \cdot V^2 C_d C_s C_p$$

where:

- ρ = density of sea water (1.025 t/m³)
- V = velocity of water over the fore deck
= 13.5 m/sec for $d \leq 0.5 d_l$,
= $13.5 \sqrt{2(1 - \frac{d}{d_l})}$, [m/sec], for $0.5 d_l < d < d_l$,
- d = distance from summer load waterline to exposed deck,
- d_l = 0.1L or 22 m whichever is the lesser,
- C_d = shape coefficient
= 0.5 for pipes, 1.3 for air pipe or ventilator heads in general, 0.8 for an air pipe or ventilator head of cylindrical form with its axis in the vertical direction.
- C_s = slamming coefficient (3.2)
- C_p = protection coefficient:
= 0.7, for pipes and ventilator heads located immediately behind a breakwater or forecastle,
= 1.0, elsewhere and immediately behind a bulwark.

7.14.3.1.2 Forces acting in the horizontal direction on the pipe and its closing device may be calculated from 7.14.3.1.1 using the largest projected area of each component.

7.14.3.2 Windlasses

7.14.3.2.1 The following pressures and associated areas are to be applied (see Figure 7.14.3.2.1):

- 200 kN/m² normal to the shaft axis and away from the forward perpendicular, over the projected area in this direction,
- 150 kN/m² parallel to the shaft axis and acting both inboard and outboard separately, over the multiple of f times the projected area in this direction, where f is defined as:

$$f = 1 + B/H, \text{ but not greater than } 2.5$$

where:

- B = width of windlass measured parallel to the shaft axis,
- H = overall height of windlass.

7.14.3.2.2 Forces in the bolts, chocks and stoppers securing the windlass to the deck are to be calculated. The windlass is supported by N bolt groups, each containing one or more bolts, see Figure 7.14.3.2.2.

7.14.3.2.3 The axial force R_i in bolt group (or bolt) i , positive in tension, may be calculated from:

$$R_{xi} = P_x h \cdot x_i A_i / I_x$$

$$R_{yi} = P_y h \cdot y_i A_i / I_y$$

$$\text{and } R_i = R_{xi} + R_{yi} - R_{si}$$

where:

- P_x = force, in [kN], acting normal to the shaft axis
- P_y = force, in [kN], acting parallel to the shaft axis, either inboard or outboard whichever gives the greater force in bolt group i
- h = shaft height above the windlass mounting, in [cm]
- x_i, y_i = x and y coordinates of bolt group i from the centroid of all N bolt groups, positive in the direction opposite to that of the applied force, in [cm]
- A_i = cross sectional area of all bolts in group i , in [cm²]
- I_x = $\Sigma A_i x_i^2$ for N bolt groups
- I_y = $\Sigma A_i y_i^2$ for N bolt groups
- R_s = static reaction at bolt group i , due to weight of windlass.

7.14.3.2.4 Shear forces F_{xi} , F_{yi} applied to the bolt group i , and the resultant combined force F_i may be calculated from:

$$F_{xi} = (P_x - \alpha g M) / N$$

$$F_{yi} = (P_y - \alpha g M) / N$$

and

$$F_i = (F_{xi}^2 + F_{yi}^2)^{0.5}$$

where:

- α = coefficient of friction (0.5)
- M = mass of windlass, in [tonnes]
- g = gravity acceleration (9.81 m/sec²)
- N = number of bolt groups.

7.14.3.2.5 Axial tensile and compressive forces in 7.14.3.2.3 and lateral forces in 7.14.3.2.4 are also to be considered in the design of the supporting structure.

7.14.4 Strength requirements

7.14.4.1 Air pipes, ventilator pipes and their closing devices

7.14.4.1.1 These requirements are additional to the *Rules for the classification of ships, Part 8 – Pipes*, 5.1 and 1.3, see also *IACS Unified Interpretation LL36*.

7.14.4.1.2 Bending moments and stresses in air and ventilator pipes are to be calculated at critical positions: at penetration pieces, at weld or flange connections, at toes of supporting brackets. Bending stresses in the net section are not to exceed 0.8 R_{eH} , where R_{eH} is the specified minimum yield stress or 0.2% proof stress of the steel at room temperature, see the *Rules for the classification of ships, Part 25 – Metallic materials*, 2.5. Irrespective of corrosion protection, a corrosion addition to the net section of 2.0 mm is then to be applied.

7.14.4.1.3 For standard air pipes of 760 mm height closed by heads of not more than the tabulated projected area, pipe thicknesses and bracket heights are specified in Table 7.14.4.1.3. Where brackets are required, three or more radial brackets are to be fitted.

Brackets are to be of gross thickness 8 mm or more, of minimum length 100 mm, and height according to Table 7.14.4.1.3 but need not extend over the joint flange for the head. Bracket toes at the deck are to be suitably supported.

7.14.4.1.4 For other configurations, loads according to 7.14.3.1 are to be applied, and means of support determined in order to comply with the requirements of 7.14.4.1.2. Brackets, where fitted, are to be of suitable thickness and length according to their height. Pipe thickness is not to be taken less than as indicated in the *Rules for the classification of ships, Part 8 – Pipes*, 1.3.

7.14.4.1.5 For standard ventilators of 900 mm height closed by heads of not more than the tabulated projected area, pipe thicknesses and bracket heights are specified in Table 7.14.4.1.5. Brackets, where required are to be as specified in 7.14.4.1.3.

7.14.4.1.6 For ventilators of height greater than 900 mm, brackets or alternative means of support are to be fitted according to the requirements of the *Rules for the classification of ships, Part 2 - Hull*. Pipe thickness is not to be taken less than as indicated in the *Rules for the classification of ships, Part 8 – Pipes*, 1.3.

7.14.4.1.7 All component parts and connections of the air pipe or ventilator are to be capable of withstanding the loads defined in 7.14.3.1.

7.14.4.1.8 Rotating type mushroom ventilator heads are unsuitable for application in the areas defined in 7.14.2.

7.14.4.2 Windlass mounts

7.14.4.2.1 Tensile axial stresses in the individual bolts in each bolt group i are to be calculated. The horizontal forces F_{xi} and F_{yi} are normally to be reacted by shear chocks. Where "fitted" bolts are designed to support these shear forces in one or both directions, the von Mises equivalent stresses in the individual bolts are to be calculated, and compared to the stress under proof load. Where pour-able resins are incorporated in the holding down arrangements, due account is to be taken in the calculations.

The safety factor against bolt proof strength is to be not less than 2.0.

7.14.4.2.2 The strength of above deck framing and hull structure supporting the windlass and its securing bolt loads as defined in 7.14.3.2 is to be according to the requirements of the *Rules for the classification of ships, Part 2 – Hull*, 9.2.

Table 7.14.4.1.3
760 mm air pipe thickness and bracket standards

Nominal pipe diameter [mm]	Minimum fitted gross thickness, the <i>Rules, Part 8 – Pipes</i> , 1.3 [mm]	Maximum projected area of head [cm ²]	Height ⁽¹⁾ of brackets [mm]
40A ⁽³⁾	6.0	-	520
50A ⁽³⁾	6.0	-	520
65A	6.0	-	480
80A	6.3	-	460
100A	7.0	-	380
125A	7.8	-	300
150A	8.5	-	300
175A	8.5	-	300
200A	8.5 ⁽²⁾	1900	300 ⁽²⁾
250A	8.5 ⁽²⁾	2500	300 ⁽²⁾
300A	8.5 ⁽²⁾	3200	300 ⁽²⁾
350A	8.5 ⁽²⁾	3800	300 ⁽²⁾
400A	8.5 ⁽²⁾	4500	300 ⁽²⁾

(1) Brackets (see 7.14.4.1.3) need not extend over the joint flange for the head.

(2) Brackets are required where the as fitted (gross) thickness is less than 10.5 mm, or where the tabulated projected head area is exceeded.

(3) Not permitted for new ships – reference is to be made to the *Rules for the classification of ships, Part 8 – Pipes*, 1.3.

Note: For other air pipe heights, the relevant requirements of section 7.14.4 are to be applied.

Table 7.14.4.1.5
900 mm ventilator pipe thickness and bracket standards

Nominal pipe diameter [mm]	Minimum fitted gross thickness, the <i>Rules, Part 8 – Pipes, 1.3</i> [mm]	Maximum projected area of head [cm ²]	Height of brackets [mm]
80A	6.3	-	460
100A	7.0	-	380
150A	8.5	-	300
200A	8.5	550	-
250A	8.5	880	-
300A	8.5	1200	-
350A	8.5	2000	-
400A	8.5	2700	-
450A	8.5	3300	-
500A	8.5	4000	-

Note: For other ventilator heights, the relevant requirements of section 7.14.4 are to be applied.

