

**RULES**  
**FOR THE CLASSIFICATION OF**  
**SHIPS**

*Part 8 – PIPING*  
**January 2025**

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**CROATIAN REGISTER OF SHIPPING**

Hrvatska (Croatia) • 21000 Split • Marasovića 67 • P.O.B. 187  
Tel.: (...) 385 (0)21 40 81 11  
Fax.: (...) 385 (0)21 35 81 59  
E-mail: [tech.coord@crs.hr](mailto:tech.coord@crs.hr)  
web site: [www.crs.hr](http://www.crs.hr)

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

**RULES FOR THE CLASSIFICATION OF SHIPS**

**Part 8 – PIPING**

have been adopted on 20th December 2024 and shall enter into force on 1st January 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 I - 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, appointees, 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 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 8 – PIPING***

All major changes in respect to the Rules for the classification of ships, Part 8 – Piping, edition January 2021, as last amended by Amendments No. 4, edition July 2024, 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 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 106  
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

**International Association of Classification Societies (IACS)**

- Unified Requirements (UR):** E8 (1996), F2 (1999), F8 (1989), F15 (rev. 7, Sep 2023), F16 (2000), F21 (1974), F22 (1974), F24 (1998), F26 (2000), F33 (1981), F35 (2005), F39 (1999), F41 (1993), F44 (2010), M11 (1972), M24 (rev. 2, Aug 2023), M57 (1993), M61 (rev. 2, Aug 2023), M64 (2004), M65 (2004), M75 (Jan 2021), P1 (2001), P2 (rev. 3, Oct 2023), P2.1 (rev. 3, Oct 2023), P2.2 (rev. 5, Oct 2023), P2.3 (Nov 2001), P2.4 (1974), P2.5 (Nov 2001), P2.6 (1987), P2.7 (rev. 3, Oct 2023), P2.7.3 (rev. 3, Oct 2023), P2.7.4 (rev. 11, Oct 2023), P2.8 (Nov 2001), P2.9 (rev. 3, Oct 2023), P2.10 (Nov 12001), P2.11 (rev. 6, Oct 2023), P2.12 (rev. 3, Feb 2021), P2.13 (rev. 1, Jan 2021), P3 (rev. 5, Apr 2021), P4 (rev. 7, Jun 2022)
- Unified Interpretations (UI):** SC56, SC58, SC99 (2005), SC111 (1995), SC118, SC123 (rev.5, July 2023), SC140 (1998), SC179 (rev. 3, Feb 2021), SC184 (2005), SC 232 (2009), SC 243 (2012), SC251 (2011), SC 255 (Cor.1 2013), MPC87 (Jan 2007), LL10 (2008), LL11 (2008), LL36 (2008), LL49 (2008), LL52 (2008), LL58 (2008)
- Recommendations (Rec.):** Rec. 100 (2008)