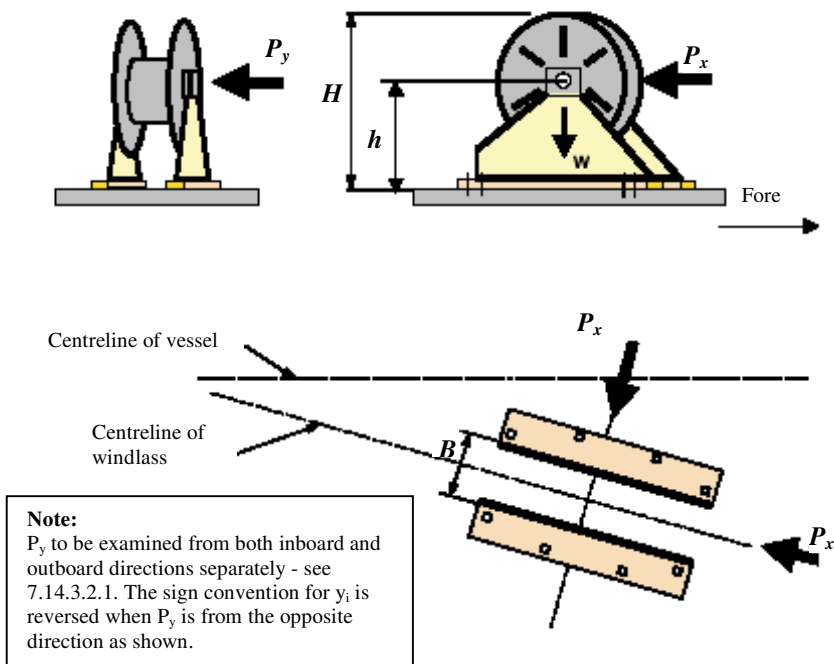


Figure 7.14.3.2.1 Direction of forces and weight

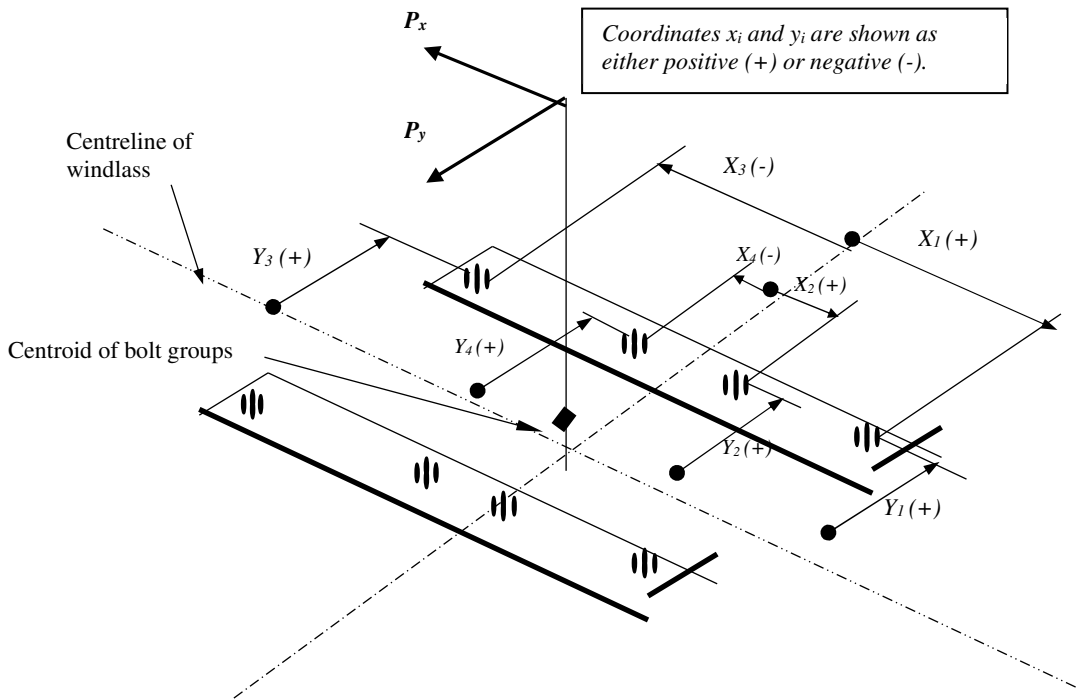


Figure 7.14.3.2.2
 Sign convention

8 ARRANGEMENT AND EQUIPMENT OF SHIP'S SPACES

8.1 GENERAL PROVISIONS

The requirements for the arrangement and equipment of machinery spaces are specified in the *Rules for the classification of ships, Part 7 - Machinery installation*, 1.11 and 1.12, and those relating to refrigerating machinery spaces, refrigerant store rooms as well as refrigerated cargo spaces are set forth in the *Rules for the classification of ships, Part 11 - Refrigerating plant*, Section 3.

8.2 LOCATION OF SPACES

8.2.1 No accommodation spaces are to be arranged forward of the collision bulkhead and abaft of the after peak bulkhead bellow the bulkhead deck.

8.3 EQUIPMENT OF DRY CARGO HOLDS

8.3.1 When in ships not having double bottom wooden lining is placed on top of the floors, it is to be solid and shall extend up to the bilge. The lining is recommended to be made of portable sections of such dimensions and so constructed as to allow of their ready removal at any place.

The thickness of a pine lining is to be:

- at least 40 mm for ships 30 m in length and less;
- at least 60 mm for ships over 30 m in length;
- at least 70 mm under cargo hatchways.

8.3.2 When in ships having double bottom wooden lining is fitted, it is to have a thickness as follows:

- at least 50 mm for ships 60 m in length and less;
- at least 65 mm for ships over 60 m in length.

The application of the lining made from synthetic material is subject to special consideration by the *Register* in each case.

8.3.3 Where cargo is discharged by grabs or other mechanism, the thickness of the wooden lining fitted under cargo hatchways is to be doubled.

8.3.4 In holds intended for carriage of grain and other bulk cargoes the wooden lining on the inner bottom, or, in case the latter is omitted, on the top of floors, is to be fitted so as to prevent wells, bilges and suction pipes of the bilge pumping from clogging.

8.3.5 The wooden lining is not to be laid directly on the inner bottom, but is to be embedded in an approved bituminous or epoxy composition, or placed on battens along the floors providing a clear space of 25-30 mm for drainage.

The wooden lining over the bilges is to be placed so as to be readily removable.

8.3.6 The bulkheads of the deep tanks are to be sheathed by wood from hold side.

8.3.7 In holds intended for the carriage of general cargoes, cargo battens made of wood or metal are to be fitted on the sides.

The thickness of wooden battens is to be as follows:

- at least 25 mm - on ships up to 20 m in length,
- at least 40 mm - on ships up to 70 m inclusive,
- at least 50 mm - on ships over 70 m in length.

The spacing between wooden battens is not to exceed 300 mm. Battens are to be attached to the side frame in such a way as to make for easy removal and replacement. It may not be necessary to provided battens if *Register* approves this on the basis of the type of cargo and ship construction.

8.3.8 All projecting parts of various equipment in the holds (manholes, air pipes sounding pipes, etc.) are to be protected with wooden screens, grids, chutes etc. Requirements for laying of piping in cargo holds are given in the *Rules for the classification of ships, Part 8 - Piping*, 5.5.

8.3.9 Construction of container cellular guides

8.3.9.1 For determining scantlings of substructures for cell guide systems and lashing devices the following design forces are to be used which are assumed to act simultaneously in the centre of gravity of stock.

- ship's transverse direction:
 $Y = 0.5 \cdot g \cdot G$, in [kN];
- ship's vertical direction:
 $Z = (1 + a_v) \cdot g \cdot G$, in [kN];

where:

- G = stack mass, in [t];
- a_v = see the *Rules, Part 2 - Hull*, 3.3.

8.3.9.2 The permissible stresses are to be taken as follows:

- normal: $\sigma = 0.67 R_{eH}$;
- shear: $\tau = 0.45 R_{eH}$;
- equivalent: $\alpha_e = \sqrt{\sigma^2 + 3\tau^2} = 0.77 R_{eH}$

8.3.10 Movable decks, platforms, ramps and other similar structures

8.3.10.1 The present requirements apply to the movable decks, platforms, ramps and other similar structures designed to be installed in two positions:

- in working position when they are used for carriage, loading or unloading of vehicles or other cargoes;
- in non-working position when they are not used for carriage, loading or unloading of vehicles or other cargoes.

8.3.10.2 The movable decks, platforms, ramps and other similar structures and also their supporting elements at ship's sides, decks and bulkheads, the pillars or suspensions for decks and platforms ensuring their proper installation in the working position are to be designed in accordance with the *Rules for the classification of ships, Part 2 - Hull*.

8.3.10.3 Arrangements are to be provided for reliable securing of the movable decks, platform ramps and other similar structures in the non-working position.

8.3.10.4 When the movable decks, platforms, ramps and other similar structures are secured in the non-working position, the hoisting gear and elements thereof are not generally to be kept under the load.

It is not permitted to secure the movable decks, platforms, ramps and other similar structures by suspending them on ropes.

8.3.10.5 The structural elements of the arrangements mentioned in 8.3.10.3 and also the associated supporting structures are to be designed to withstand the forces resulting from the application of the loads P_x, P_y, P_z , as obtained from the formulae given below, to the centres of gravity of the considered section of the deck, platform, ramp or other similar structures:

$$\begin{aligned} P_x &= m \cdot g \cdot a_x, \text{ in [N]}, \\ P_y &= m \cdot g \cdot a_y, \text{ in [N]}, \\ P_z &= m \cdot g \cdot (1 + a_z), \text{ in [N]}, \end{aligned}$$

where:

$$\begin{aligned} P_x &= \text{horizontal load parallel to the centre plane of the ship, n; (consideration is to be given to the cases when the load } P_x \text{ is directed both forward and aft);} \\ P_y &= \text{horizontal load parallel to the midstation plane, in [N], (consideration is to be given to the cases when the load } P_y \text{ is directed both to the nearest ship's side and to the opposite side);} \\ P_z &= \text{vertical load directed downward, in [N];} \\ m &= \text{mass of the considered section, in [kg];} \\ g &= 9.81 \text{ m/s}^2; \\ a_x, a_y, a_z &= \text{dimensionless accelerations, see the Rules, Part 2 - Hull, 3.5.} \end{aligned}$$

8.3.10.6 When determining the forces affecting the structural elements of the arrangements specified in 8.3.10.3 and the associated supporting structures with regard to the provisions of 8.3.10.5, the loads P_x, P_y and P_z are regarded as separately applied i.e. no account is taken of their combined action and of the frictional forces originating on the surfaces of the considered sections of decks, platforms, ramps or other similar structures which are in contact with the associated supporting structures.

8.3.10.7 When the structural elements of the arrangements specified in 8.3.10.3 and the associated supporting structures are under the effect of the loads determined according to the provisions of 8.3.10.5 and 8.3.10.6, the stresses in their parts are not to exceed 0,7 times the upper yield stress of material.

Under the effect of these loads the safety factor of the wire ropes in relation to their actual breaking strength is not to be less than 4; the safety factor of the chain cables in relation to the proof load of the chain is not to be less than 2; the margin of safety against buckling of the elements subjected to the compression stress is not to be less than 2.

8.3.10.8 Wire ropes used in the arrangements specified in 8.3.10.3 shall satisfy the *Rules for the classification of ships, Part 25 - Metallic materials*, 8.

8.4 EXITS, DOORS, CORRIDORS, STAIRWAYS AND VERTICAL LADDERS

8.4.1 General

Location and arrangement of exits, doors, corridors, stairways and vertical ladders shall ensure ready access of persons from spaces to the places of embarkation into lifeboats and liferafts in accordance with the *Rules for the classification of ships, Part 17 - Fire protection*.

8.5 GUARD RAILS, BULWARK AND GANGWAYS

8.5.1 All exposed parts of the freeboard decks, superstructure decks and deckhouse tops are to be provided with efficient guard rails or bulwarks; in case of ships intended for carriage of timber deck cargo collapsible railing or storm rails are to be fitted on this cargo.

8.5.2 The height of the bulwark or guard rails above the deck is not to be less than 1 m. However, where this height would interfere with the normal operation of the ship, a lesser height may be approved provided the adequate protection of passengers and crew is ensured to the satisfaction of the *Register*.

8.5.3 The distance between the stanchions of the guard rails is not to be more than 1,5 m. At least every third stanchion is to be supported by a stay.

Removable and hinged stanchions are to be capable of being locked in the upright position.

8.5.4 Hand rails and guard rails are generally to be of rigid construction. Chains and wire ropes may be accepted in lieu of guard rails by the *Register* in special circumstances. In that case, chains and wire ropes are to be made taut by means of turnbuckles.

8.5.5 The opening below the lowest course of the guard rails is not to exceed 230 mm. The other courses of rails are not to be more than 380 mm apart. An exception is made for the guard rails above the timber deck cargo where the height from the base to the lowest course and other course spacing are not to exceed 330 mm. In the case of ships with rounded gunwale, the guard rails supports are to be placed on the flat of the deck.

8.5.6 Type "A" ships with bulwarks as well as Type "B" ships with a freeboard reduced to that required for Type "A" ships shall have open rails fitted for at least half the length of the exposed parts of the weather deck, or other effective water freeing arrangements. The upper edge of the sheer strake is not to be greater than 150 mm.

Where superstructures are connected by trunks, open rails are to be fitted for the whole length of the exposed parts of the freeboard deck.

8.5.7 The bulwark, if arranged, shall comply with the *Rules for the classification of ships, Part 2 - Hull*, 5.6.

8.5.8 Satisfactory means in the form of life lines, gangways, under deck passages, etc. are to be provided for the protection of the crew in getting to and from their quarters, the

machinery space and all other parts used in the necessary work of the ship.

The type, design and arrangement are to be specially considered by the *Register* in each case depending on the ship's type and freeboard height.

8.5.9 The gangway is to be designed in compliance with the *Rules for the classification of ships, Part 2 - Hull*.

8.6 ACCESS TO THE CARGO AREA OF OIL TANKERS AND BULK CARRIERS

Special measures are to be taken for safe access to and working in spaces in and forward of the cargo area of tankers and bulk carriers for the purpose of maintenance and carrying out surveys.

NOTE: This requirement is considered to be complied with where *SOLAS, Chapter II-1, Reg. 3-6, is adhered to*.

For the application of this requirement see also *IACS Unified Interpretations SC190/Rev.2, Nov.2024 and SC191 Rev.9, Nov.2024*.

Abstract of this Regulation is given in the following Sections.

8.6.1 Means of access and safe access to cargo holds, cargo tanks, ballast tanks and other spaces

8.6.1.1 Means of access to cargo and other spaces

8.6.1.1.1 Each space shall be provided with a permanent means of access to enable, throughout the life of a ship, overall and close-up inspections and thickness measurements of the ship's structures to be carried out by the Administration, the company, as defined in regulation IX/1, and the ship's personnel and others as necessary. Such means of access shall comply with the requirements of paragraph 8.6.3.10 to 8.6.3.12 and with the Technical provisions for means of access for inspections, adopted by the Maritime Safety Committee by resolution *MSC.133(76)*, as may be amended by the Organization, provided that such amendments are adopted, brought into force and take effect in accordance with the provisions of article VIII of the *SOLAS Convention* concerning the amendment procedures applicable to the Annex other than Chapter 1.

Interpretation:

Each space for which close-up inspection is not required such as fuel oil tanks and void spaces forward of cargo area, may be provided with a means of access necessary for overall survey intended to report on the overall conditions of the hull structure.

8.6.1.1.2 Where a permanent means of access may be susceptible to damage during normal cargo loading and unloading operations or where it is impracticable to fit permanent means of access, the Administration may allow, in lieu thereof, the provision of movable or portable means of access, as specified in the Technical provisions, provided that the means of attaching, rigging, suspending or supporting the portable means of access forms a permanent part of the ship's structure.

All portable equipment is to be capable of being readily erected or deployed by ship's personnel.

8.6.1.1.3 The construction and materials of all means of access and their attachment to the ship's structure shall be to the satisfaction of the Administration. The means of access shall be subject to survey prior to, or in conjunction with, its use in carrying out surveys in accordance with regulation I/10.

8.6.1.2 Safe access to cargo holds, cargo tanks, ballast tanks and other spaces

8.6.1.2.1 Safe access to cargo holds, cofferdams, ballast tanks, cargo tanks and other spaces in the cargo area are to be direct from the open deck and such as to ensure their complete inspection. Safe access to double bottom spaces may be from a pump-room, deep cofferdam, pipe tunnel, cargo hold, double hull space or similar compartment not intended for the carriage of oil or hazardous cargoes.

8.6.1.2.2 Tanks, and subdivisions of tanks, having a length of 35 m or more, are to be fitted with at least two access hatchways and ladders, as far apart as practicable. Tanks less than 35 m in length are to be served by at least one access hatchway and ladder.

When a tank is subdivided by one or more swash bulkheads or similar obstructions which do not allow ready means of access to the other parts of the tank, at least two hatchways and ladders are to be fitted.

8.6.1.2.3 Each cargo hold is to be provided with at least two means of access as far apart as practicable.

In general, these accesses are to be arranged diagonally, for example one access near the forward bulkhead on the port side, the other one near the aft bulkhead on the starboard side.

8.6.2 Definitions

8.6.2.1 Rung

Rung means the step of a vertical ladder or step on the vertical surface.

8.6.2.2 Tread

Tread means the step of an inclined ladder or step for the vertical access opening.

8.6.2.3 Flight of an inclined ladder

Flight of an inclined ladder means the actual stringer length of an inclined ladder. For vertical ladders, it is the distance between the platforms.

8.6.2.4 Stringer

Stringer means:

- the frame of a ladder; or
- the stiffened horizontal plating structure fitted on the side shell, transverse bulkheads and/or longitudinal bulkheads in the space.

For the purpose of ballast tanks of less than 5 m width forming double side spaces, the horizontal plating structure is credited as a stringer and a longitudinal permanent means of access, if it provides a continuous passage of 600 mm or

more in width past frames or stiffeners on the side shell or longitudinal bulkhead. Openings in stringer plating utilised as permanent means of access are to be arranged with guard rails or grid covers to provide safe passage on the stringer or safe access to each transverse web.

8.6.2.5 Vertical ladder

Vertical ladder means a ladder of which the inclined angle is 70° and over up to 90°. A vertical ladder is not to be skewed by more than 2°.