Contents

	Page
<b>1 GENERAL.....</b>	<b>1</b>
1.1 APPLICATION .....	1
1.2 SCOPE OF SUPERVISION .....	2
1.3 PIPELINES.....	4
1.4 PIPE VALVES AND FITTINGS .....	17
1.5 OPENINGS AND FITTINGS IN SHELL PLATING .....	18
1.6 PIPES ROUTING.....	21
1.7 APPLICATION OF PLASTIC PIPES ON SHIPS .....	24
1.8 FLOW VELOCITY IN PIPING SYSTEMS .....	32
1.9 MACHINERY, CONTROL AND MONITORING.....	35
1.10 TYPE APPROVAL OF MECHANICAL JOINTS ( <i>IACS UR P2.11</i> ) .....	35
1.11 TESTS OF FLEXIBLE HOSE ASSEMBLIES ( <i>IACS UR P2.12.5</i> ).....	40
<b>2 BILGE SYSTEM .....</b>	<b>41</b>
2.1 PUMPS .....	41
2.2 PIPE DIAMETERS .....	43
2.3 PIPING ARRANGEMENT .....	44
2.4 DRAINAGE OF MACHINERY SPACES .....	45
2.5 DRAINAGE OF TUNNELS .....	46
2.6 DRAINAGE OF CARGO HOLDS .....	46
2.7 DRAINAGE OF REFRIGERATED CARGO SPACES .....	47
2.8 DRAINAGE OF DEEP TANKS .....	47
2.9 DRAINAGE OF COFFERDAMS .....	47
2.10 DRAINAGE OF FORE AND AFTER PEAK.....	47
2.11 DRAINAGE OF OTHER SPACES.....	47
2.12 SPECIFIC REQUIREMENTS FOR DRAINAGE OF FORWARD SPACES IN BULK, ORE AND COMBINATION CARRIERS ("dewatering system") .....	48
<b>3 BALLAST SYSTEM .....</b>	<b>50</b>
3.1 GENERAL.....	50
3.2 PUMPS .....	50
3.3 PIPING ARRANGEMENT .....	50
3.4 REQUIREMENTS ON BALLAST WATER EXCHANGE AT SEA.....	51
3.5 INSTALLATION OF BALLAST WATER MANAGEMENT SYSTEMS .....	52
<b>4 CARGO PIPING SYSTEM OF OIL TANKERS AND OIL COLLECTING SHIPS .....</b>	<b>53</b>
4.1 PUMPS AND THEIR DRIVES.....	53
4.2 PIPING ARRANGEMENT .....	53
4.3 OIL COLLECTING SYSTEM IN OIL COLLECTING SHIPS.....	54
4.4 FORE AND AFT CARGO LOADING AND UNLOADING PIPING SYSTEM IN TANKERS .....	54
4.5 INTEGRATED CARGO AND BALLAST SYSTEMS ON TANKERS .....	55
4.6 PARTICULAR REQUIREMENTS FOR COMBINATION CARRIERS.....	55
<b>5 AIR, GAS VENT, OVERFLOW AND SOUNDING SYSTEMS.....</b>	<b>56</b>
5.1 AIR PIPES.....	56
5.2 CARGO TANK VENTING, PURGING AND GAS-FREEING.....	61
5.3 OVERFLOW PIPES.....	62
5.4 OVERFLOW TANKS.....	62
5.5 SOUNDING ARRANGEMENTS .....	62
<b>6 EXHAUST GAS SYSTEM .....</b>	<b>65</b>
6.1 EXHAUST GAS PIPES .....	65
6.2 SILENCERS AND SPARK ARRESTERS .....	66
6.3 USE OF NON-METALLIC MATERIALS .....	66
6.4 ADDITIONAL REQUIREMENTS FOR EXHAUST GAS TREATMENT SYSTEMS .....	66
<b>7 VENTILATION SYSTEM.....</b>	<b>67</b>
7.1 VENTILATION GENERALLY .....	67
7.2 VENTILATION OF CARGO SHIPS OF 500 TONS GROSS TONNAGE AND UPWARDS, PASSENGER SHIPS CARRYING NOT MORE THAN 36 PASSENGERS AND SPECIAL PURPOSE SHIPS CARRYING NOT MORE THAN 200 PERSONS IN ADDITION TO CREW MEMBERS.....	67
7.3 VENTILATION OF PASSENGER SHIPS CARRYING MORE THAN 36 PASSENGERS AND SPECIAL PURPOSE SHIPS CARRYING MORE THAN 200 PERSONS IN ADDITION TO CREW MEMBERS .....	67