8.6.2.6 Overhead obstructions

Overhead obstructions mean the deck or stringer structure including stiffeners above the means of access.

8.6.2.7 Distance below deck head

Distance below deck head means the distance below the plating.

8.6.2.8 Cross deck

Cross deck means the transverse area of the main deck which is located inboard and between hatch coamings.

8.6.3 Technical provisions

8.6.3.1 Structural members subject to the close-up inspections and thickness measurements of the ship's structure, except those in double bottom spaces, are to be provided with a permanent means of access to the extent as specified in Table 8.6.3.1 and Table 8.6.3.2, as applicable. For oil tankers and wing ballast tanks of ore carriers, approved alternative methods may be used in combination with the fitted permanent means of access, provided that the structure allows for its safe and effective use.

8.6.3.2 Permanent means of access should as far as possible be integral to the structure of the ships, thus ensuring that they are robust and at the same time contributing to the overall strength of the structure of the ship.

8.6.3.3 Elevated passageways forming sections of a permanent means of access, where fitted, are to have a minimum clear width of 600 mm, except for going around vertical webs where the minimum clear width may be reduced to 450 mm, and have guard rails over the open side of their entire length. Sloping structures providing part of the access are to be of a non-skid construction. Guard rails are to be 1,000 mm in height and consist of a rail and an intermediate bar 500 mm in height and of substantial construction. Stanchions are to be not more than 3 m apart.

8.6.3.4 Access to permanent means of access and vertical openings from the ship's bottom are to be provided by means of easily accessible passageways, ladders or treads. Treads are to be provided with lateral support for the foot. Where the rungs of ladders are fitted against a vertical surface, the distance from the centre of the rungs to the surface is to be at least 150 mm. Where vertical manholes are fitted higher than 600 mm above the walking level, access is to be facilitated by means of treads and hand grips with platform landings on both sides.

8.6.3.5 Permanent inclined ladders are to be inclined at an angle of less than 70°. There shall be no obstructions within 750 mm of the face of the inclined ladder, except that in way of

an opening this clearance may be reduced to 600 mm. Resting platforms of adequate dimensions are to be provided, normally at a maximum of 6 m vertical height. Ladders and handrails are to be constructed of steel or equivalent material of adequate strength and stiffness and securely attached to the structure by stays. The method of support and length of stay is to be such that vibration is reduced to a practical minimum. In cargo holds, ladders are to be designed and arranged so that cargo handling difficulties are not increased and the risk of damage from cargo handling gear is minimised.

8.6.3.6 The width of inclined ladders between stringers is not to be less than 400 mm. The treads are to be equally spaced at a distance apart, measured vertically, of between 200 mm and 300 mm. When steel is used, the treads are to be formed of two square bars of not less than 22 mm by 22 mm in section, fitted to form a horizontal step with the edges pointing upward.

The treads are to be carried through the side stringers and attached thereto by double continuous welding. All inclined ladders are to be provided with handrails of substantial construction on both sides, fitted at a convenient distance above the treads.

8.6.3.7 For vertical ladders or spiral ladders, the width and construction are to be in accordance with international or national standards accepted by the Administration.

8.6.3.8 No free-standing portable ladder is to be more than 5 m long.

8.6.3.9 Alternative means of access include, but are not limited to, such devices as:

- hydraulic arm fitted with a stable base
- wire lift platform
- staging
- rafting
- robot arm or remotely operated vehicle (ROV)
- rope access
- portable ladders more than 5 m long are only to be utilised if fitted with a mechanical device to secure the upper end of the ladder
- other means of access, approved by and acceptable to the Administration.

Means for safe operation and rigging of such equipment to and from and within the spaces are to be clearly described in the Ship Structure Access Manual.

8.6.3.10 For access through horizontal openings, hatches or manholes, the minimum clear opening is not to be less than 600 mm x 600 mm. When access to a cargo hold is arranged through the cargo hatch, the top of the ladder is to be placed as close as possible to the hatch coaming. Access hatch coamings having a height greater than 900 mm is to also have steps on the outside in conjunction with the ladder.

8.6.3.11 For access through vertical openings, or manholes, in swash bulkheads, floors, girders and web frames providing passage through the length and breadth of the space, the minimum opening is not to be less than 600 mm x 800 mm at a height of not more than 600 mm from the passage unless gratings or other foot holds are provided.

8.6.3.12 For oil tankers of less than 5000 tonnes deadweight, the Administration may approve, in special circumstances, smaller dimensions for the openings referred to in

8.6.3.10 and 8.6.3.11, if the ability to traverse such openings or to remove an injured person can be proved to the satisfaction of the Administration.

8.6.3.13 For bulk carriers, access ladders to cargo holds and other spaces are to be:

8.6.3.13.1 Where the vertical distance between the upper surface of adjacent decks or between deck and the bottom of the cargo space is not more than 6 m, either a vertical ladder or an inclined ladder.

8.6.3.13.2 Where the vertical distance between the upper surface of adjacent decks or between deck and the bottom of the cargo space is more than 6 m, an inclined ladder or series of inclined ladders at one end of the cargo hold, except the uppermost 2,5 m of a cargo space measured clear of overhead obstructions and the lowest 6 m may have vertical ladders, provided that the vertical extent of the inclined ladder or ladders connecting the vertical ladders is not less than 2,5 m.

The second means of access at the other end of the cargo hold may be formed of a series of staggered vertical ladders, which should comprise of one or more ladder linking platforms spaced not more than 6 m apart vertically and displaced to one side of the ladder. Adjacent sections of ladder are to be laterally offset from each other by at least the width of the ladder. The uppermost entrance section of the ladder directly exposed to a cargo hold is to be vertical for a distance of 2,5 m measured clear of overhead obstructions and connected to a ladder-linking platform.

8.6.3.13.3 A vertical ladder may be used as a means of access to topside tanks, where the vertical distance is 6 m or less between the deck and the longitudinal means of access in the tank or the stringer or the bottom of the space immediately below the entrance. The uppermost entrance section from deck of the vertical ladder of the tank is to be vertical for a distance of 2,5 m measured clear of overhead obstructions and comprise a ladder linking platform, unless landing on the longitudinal means of access, the stringer or the bottom within the vertical distance, displaced to one side of a vertical ladder.

8.6.3.13.4 Unless allowed in 8.6.3.13.3 above, an inclined ladder or combination of ladders is to be used for access to a tank or a space where the vertical distance is greater than 6 m between the deck and a stringer immediately below the entrance, between stringers, or between the deck or a stringer and the bottom of the space immediately below the entrance.

8.6.3.13.5 In case of 8.6.3.13.4 above, the uppermost entrance section from deck of the ladder is to be vertical for a distance of 2,5 m clear of overhead obstructions and connected to a landing platform and continued with an inclined ladder.

The flights of inclined ladders are not to be more than 9 m in actual length and the vertical height is not normally to be more than 6 m. The lowermost section of the ladders may be vertical for a distance of not less than 2,5 m.

8.6.3.13.6 In double-side skin spaces of less than 2,5 m width, the access to the space may be by means of vertical ladders that comprise of one or more ladderlinking platforms spaced not more than 6 m apart vertically and displaced to one side of the ladder.

Adjacent sections of ladder are to be laterally offset from each other by at least the width of the ladder.

8.6.3.13.7 A spiral ladder is considered acceptable as an alternative for inclined ladders. In this regard, the uppermost 2,5 m can continue to be comprised of the spiral ladder and need not change over to vertical ladders.

8.6.3.13.8 The uppermost entrance section from deck of the vertical ladder providing access to a tank is to be vertical for a distance of 2,5 m measured clear of overhead obstructions and comprise a ladder linking platform, displaced to one side of a vertical ladder.

The vertical ladder can be between 1,6 m and 3 m below deck structure if it lands on a longitudinal or athwartship permanent means of access fitted within that range.

8.6.4 Ship structure access manual

8.6.4.1 A ship's means of access to carry out overall and close-up inspections and thickness measurements are to be described in a Ship structure access manual approved by the Administration, an updated copy of which is to be kept on board. The Ship structure access manual shall include the following for each space in the cargo area:

- plans showing the means of access to the space, with appropriate technical specifications and dimensions,
- plans showing the means of access within each space to enable an overall inspection to be carried out, with appropriate technical specifications and dimensions. The plans shall indicate from where each area in the space can be inspected.
- plans showing the means of access within the space to enable close-up inspections to be carried out, with appropriate technical specifications and dimensions. The plans shall indicate the positions of critical structural areas, whether the means of access is permanent or portable and from where each area can be inspected.
- instructions for inspecting and maintaining the structural strength of all means of access and means of attachment, taking into account any corrosive atmosphere that may be within the space,
- instructions for safety guidance when rafting is used for close-up inspections and thickness measurements,
- instructions for the rigging and use of any portable means of access in a safe manner,
- an inventory of all portable means of access,
- records of periodical inspections and maintenance of the ship's means of access.

8.6.4.2 For the purpose of these regulations "critical structural areas" are locations which have been identified from calculations to require monitoring or from the service history of similar or sister ships to be sensitive to cracking, buckling, deformation or corrosion which would impair the structural integrity of the ship.

8.6.4.3 For the guidelines when compiling the Ship structure access manual described in Section 8.6.4, see [IACS Rec. 90/Rev.2 Nov.2024](#), and [Rec. 91/Rev.3 Apr 2019](#).

8.6.5 Safe access to tanker bows

8.6.5.1 Every tanker is to be provided with the means to enable the crew to gain safe access to the bow even in severe weather conditions.

8.6.5.2 For the purpose of this regulation, tankers include oil tankers as defined in SOLAS, Chapter II-1, Reg.2, chemical tankers as defined in regulation VII/8.2 and gas carriers as defined in regulation VII/11.2.

8.6.5.3 Such means of access are to be in accordance with the requirements of guidelines for safe access to tanker bow (Res. MSC.62(67)) and are to be approved by the Register. Interpretation of SOLAS II-1/3-3.2, Safe access to tanker bows, for all vessels subject to that regulation, is provided in IACS Unified Interpretations SC138 and LL50.

Table 8.6.3.1 Means of access for ballast and cargo tanks of oil tankers

1. Water ballast tanks except those specified in the right column, and cargo oil tanks	2. Water ballast wing tanks of less than 5 m width forming double side spaces and their bilge hopper sections
Access to the underdeck and vertical structure	
<p>1.1 For tanks of which the height is 6 m and over containing internal structures, permanent means of access are to be provided in accordance with .1 to .6:</p> <ul style="list-style-type: none"> .1 continuous athwartship permanent access arranged at each transverse bulkhead on the stiffened surface, at a minimum of 1.6 m to a maximum of 3 m below the deck head; .2 at least one continuous longitudinal permanent means of access at each side of the tank. One of these accesses is to be at a minimum of 1.6 m to a maximum of 6 m below the deck head and the other is to be at a minimum of 1.6 m to a maximum of 3 m below the deck head; .3 access between the arrangements specified in .1 and .2 and from the main deck to either .1 or .2; .4 continuous longitudinal permanent means of access which are integrated in the structural member on the stiffened surface of a longitudinal bulkhead, in alignment, where possible, with horizontal girders of transverse bulkheads are to be provided for access to the transverse webs unless permanent fittings are installed at the uppermost platform for use of alternative means, as defined in paragraph 8.6.3.9 of the Technical provisions, for inspection at intermediate heights; .5 for ships having cross-ties which are 6 m or more above tank bottom, a transverse permanent means of access on the cross-ties providing inspection of the tie flaring brackets at both sides of the tank, with access from one of the longitudinal permanent means of access in .4; and .6 alternative means as defined in paragraph 8.6.3.9 of the Technical provisions may be provided for small ships as an alternative to .4 for cargo oil tanks of which the height is less than 17 m. 	<p>2.1 For double side spaces above the upper knuckle point of the bilge hopper sections, permanent means of access are to be provided in accordance with .1 to .3:</p> <ul style="list-style-type: none"> .1 the vertical distance between horizontal uppermost stringer and deck head is 6 m or more, one continuous longitudinal permanent means of access is to be provided for the full length of the tank with a means to allow passing through transverse webs installed at a minimum of 1.6 m to a maximum of 3 m below the deck head with a vertical access ladder at each end of the tank; .2 continuous longitudinal permanent means of access, which are integrated in the structure, at a vertical distance not exceeding 6 m apart; and .3 plated stringers are, as far as possible, to be in alignment with horizontal girders of transverse bulkheads.

<p>1. Water ballast tanks except those specified in the right column, and cargo oil tanks</p>	<p>2. Water ballast wing tanks of less than 5 m width forming double side spaces and their bilge hopper sections</p>
<p>1.2 For tanks of which the height is less than 6 m, alternative means as defined in paragraph 8.6.3.9 of the Technical provisions or portable means may be utilised in lieu of the permanent means of access.</p>	<p>2.2 For bilge hopper sections of which the vertical distance from the tank bottom to the upper knuckle point is 6 m and over, one longitudinal permanent means of access is to be provided for the full length of the tank. It is to be accessible by vertical permanent means of access at each end of the tank.</p> <p>2.2.1 The longitudinal continuous permanent means of access may be installed at a minimum 1.6 m to maximum 3 m from the top of the bilge hopper section. In this case, a platform extending the longitudinal continuous permanent means of access in way of the webframe may be used to access the identified structural critical areas.</p> <p>2.2.2 Alternatively, the continuous longitudinal permanent means of access may be installed at a minimum of 1.2 m below the top of the clear opening of the web ring allowing a use of portable means of access to reach identified structural critical areas.</p>
<p>Fore peak tanks</p> <p>1.3 For fore peak tanks with a depth of 6 m or more at the centre line of the collision bulkhead, a suitable means of access are to be provided for access to critical areas such as the underdeck structure, stringers, collision bulkhead and side shell structure.</p> <p>1.3.1 Stringers of less than 6 m in vertical distance from the deck head or a stringer immediately above are considered to provide suitable access in combination with portable means of access.</p> <p>1.3.2 In case the vertical distance between the deck head and stringers, stringers or the lowest stringer and the tank bottom is 6 m or more, alternative means of access as defined in paragraph 3.9 of the Technical provisions are to be provided.</p>	<p>2.3 Where the vertical distance referred to in 2.2 is less than 6 m, alternative means as defined in paragraph 3.9 of the Technical provisions or portable means of access may be utilised in lieu of the permanent means of access. To facilitate the operation of the alternative means of access, in-line openings in horizontal stringers are to be provided.</p> <p>The openings are to be of an adequate diameter and are to have suitable protective railings.</p>

Table 8.6.3.2 Means of access for bulk carriers ¹⁾

1. Cargo holds	2. Ballast tanks
<p>Access to the underdeck structure</p> <p>1.1 Permanent means of access are to be fitted to provide access to the overhead structure at both sides of the cross deck and in the vicinity of the centreline.</p> <p>Each means of access are to be accessible from the cargo hold access or directly from the main deck and installed at a minimum of 1.6 m to a maximum of 3 m below the deck.</p> <p>1.2 An athwartship permanent means of access fitted on the transverse bulkhead at a minimum 1.6 m to a maximum 3 m below the cross-deck head is accepted as equivalent to 1.1.</p> <p>1.3 Access to the permanent means of access to overhead structure of the cross deck may also be via the upper stool.</p> <p>1.4 Ships having transverse bulkheads with full upper stools with access from the main deck which allows monitoring of all framing and plates from inside do not require permanent means of access of the cross deck.</p> <p>1.5 Alternatively, movable means of access may be utilised for access to the overhead structure of the cross deck if its vertical distance is 17 m or less above the tank top.</p>	<p>Top side tanks</p> <p>2.1 For each topside tank of which the height is 6 m and over, one longitudinal continuous permanent means of access are to be provided along the side shell webs and installed at a minimum of 1.6 m to a maximum of 3 m below deck with a vertical access ladder in the vicinity of each access to that tank.</p> <p>2.2 If no access holes are provided through the transverse webs within 600 mm of the tank base and the web frame rings have a web height greater than 1 m in way of side shell and sloping plating, then step rungs/grab rails are to be provided to allow safe access over each transverse web frame ring.</p> <p>2.3 Three permanent means of access, fitted at the end bay and middle bay of each tank, are to be provided spanning from tank base up to the intersection of the sloping plate with the hatch side girder. The existing longitudinal structure, if fitted on the sloping plate in the space may be used as part of this means of access.</p> <p>2.4 For topside tanks of which the height is less than 6 m, alternative means as defined in paragraph 8.6.3.9 of the Technical provisions or portable means may be utilised in lieu of the permanent means of access.</p>
<p>Access to the vertical structure</p> <p>1.6 Permanent means of vertical access are to be provided in all cargo holds and built into the structure to allow for an inspection of a minimum of 25 % of the total number of hold frames port and starboard equally distributed throughout the hold including at each end in way of transverse bulkheads. But in no circumstance shall this arrangement be less than 3 permanent means of vertical access fitted to each side (fore and aft ends of hold and mid-span).</p> <p>Permanent means of vertical access fitted between two adjacent hold frames is counted for an access for the inspection of both hold frames. A means of portable access may be used to gain access over the sloping plating of lower hopper ballast tanks.</p> <p>1.7 In addition, portable or movable means of access are to be utilised for access to the remaining hold frames up to their upper brackets and transverse bulkheads.</p> <p>1.8 Portable or movable means of access may be utilised for access to hold frames up to their upper bracket in place of the permanent means required in 1.6. These means of access are to be carried on board the ship and readily available for use.</p> <p>1.9 The width of vertical ladders for access to hold frames is to be at least 300 mm, measured between stringers.</p>	<p>Bilge hopper tanks</p> <p>2.5 For each bilge hopper tank of which the height is 6 m and over, one longitudinal continuous permanent means of access are to be provided along the side shell webs and installed at a minimum of 1.2 m below the top of the clear opening of the web ring with a vertical access ladder in the vicinity of each access to the tank.</p> <p>2.5.1 An access ladder between the longitudinal continuous permanent means of access and the bottom of the space is to be provided at each end of the tank.</p> <p>2.5.2 Alternatively, the longitudinal continuous permanent means of access can be located through the upper web plating above the clear opening of the web ring, at a minimum of 1.6 m below the deck head, when this arrangement facilitates more suitable inspection of identified structurally critical areas. An enlarged longitudinal frame can be used for the purpose of the walkway.</p> <p>For double-side skin bulk carriers, the longitudinal continuous permanent means of access may be installed within 6 m from the knuckle point of the bilge, if used in combination with alternative methods to gain access to the knuckle point.</p> <p>2.6 If no access holes are provided through the transverse ring webs within 600 mm of the tank base and the web frame rings have a web height greater than 1 m in way of side shell and sloping plating, then step rungs/grab rails are to be provided to allow safe access over each transverse web frame ring.</p>