7.4	VENTILATION OF TANKERS AND COMBINATION CARRIERS.....	67
7.5	VENTILATION OF MACHINERY SPACES AND TUNNELS.....	68
7.6	VENTILATION OF SPECIAL CATEGORY SPACES, CARGO SPACES INTENDED FOR CARRIAGE OF MOTOR VEHICLES WITH FUEL IN THEIR TANKS AND CLOSED RO-RO CARGO SPACES .....	69
7.7	VENTILATION OF CARGO SPACES ADAPTED FOR CARRIAGE OF DANGEROUS GOODS .....	69
7.8	VENTILATION OF REFRIGERATED SPACES.....	69
7.9	FIRE-EXTINGUISHING AND SMOTHERING STATIONS .....	69
7.10	VENTILATION OF ACCUMULATOR BATTERY ROOMS AND BOXES.....	69
7.11	VENTILATION OF HANGARS FOR HELICOPTERS.....	70
7.12	VENTILATION OF RADIO ROOM.....	70
7.13	VENTILATION OF OIL COLLECTING SHIPS.....	70
7.14	VENTILATION OF SPACES WITH INERT GAS OR NITROGEN SYSTEM DEVICES.....	70
<b>8</b>	<b>FUEL OIL SYSTEM .....</b>	<b>72</b>
8.1	GENERAL.....	72
8.2	PIPING ARRANGEMENT .....	72
8.3	ARRANGEMENTS FOR HEATING OF FUEL OIL IN TANKS .....	73
8.4	DRAINAGE ARRANGEMENTS OF FUEL OIL TANKS.....	74
8.5	ARRANGEMENTS FOR COLLECTION OF LEAKAGE FUEL.....	74
8.6	FILLING OF FUEL OIL TANKS .....	74
8.7	FUEL OIL TANKS.....	74
8.8	FUEL OIL SUPPLY SYSTEM OF INTERNAL COMBUSTION ENGINES.....	75
8.9	FUEL OIL SYSTEM OF BOILERS.....	76
8.10	FUEL OIL SUPPLY TO GAS TURBINES.....	76
8.11	USAGE OF CRUDE OIL AND CARGO RESIDUES AS FUEL FOR BOILERS .....	76
8.12	FUEL PUMP ARRANGEMENT ON SHIPS OPERATING IN EMISSION CONTROL AREAS .....	78
<b>9</b>	<b>LUBRICATING OIL SYSTEM .....</b>	<b>79</b>
9.1	LUBRICATING OIL PUMPS OF INTERNAL COMBUSTION ENGINES, GEARS AND COUPLINGS .....	79
9.2	LUBRICATING OIL SUPPLY SYSTEM OF INTERNAL COMBUSTION ENGINES AND GEARS.....	79
9.3	LUBRICATING OIL PUMPS OF STEAM TURBINES .....	80
9.4	LUBRICATING OIL SUPPLY SYSTEM OF STEAM TURBINES AND GEARS.....	80
9.5	LUBRICATING OIL TANKS.....	80
9.6	ARRANGEMENTS FOR COLLECTION OF LEAKAGE OIL .....	81
9.7	LUBRICATING OIL SYSTEM OF GAS TURBINE.....	81
<b>10</b>	<b>COOLING WATER SYSTEM.....</b>	<b>82</b>
10.1	PUMPS .....	82
10.2	PIPING ARRANGEMENT .....	83
10.3	COOLING WATER FILTERS .....	83
10.4	COOLING OF INTERNAL COMBUSTION ENGINES .....	83
10.5	COOLING OF GAS TURBINE SYSTEMS.....	83
10.6	COOLER INSTALLATIONS EXTERNAL TO THE HULL .....	83
<b>11</b>	<b>COMPRESSED AIR SYSTEM .....</b>	<b>85</b>
11.1	NUMBER AND CAPACITY OF STARTING AIR RECEIVERS .....	85
11.2	COMPRESSORS .....	86
11.3	PIPING ARRANGEMENT .....	86
<b>12</b>	<b>FEED WATER SYSTEM .....</b>	<b>87</b>
12.1	PUMPS .....	87
12.2	PIPING ARRANGEMENT .....	87
12.3	TANKS .....	87
<b>13</b>	<b>STEAM AND CONDENSATE SYSTEMS.....</b>	<b>88</b>
13.1	APPLICATION.....	88
13.2	AVAILABILITY .....	88
13.3	STEAM LINES AND ARRANGEMENTS.....	88
13.4	STEAM LINES IN OIL TANKERS CARGO AREA .....	88
13.5	BLOW-OFF ARRANGEMENTS OF STEAM LINES .....	89
13.6	TURBINE STEAM LINE CONNECTIONS .....	89
13.7	CALCULATION OF THERMAL EXPANSION OF STEAM PIPES .....	89
13.8	CONDENSATE SYSTEMS .....	90
<b>14</b>	<b>HYDRAULIC SYSTEMS .....</b>	<b>92</b>
14.1	APPLICATION.....	92
14.2	BASIC DESIGN REQUIREMENTS.....	92

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14.3	GENERAL.....	92
14.4	PUMPS AND ACCESSORIES .....	92
14.5	HYDRAULIC TANKS AND OTHER COMPONENTS .....	93
14.6	CONTROL AND MONITORING .....	93
<b>15</b>	<b>SYSTEMS WITH THERMAL FLUIDS BASED ON MINERAL OILS .....</b>	<b>94</b>
15.1	PUMPS .....	94
15.2	EXPANSION TANKS .....	94
15.3	OIL STORAGE TANKS .....	94
15.4	LAYOUT OF PIPES .....	94
15.5	VENT PIPES .....	94
15.6	ARRANGEMENTS FOR COLLECTION OF THERMAL OIL LEAKAGE AND ITS DISCHARGE.....	94
15.7	COOLING OF THERMAL OIL.....	94
15.8	BOILERS FOR HEATING OF THERMAL OILS.....	94
15.9	INSULATION .....	94
15.10	HEATING OF LIQUID CARGO .....	94
15.11	TESTS OF PIPING IN THERMAL OIL SYSTEMS.....	94
<b>16</b>	<b>SCUPPERS, INLETS AND DISCHARGES .....</b>	<b>95</b>
16.1	GENERAL.....	95
16.2	SCUPPERS AND DISCHARGES .....	95
16.3	SCUPPER AND DISCHARGE PIPES .....	95
<b>17</b>	<b>HYDROSTATIC TESTS .....</b>	<b>98</b>
17.1	GENERAL.....	98
17.2	HYDROSTATIC TESTS OF PIPING.....	98
17.3	HYDROSTATIC TESTS OF VALVES AND FITTINGS.....	98