1. Cargo holds	2. Ballast tanks
<p>1.10 A single vertical ladder over 6 m in length is acceptable for the inspection of the hold side frames in a single skin construction.</p> <p>1.11 For double-side skin construction no vertical ladders for the inspection of the cargo hold surfaces are required. Inspection of this structure is to be provided from within the double hull space.</p>	<p>2.7 For bilge hopper tanks of which the height is less than 6 m, alternative means as defined in paragraph 8.6.3.9 of the Technical provisions or portable means may be utilised in lieu of the permanent means of access. Such means of access are to be demonstrated that they can be deployed and made readily available in the areas where needed.</p> <p>Double-skin side tanks</p> <p>2.8 Permanent means of access are to be provided in accordance with the applicable sections of Table 8.6.3.1.</p>
	<p>Fore peak tanks</p> <p>2.9 For fore peak tanks with a depth of 6 m or more at the centreline of the collision bulkhead, a suitable means of access are to be provided for access to critical areas such as the underdeck structure, stringers, collision bulkhead and side shell structure.</p> <p>2.9.1 Stringers of less than 6 m in vertical distance from the deck head or a stringer immediately above are considered to provide suitable access in combination with portable means of access.</p> <p>2.9.2 In case the vertical distance between the deck head and stringers, stringers or the lowest stringer and the tank bottom is 6 m or more, alternative means of access as defined in paragraph 8.6.3.9 of the Technical provisions are to be provided.</p>
<p>Note: For ore carriers, permanent means of access are to be provided in accordance with the applicable sections of Table 8.6.3.1 and Table 8.6.3.2.</p>	

ANNEX A SPECIAL REQUIREMENTS FOR THE PASSENGER SHIPS IN DOMESTIC SERVICE CLASS "D"

A.1 GENERAL

A.1.1 Requirements of this Section apply to passenger ships in domestic service class "D" operating exclusively in the area of navigation 6 and 7, in the period from April 1 to October 31, and carrying passengers on a daily trips or carrying not more than 36 cabin passengers

A.2 WINDOWS IN THE SIDE SHELL PLATING, EXTERNAL SUPERSTRUCTURE AND FORECASTLE BULKHEADS LEADING TO COMPARTMENTS WHICH ARE INCLUDED IN STABILITY CALCULATIONS

A.2.1 Glass intended for ship's windows shall be safety toughened glass approved by the *Register*.

A.2.2 In order to accept the windows it is necessary the following:

- the drawings of the windows are to be submitted for approval;
- that the arrangement of the window onboard complies with the approved documentation;
- the verification of the windows arrangement in relation to approved documentation is to be carried out;
- after installation onboard the weathertightness testing (hose test) in accordance with the Rules, Part 3 - Hull equipment, 1.2.4.2, in the presence of *Register's* surveyor is to be carried out.

A.2.3 In the drawings of the windows shall be specified: dimensions of clear light openings, glass thicknesses, opening type / non-opening type, frame materials, the method of fastening, sealing arrangements and the type of glass.

A.2.4 As a basis for approval the following to be submitted: an individual *Register's* approval for such or similar windows, appropriate standard or type approval according to which the windows are made or submit documentation with construction details for approval.

A.2.5 The manufacturer shall be approved by the *Register* or by other recognized classification society.

A.2.6 Based on special consideration, the *Register* can accept the oval windows for ships with assigned freeboard greater than the minimum value calculated according to provisions of ICLL 1966, as amended, at the places where the side scuttles are required provided that they comply with the following requirements:

- the lower edge of the opening must be located at least 600 mm above the freeboard deck; and
- thickness of toughened glass shall be at least as required in ISO standard 11336-1 for the glazed opening at the position

under consideration and actual area of the clear light opening.

If such windows are easily accessible from the protected spaces they can be provided with removable weathertight covers (blinking plates) kept in sea lashing inside that watertight compartment or in its immediate vicinity instead of hinged inside deadlights.

A.3 WINDOWS IN THE EXTERNAL WALLS OF THE SUPERSTRUCTURE OR DECKHOUSES NOT LEADING TO COMPARTMENTS WHICH ARE INCLUDED IN STABILITY CALCULATIONS

A.3.1 Glass intended for ship's windows shall be safety toughened glass approved by the *Register*.

A.3.2 For arrangement and thickness of the glass ISO standard 11336-1 may be accepted.

A.3.3 In order to accept the windows it is necessary the following:

- the drawings of the windows are to be submitted for approval;
- that the arrangement of the window onboard complies with the approved documentation;
- the verification of the windows arrangement in relation to approved documentation is to be carried out;
- after installation onboard the weathertightness testing (hose test) in accordance with the requirements in 1.2.4.2, in the presence of *Register's* surveyor is to be carried out. The test pressure required by Section 1.2.4.2 can be reduced to the equivalent of 2 m of water column height at the hose outlet. For the windows on the upper decks outside the bow exposed areas (more than 7 m behind the forward collision bulkhead) test pressure may be further reduced to a minimum ("spraying" around the window frame).

A.3.4 In the drawings of the windows shall be specified: dimensions of clear light openings, glass thicknesses, opening type / non-opening type, frame materials, the method of fastening, sealing arrangements and the type of glass.

A.3.5 As a basis for approval the following to be submitted: an individual *Register's* approval for such or similar windows, appropriate standard or type approval according to which the windows are made or submit documentation with construction details for approval.

A.3.6 The required thicknesses of toughened safety glass panes in standard rectangular windows above weather deck are given in Table A.3.6 as a function of the standard sizes of clear light (final approval thickness may be different from those in the Table A.3.6):

Table A.3.6

Nominal sizes (clear light) of rectangular window, in [mm]	Thickness of toughened glass, in [mm]
300 x 500	6
355 x 500	6
400 x 560	6
450 x 630	6
500 x 710	6
560 x 800	7
900 x 630	8
1000 x 710	8
1100 x 800	9

The *Register* reserves the right to limit the sizes of the windows or to require increased thickness of the glass of windows that are located on the front wall of the superstructure.

A.3.7 The use of other materials (except toughened safety glass) may be approved provided that the required thickness of the toughened glass is increased by 1.3 times for polycarbonate panels, or 1.5 times of acrylic sheets.

The thickness of the laminated glass is not to be less than the value given by following formula:

$$t_e^2 = t_{i1}^2 + t_{i2}^2 + \dots t_{in}^2$$

where:

- t_e = equivalent thickness of the monolithic glass;
- t_i = the thickness of a single plate in the laminate;
- n = the total number of laminated panes.

A.4 SIDESCUTTLES BELOW THE MAIN DECK

A.4.1 The sidescuttles below the main deck shall be made in accordance with the requirements of *Rules for the classification of ships, Part 3 - Hull equipment, 7.2*.

A.4.2 The required thicknesses of toughened safety glass for openings below the weather deck having surfaces not exceeding 0,16m² are given in Table A.4.2 as a function of the standard sizes of clear light (final approval thickness may be different from those in the Table A.4.2):

Table A.4.2

Clear light diameter, in [mm]	Thickness of toughened glass, in [mm]
200	8
250	8
300	10
350	12
400	12
450	15

Acceptance of the openings with surface exceeding 0,16 m² is subject to special consideration and approval of the *Register*.

A.5 EXTERNAL DOORS ON THE MAIN DECK LEADING TO COMPARTMENTS BELOW THE MAIN DECK

A.5.1 External doors on the main deck leading to compartments below the main deck shall be weathertight.

Alternatively, if the doors are not weathertight, the companionways to the ship's spaces located below the main deck can be protected by a weathertight cover behind the door and openable from both sides (e.g. companionway to the machinery space).

A.5.2 In order to accept the doors it is necessary the following:

- the drawings of the doors are to be submitted for approval;
- that the arrangement of the doors onboard complies with the approved documentation;
- after installation on board the weathertightness testing (hose test) in accordance with the *Rules for the classification of ships, Part 3 - Hull equipment, 1.2.4.2*, in the presence of *Register's* surveyor is to be carried out.

A.5.3 In the drawings of the doors shall be specified: dimensions of clear light openings, opening direction, wing and frame materials, the method of fastening, closing and sealing arrangements.

A.5.4 As a basis for approval the following to be submitted: an individual *Register's* approval for such or similar doors, appropriate standard or type approval according to which the doors are made or submit documentation with construction details for approval.