# 1 GENERAL

## 1.1 APPLICATION

**1.1.1** Unless otherwise specified, the requirements of subject Part of the Rules for the classification of ships (hereafter called: the Rules) of the *CROATIAN REGISTER OF SHIP-PING* (hereinafter referred to as: the *Register*) apply to the piping systems as follows:

- .1 General requirements in Section 1 and 17 shall apply to piping systems made of carbon, carbon-manganese, alloy steels or non-ferrous material normally installed on board ships for services considered in Table 1.2.2, as applicable.  
These requirements cover the following services: air, vapour, gas (excluding that mentioned in 1.1.1.4), water, lubricating oil, fuel oil, hydraulic fluid systems, thermal fluid systems, toxic gas and liquids, cargo oil and tank cleaning piping and open-ended lines such as drains, overflows, vents and boiler escape pipes. They do not include pipes forming integral part of boiler.
- .2 Specific requirements for particular piping systems are given in Sections 2 to 16.

The requirements of this Part of the Rules do not apply to the following piping systems:

- .3 Chemical cargo piping systems of ships subject to the IBC Code and shipboard hydrocarbon/chemical process piping systems.
- .4 Gas cargo/fuel and process piping systems of ships, subject to the IGC Code and gas fuel piping systems of ships subject to the IGF Code.
- .5 Piping systems for other low flashpoint fuels defined in SOLAS II-1/2.29.

The requirements for the systems that were not mentioned in this Part are set out in the relevant Parts of the Rules.

**1.1.2** Unless otherwise specified, the documents listed in Table 1.1.2 are to be submitted as applicable.

**1.1.3** Machinery and other elements of piping systems stated in 1.1.1 shall ensure their reliable operation under environmental conditions according to requirements stated in *Rules for the classification of ships, Part 7 - Machinery Installation*, 1.6.

**1.1.4** Definitions and explanations relating to general terminology of the Rules are given in the *Rules are given in Part 1 - General Requirements, Chapter 1 – General information*.

Unless otherwise specified, following definitions and explanations shall apply to this Part of the Rules:

- .1 Piping and piping systems
  - *Piping* includes pipes and their connections, flexible hoses and expansion joints, valves and their actuating

systems, other accessories (filters, level gauges, etc.) and pump casings.

- *Piping systems* include piping and all the interfacing equipment such as tanks, pressure vessels, heat exchangers, pumps and centrifugal purifiers, but do not include boilers, turbines, internal combustion engines and reduction gears.

- .2 *Design pressure* of a piping system is the pressure considered by the manufacturer to determine the scantling of the system components. It is not to be taken less than the maximum working pressure expected in this system or the highest setting pressure of any safety valve or relief device, whichever is the greater.
  - For power piping for hydraulic steering gears, the *design pressure* is not to be less than 1,25 times the maximum working pressure, or the highest setting pressure of any safety valve or relief device, whichever is the greater.
  - For a boiler feed system, the *design pressure* is not to be less than 1,25 times the design pressure of the boiler or the maximum pressure expected in the feed piping, whichever is the greater.
  - For steam piping located upstream of pressure reducing valves (high pressure side), the *design pressure* is not to be less than the setting pressure of the boiler or superheater safety valves.
  - For piping system located on the low pressure side of a pressure reducing valve where no safety valve is provided, the *design pressure* is not to be less than the maximum pressure on the high pressure side of the pressure reducing valve.
  - For piping system located on the delivery side of a pump or a compressor, the *design pressure* is not to be less than the setting pressure of the safety valve for displacement pumps or the maximum pressure resulting from the operating (head-capacity) curve for centrifugal pumps, whichever is the greater.
- .3 *Design temperature* of a piping system is the maximum temperature of the medium inside the system.
- .4 *Flammable oils* include fuel oils, lubricating oils, thermal oils and hydraulic oils.