A.5.5 All doors shall be fitted with a self-closing devices. All doors must be fitted with a gasket. Self-closing device can be replaced by a clearly visible inscription "close after passing" on both sides of the door.

A.6 EXTERNAL DOORS ON THE MAIN DECK NOT LEADING TO COMPARTMENTS BELOW THE MAIN DECK AND ARE NOT INCLUDED IN STABILITY CALCULATIONS

A.6.1 In order to accept the doors it is necessary the following:

- the drawings of the doors are to be submitted for approval;
- that the arrangement of the doors onboard complies with the approved documentation;
- the verification of the doors arrangement in relation to approved documentation is to be carried out;
- after installation onboard the weathertightness testing (hose test) in accordance with the requirements in 1.2.4.2, in the presence of *Register's* surveyor is to be carried out. The test pressure required by 1.2.4.2 can be reduced to the equivalent of 2 m of water column height at the hose outlet. For the doors on the upper decks outside the bow exposed areas (more than 7 m behind the forward collision bulkhead) test pressure may be further reduced to a minimum ("spraying" around the door frame).

A.6.2 In the drawings of the doors shall be specified: dimensions of clear light openings, opening direction, wing and frame materials, the method of fastening, closing and sealing arrangements.

A.6.3 As a basis for approval the following to be submitted: an individual *Register's* approval for such or similar doors, appropriate standard or type approval according to which the doors are made or submit documentation with construction details for approval.

A.7 CERTIFICATES OF THE MOORING EQUIPMENT (BOLLARDS, FAIRLEADERS, ETC.)

A.7.1 Bollards, chocks and fairleads shall be at least in accordance with SB standards and made by an approved manufacturer (or shipyard). Upon completion of the works the manufacturer's certificate should be issued.

A.7.2 If this is the case in the drawing "Anchoring and mooring plan" is sufficient to state a reference to the applied SB standard.

A.7.3 If a given design is not according to SB standards, it shall be demonstrated equivalence of the design (by submitting for approval detailed technical documentation for each mooring element, then to build it by approved manufacturers and, finally, to properly test it) to, consequently, be regarded as equivalent to relevant SB standard (for appliance at passenger ships in domestic service, area of navigation 6).

A.8 ACCEPTANCE OF THE ATTESTATION OF THE ANCHORING EQUIPMENT (ANCHORS AND CHAIN CABLES)

A.8.1 In order to accept the anchors and chain cables it is necessary the following:

- the drawings Anchoring arrangement and Calculation of equipment number are to be submitted for approval;
- that the anchoring arrangement onboard complies with the approved documentation;
- the verification of the anchoring arrangement in relation to approved documentation is to be carried out

A.8.2 Anchors and chains shall be of an approved type (they must have *Register's* certificates or certificates of any other recognized classification society issued on behalf of the *Register*).

A.8.3 The length of anchor chain cables shall be in accordance with the calculated equipment number.

A.8.4 The mass of anchors shall be in accordance with the calculated equipment number.

A.8.5 The procedure in case of reattestation of the anchors that do not have the appropriate certificate

A.8.5.1 For all anchors the following tests shall be carried out:

- visual inspection and control of dimensions: dimension values must be within the tolerances specified in the *Rules for the classification of ships, Part 25 - Metallic materials*, 6.3.1;
- non-destructive testing (NDE): fabrication welds, local weld repairs, feeders and risers of castings should be tested by PT or MT method;
- proof load test: all anchors are to be tested by proof load exceeding 33% of that which is stated in this Rules, Table 3.3.5.9-1 for normal anchor equal weight. As example, for the high holding power anchor of 360 kg of the mass proof load is 1.33 x 90.6 kN which amounts to 120.5 kN.

A.8.5.2 If all anchors meet the above tests is necessary to select at least one anchor of each type of anchor for further destructive testing.

Tests of the anchors' parts are set forth in the *Rules for the classification of ships, Part 25 - Metallic materials*, 6.4.2.

Parts of anchors that should be tested are:

- Fluke;
- Shank;
- Trunnion pin;
- Shackle;
- Shackle pin.

A.10.5.3 The above tests are given under the assumption that all parts of the anchor are castings.

A.8.5.4 Before starting the test procedure a detailed plan for the required inspection and testing of anchors based on above shall be submitted to the *Register* for approval.

A.8.6 The procedure in case of re-attestation of the anchor chain cables that do not have the appropriate certificate

A.8.6.1 For all anchor chain cables in according to submitted list the visual inspection and control of dimensions is to be carried out. Dimension values must be within the tolerances specified in the *Rules for the classification of ships, Part 25 - Metallic materials*, 7.2 and 7.3.

It is necessary to determine the diameter of the chain and the composition of the chain, as appropriate:

- how the individual chain lengths are interconnected if the chain cable is not in one piece,
- type and number of joining shackle (kenter) and the end link,
- chain links with anchor shackle,
- type and number of swivels in the chain.

A.8.6.2 After the test with acceptable results it is necessary on the part of the chain length of about 2 m for all diameters chains to perform the following tests:

- tensile test with proof loads (proof and breaking load to be calculated in according to the *Rules for the classification of ships, Part 25 - Metallic materials*, Table 7.4.1.2.),
- the chain cable is to be subjected to a proof load for the category CRS-L2,
- the chain cable is to be subjected to a breaking load for the category CRS-L2,
- testing of mechanical properties (as defined in the *Rules for the classification of ships, Part 25 - Metallic Materials*, 7.4.3),
- chemical analysis.

Tests of individual chain lengths of the chain cable are given in the *Rules for the classification of ships, Part 25 - Metallic Materials*, 7.4.

A.8.6.3 All samples shall be taken and marked in the presence of *Register's* surveyor.

A.8.6.4 For all anchors and anchor chains is necessary to calculate the test loads in accordance with the applicable sections of the Rules.

A.8.6.5 Before starting the test procedure a detailed plan for the required inspection and testing of the anchor cables based on above shall be submitted to the *Register* for approval.

A.9 STRUCTURAL TEST OF CHAIN LOCKERS

A.9.1 If a conventional anchor chain locker is not fitted onboard (separate watertight and drained area in which anchor chain are stowed), then there are no special requirements for its pressing by filling water column in order to determine the structural integrity.

A.9.2 However, since the chain locker always should be dray at the bottom of such space below the chain should be placed grids (may be wooden grid), below which should be the opening for the outflow of water in the bilge, or into a separate chamber where it will be drain by pump.

A.9.3 However, in this case, such a space for the stowage of the chain cable (in front of the forward collision bulkhead or its continuation above the main bulkhead deck) should be tested, depending on the basic categorization of that space. Requirements for the testing of certain types of spaces are explained in detail in the *Rules for the classification of ships, Part 2 - Hull*, Table 11.6.1.

A.10 CHAIN STOPPERS

A.10.1 Instead of testing of the chain stopper an equivalent technical solution can be accepted. For this purpose a complete calculation of the stopper, including solution of the securing of stopper's self-unlocking and other accompanying technical documentation (connection of the stopper with the deck construction and under deck reinforcements in way of the stopper) should be submitted to the *Register* for approval.

After the approval of the technical documentation and stopper is installed on the ship the *Register* has to check the stoppers arrangement in relation to approved documentation and, if required, carry out testing.

A.11 WATERTIGHT DOORS

A.11.1 The doors connecting the engine room and the steering gear compartment shall be watertight unless both compartment are considered as simultaneously flooded in damaged stability calculations and the results of the calculations prove that all requested stability criteria have been met after flooding.

A.11.2 The watertight doors (for example, on the watertight bulkhead between the aft peak and the engine room, for vessels that cannot satisfy the stability criteria in the case of simultaneously flooding of the two aft compartment, mentioned above) shall be certified to a head of water at least to the level of freeboard deck at the position of bulkhead in question.

A.11.3 It is also necessary to obtain and submit to the *Register* a certificate for the fitted door to confirm the watertightness to a head of water at least to the level stated above. Since the doors are mostly standard SB version of the "watertight doors", it is enough to test one example of the corresponding SB type to be approved (can also be the example from a new buildings before it's installation) to the appropriate head of water (up to 3 m) and then reinspect the already fitted doors (tested by the appropriate method of weathertightness after installation) to confirm that those are of the tested standard version.

A.11.4 The watertight doors inside the hull shall additionally be fitted with a device which indicates that the doors are in the open position and provides appropriate signalling on the navigation bridge (for example, red light, with the plate labelled "Open watertight door at R.xx").

ANNEX B APPROVAL AND CERTIFICATION OF CONTAINER SECURING SYSTEMS AND REQUIREMENTS FOR LASHING SOFTWARE

B.1 APPROVAL AND CERTIFICATION OF CONTAINER SECURING SYSTEMS

B.1.1 General

Requirements of this Section apply to all seagoing dedicated container ships which shall comply with these minimum requirements.

It is important for the safety of the ship and the protection of the cargo and personnel that the cargo is secured properly especially accounting for strength of the supporting structures and securing fittings. Hereto, a scope containing the following for approval and/or certification of container securing systems is defined:

- fixed and portable container securing fittings;
- arrangement plan of fixed container securing fittings;
- drawings of container supporting structures (container stanchions, hatch covers, lashing bridges, and cell guides, if any);
- cargo safe access plan;
- container stowage and securing plan;
- lashing software.