Other definitions and explanations for the purpose of this Part of the Rules, have been adopted as listed in the *Rules for the classification of ships, Part 7 – Machinery Installation, Part 9 – Machines, Part 10 – Boilers, Heat Exchangers and Pressure Vessels, Part 11 – Refrigerating Plant* and other referent Rules.

## 1.2 SCOPE OF SUPERVISION

**1.2.1** General provisions relating to the classification procedure, supervision during construction and testing as well as requirements for technical documentation to be submitted to the *Register* for consideration and approval are set forth in the *Rules for the classification of ships, Part 1 - General requirements, Chapter 2 – Survey during construction and initial survey*.

**1.2.2** For purpose of testing, selection of joint types and heat treatment, depending on intended service and working media characteristics, piping systems are subdivided into classes (see Figure 1.2.2 and Table 1.2.2).

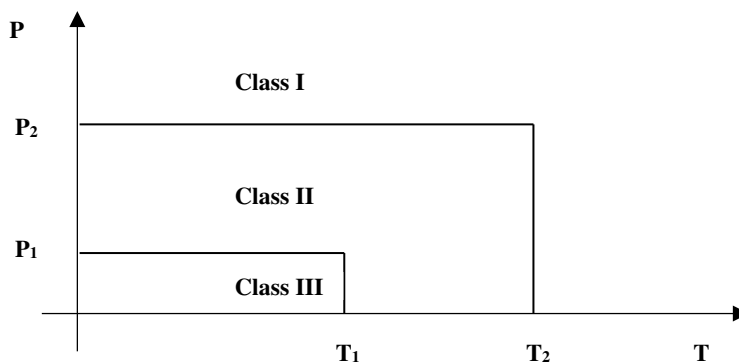
**1.2.3** Pipes, valves and fittings of Class I and Class II, as well as the valves and fittings on the collision bulkhead, on ship's sides and bottom, and remote controlled valves are subject to supervision by the *Register* in the course of manufacture.

Table 1.1.2

No.	I/A (1)	Document (2)
1.	I	Technical description of piping systems
2.	A	„Standard practice“ document comprising drawings and/or selected standards for particular details applied in piping systems generally (such as pipe penetrations, duct penetrations, pipe connections, pipe supports, shell side distant pieces and fittings, scuppers, suction bell mouths, sounding pipes arrangement, ventilation openings, valve controls extension, etc.)
3.	A	Drawings showing the arrangement of sea chests, ship side valves and fittings
4.	A	Drawings for cargo related piping systems, such as liquid cargo (oil, toxic media), tanks cleaning and washing, tanks venting and purging, inert gas systems
5.	A	Refrigerating system diagrams (refrigerant - Freon, ammonia, brine)
6.	A	Engine room ventilation system diagram and preliminary calculation
7.	I	Sanitary and drinking water supply system diagram, including preliminary calculation of minimal capacity for holding tank, as required in the <i>Rules for technical supervision of sea-going ships, Part 20 - Pollution prevention, 4.1</i>
8.	A	Sanitary discharges and sewage treatment plant diagram, including preliminary calculation of minimal capacity for holding tank and treatment plant, as required in the <i>Rules for technical supervision of sea-going ships, Part 22 - Pollution prevention, 5</i>
9.	A	Fuel oil system diagram, presenting the arrangements for the filling, storage, conditioning, purification, service and drainage of fuel on board
10.	A	Drawing of the fuel oil tanks not forming part of the ship's structure, if any
11.	A	Lubricating oil system diagram, presenting the arrangements for the filling, storage, purification, service and drainage of lub. oil on board
12.	A	Cooling system diagrams (sea water, fresh water, oil)
13.	A	Compressed air system diagram, including: - starting air calculation as per Rule requirements - procedure and preliminary calculation showing how the propulsion may be restored within 30 min after "dead ship conditions" (see the <i>Rules for the classification of ships, Part 7 - Machinery Installations, 1.4.7</i> )
14.	A	Exhaust gas system diagram, including justification for applied compensation of thermal expansion (preliminary calculation)
15.	A	Steam system diagram, including the arrangement of safety valves exhaust and drain pipes For high temperature steam pipes, a stress calculation and drawing for actual piping arrangement presentation in three dimensions shall be submitted
16.	A	Boiler feed water and condensate system diagram
17.	A	Hydraulic system diagram (intended for essential services or located in machinery spaces)
18.	A	Thermal oil system diagram
19.	A	Ballast system diagram
20.	A	Bilge and sludge systems diagram, including calculation for the bilge main, bilge branch lines and bilge pumps capacity as per Rule requirements
21.	A	System diagram for the drainage of fire-fighting water from closed vehicle and ro-ro spaces and special category spaces (as per IMO MSC.1/Circ.1320)
22.	A	Arrangement of drains and scuppers from weather decks
23.	A	Drip trays arrangement and gutterway draining system diagram