NOTE: This Section of the Rules is to be uniformly implemented by the Register on ships contracted for construction on or after 1 July 2025. The “contracted for construction” date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder.

B.1.2 Fixed and Portable Container Securing Fittings

Fixed container securing fittings are used to secure and support containers and are permanently welded to the ship structure.

Portable¹ container securing fittings are used to secure containers and are not categorised as fixed container securing fittings.

Minimum Breaking Load corresponds to the minimum load at which the first crack appears in the tested representative samples.

Minimum Proof Load corresponds to the test load which visible permanent deformation is not allowed.

B.1.2.3 Drawings

Drawings of fixed and portable container securing fittings showing dimensions, materials, design loads, and

manufacturer’s markings are to be submitted to the Register for approval.

B.1.2.4 Prototype Testing

Each fixed and portable container securing fitting type is subject to prototype testing to determine the minimum breaking loads.

The minimum breaking load obtained from prototype testing is to be equal to or exceed the design minimum breaking load.

B.1.2.5 Production Testing

Fixed and portable container securing fittings are subject to production testing prior to delivery or installation.

A number of samples from a batch of the container securing fittings is to be loaded to minimum proof load of the fittings.

The production testing approval documents of delivered container securing fittings are to be kept on board and may be included in the approved Cargo Securing Manual.

B.1.2.6 Arrangement Plan of Fixed Container Securing Fittings

The plan detailing the arrangement of the fixed container securing fittings is to be approved. The arrangement plan is to include the following for all areas where the fittings are installed:

- The type of fixed container securing fittings such as container foundations² and lashing eye plates;
- Unambiguous location of installed fittings such as their location relative to clearly described locations of the ship structures.

B.1.3 Drawings of Container Supporting Structures

The drawings of the structures necessary for conducting container stowage and securing are subject to approval. The drawings are to be detailed enough to allow their model generation for structural analyses.

A plan is to be provided showing all relevant design loads for structural assessment of the container supporting structures and their foundations.

Structures involved in container stowage and securing include:

- hatch covers;
- container stanchions³;
- lashing bridges;
- cell guides.

B.1.4 Cargo Safe Access Plan

The cargo safe access plan is to be examined for its compliance with the requirements prescribed in IMO MSC.1/Circ.1353/Rev.2.

¹ “Portable” and “loose” container securing fittings are used interchangeably in different container securing contexts.

² Container foundations are called twistlock foundations, or base foundations in different container securing contexts. Likewise, “foundation” and “socket” are used interchangeably.

³ Container stanchions are called container stools, or container pedestals in different container securing contexts.

B.1.5 Container Stowage and Securing Plan

If the stowage and securing plan, as referred to in MSC.1/Circ.1353/Rev.2, 4.2.1 and 4.2.2, is required by the flag Administration, the plan is subject to approval in accordance with B.1.5.1 and B.1.5.2.

B.1.5.1 Container Stowage Plan

The container stowage plan is to include at least the following information for each container type the ship is designed for:

- longitudinal and athwartship views of under deck and on deck stowage locations of containers including reefers as appropriate;
- alternative stowage patterns for containers of different dimensions;
- maximum stack masses;
- maximum stack heights with respect to approved sight lines; and
- maximum nominal container capacity.

B.1.5.2 Container Securing Arrangement Plan

The container securing arrangement plan is to contain all information necessary to prepare lashing calculations. The container securing arrangement plan is to include at least the following information:

- summary of ship particulars such as IMO No., length and breadth;
- summary of loading conditions showing relevant input parameters such as draught and GM;
- longitudinal views of under deck and on deck stowage locations of containers as appropriate showing nominal capacity;
- maximum stack masses⁴;
- relevant properties of securing fittings, including permissible loads;
- graphical presentation of container and lashing arrangements in each bay on deck and in holds for sample loading conditions for each container type the ship is allowed to carry;
- stack total mass and the sequence of masses in a stack;
- minimum quantity of fittings required to secure containers for the presented sample loading conditions.

B.2 LASHING SOFTWARE

B.2.1 General

B.2.1.1 Application

Requirements of this Section apply to all seagoing dedicated container ships which shall comply with these minimum requirements, if the ship is equipped with lashing software on board.

B.2.1.2 Definition

Lashing software is an electronic data processing tool for onboard analysis of forces in container stacks

and thereby reflects the parameters of the lashing system as described in the Cargo Securing Manual prepared in accordance with the flag Administration requirements.

An approved lashing software is not a substitute for the approved Cargo Securing Manual. It is considered as a supplement to the approved Cargo Securing Manual.

The lashing software is a ship specific tool, and the results of the calculations are only applicable to the ship for which it has been approved.

B.2.2 Operation Manual

An operation manual is to be provided for the lashing software and be kept on board. The language of the operation manual is to be the same as the language of the approved Cargo Securing Manual. A translation into another language considered appropriate may be required.

The operation manual should contain descriptions and instructions, as appropriate, as per the following list:

- a general description of the lashing software;
- installation;
- function keys;
- menu displays;
- input and output data;
- required minimum hardware to operate the software;
- instruction on testing the lashing software with the test loading condition;
- a list of all terms, definitions, error messages and warnings likely to be encountered by the user; and
- in the case of error messages and warnings, there are to be unambiguous user instructions for subsequent action to be taken in each case.

B.2.3 Functional Requirements

The lashing software is to be capable of calculating forces on containers and container securing equipment for any loading conditions for each container stack.

It is also to be capable of indicating the respective permissible values in order to assist the master in his/her judgement on whether the ship is loaded within the approved limits. The following parameters are to be presented:

- summary of ship particulars such as IMO No., length, and breadth;
- summary of loading conditions showing relevant input parameters such as draught and GM;
- stack and container positions;
- actual stack weights verified against permissible stack weights;
- relevant properties of securing devices, including permissible loads;
- accelerations and other external forces such as wind containers are exposed to;
- listing of all calculated forces on containers and container securing equipment, and evaluation of compliance of the calculated forces with the corresponding allowable values.

The container and lashing arrangements in each bay on deck and in holds are to be shown graphically. The data

⁴ "Mass" and "weight" are used interchangeably in different container securing contexts.

are to be presented on screen and in hard copy printout in a clear and unambiguous manner. A clear warning is to be given on screen and in hard copy printout if any of the allowable forces are exceeded.

In addition to the printout content, each page of the printout is to contain ship's identification, lashing software name and version number, date and time of the printout, and the title of the loading condition. The printout is to be paginated sequentially, and the total number of printout pages are to be shown. Units of measurement are to be clearly identified and used consistently.

Incorrect data input by the users, such as negative draught values, are to be prohibited. An error message is to be prompted on screen and in hard copy printout in a clear and unambiguous manner.

B.2.4 Test Loading Conditions

The lashing software is to be delivered with test loading conditions for selected stacks and bays covering applicable stowage patterns for containers of different dimensions contained in the Cargo Securing Manual.

The test loading conditions and their results are to be permanently stored in the computer where the lashing software is installed and be protected against unintentional or unauthorized modifications and access.

B.2.5 Approval of Lashing Software

The lashing software is subject to approval by the *Register* and is to include:

- verification of type approval, if any;
- verification that the latest ship data has been used;
- verification and approval of the test loading conditions and their results;
- verification if requirements of B4.3 are satisfied;
- checking of proper installation, and verification of the instrument on board in accordance with the approved test loading conditions;
- checking the availability of the operation manual on board.

In case of modifications implying changes in the ship's design or container securing arrangement, the software is to be modified accordingly and re-approved by the *Register*. Any changes in software version related to the container securing calculations are to be reported to and be approved by the *Register*.

Upon installation, the lashing software is to be verified with the approved test loading conditions in the presence of *Register* surveyor. It is to be checked that the operation manual for the lashing software is available on board.

Verification by the *Register* does not absolve the shipowner of responsibility for ensuring that the information supplied into the lashing software is consistent with the current condition of the ship and approved Cargo Securing Manual.

B.2.6 Acceptable Tolerances

The accuracy of the computational results from the lashing software for the particular ship, on which the lashing software will be installed, is to be determined by using reference computation results deemed appropriate by the *Register*.

The tolerance of the accuracy of the results from the lashing software is to be below 1.0% of the allowable values. However, deviations may be accepted subject to review by the *Register* provided that there is a satisfactory explanation for the deviation and that there will be no adverse effects on the safety of the ship.

B.2.7 Annual and Renewal Survey

At each annual and renewal survey, it is to be checked that the operation manual is available on board.

The lashing software is to be checked for accuracy annually by the ship's Master by applying the test loading conditions. If the surveyor of the *Register* is not present for lashing software check, a copy of the test loading condition results obtained by this check is to be retained on board as documentation of satisfactory testing for the surveyor's verification at the next scheduled survey.

At each renewal survey this checking is to be done in the presence of the surveyor of the *Register*.

B.2.8 Other Requirements

The lashing software and its data are to be protected against unintentional or unauthorized modifications and access.