Table 1.1.2 - continued

24.	A	Fixed fire extinguishing system diagram (based on water, gas, foam, dry powder), as required by the Rules Part 17
25.	A	Air, sounding and overflow systems diagram
26.	A	Drawings for hydraulic and pneumatic remote control systems
27.	A	Diagram of the remote level gauging system
28.	A	Oxyacetylene welding system diagram (as required by <i>the Rules for the classification of ships, Part 17 – Fire protection, 2.1.12</i> )
29.	A	Drawings and specification for valves and accessories if not designed in accordance with recognised standards
<p>(1) A = to be submitted for approval I = to be submitted for information</p> <p>(2) As far as applicable, the diagrams are to include relevant indication/information about the (local and remote) control, monitoring and automation systems.</p>		



(P = design pressure; T = design temperature)

Figure 1.2.2

Table 1.2.2

Piping system for	Class I $P > \text{ or } T >$	Class II (7)	Class III $P \leq \text{ and } T \leq$
Toxic or corrosive media	Without special safeguards	With special safeguards 1.2	Not applicable
Flammable media heated above flash point or with flash point below 60°C	Without special safeguards	With special safeguards 1	Not applicable
Steam	1,6 300	Any pressure-temperature combination not belonging to Class I or III	0,7 170
Thermal Oil	1,6 300		0,7 150
Fuel Oil Lubricating Oil Flammable Hydraulic Oil	1,6 150		0,7 60
Other Media 5.6	4,0 300		1,6 200

Table 1.2.2 - continued

<p><b>Notes:</b></p> <ol style="list-style-type: none"> <li>1) Safeguards for reducing leakage possibility and limiting its consequences: e.g. pipes led in positions where leakage of internal fluids will not cause a potential hazard or damage to surrounding areas which may include the use of pipe ducts, shielding, screening etc.</li> <li>2) Class II pipes are not to be used for toxic media.</li> <li>3) Cargo oil pipes belong to Class III.</li> <li>4) <math>P</math> = Design pressure [MPa]; <math>T</math> = Design temperature [°C]. (see 1.3.4.1).</li> <li>5) Including water, air, gases, non-flammable hydraulic oil, Urea for SCR systems*</li> <li>6) Open ended pipes (drains, overflows, vents, exhaust gas lines, boiler escape pipes) irrespective of the temperature, belong to Class III pipes.</li> <li>7) Valves and fittings on the ship side, collision bulkheads and flammable oil tanks boundary exposed to static pressure belong to Class II.</li> </ol> <p>* When piping materials selected according to ISO 18611-3:2014 for Urea in SCR systems.</p>
---

## 1.3 PIPELINES

### 1.3.1 Materials, manufacture and application

**1.3.1.1** Materials used for manufacture of pipes, valves and fittings shall comply with the requirements of the *Rules for the classification of ships, Part 25 – Metallic Materials*.

Materials for pipes, valves and fittings intended for aggressive corrosive media, will be considered by the *Register* in each particular case.

**1.3.1.2** Steel pipes for piping systems of Classes I and II shall be seamless pipes, or pipes fabricated with a welding procedure, considered by the *Register* to be equivalent to seamless pipes. In general, pipes, valves and fittings of carbon steel and carbon manganese steel shall be used for temperatures not exceeding 400 °C, and these of low-alloy steel for temperatures not exceeding 500 °C.

These steels may be admitted for temperatures higher than the above mentioned, if their mechanical properties and the average stress to produce rupture (i.e. tensile strength after 100,000 hours at the design temperature) comply with the effective standards and are guaranteed by the steel maker as suitable for high temperature service.

Pipes, valves and fittings for media with temperature above 500 °C shall be manufactured of alloy steel. Exhaust gas pipes are excluded from this requirement.

**1.3.1.3** Copper and copper alloy pipes shall be seamless or fabricated by other procedure approved by the *Register*.

Copper pipes for Classes I and II shall be seamless.

Copper and copper alloy pipes, valves and fittings, in general, shall not be used for temperatures exceeding 200°C, and copper-nickel alloy piping for temperatures exceeding 300°C (see Table 1.3.4.1-3). Bronze valves and fittings shall not be used for temperatures exceeding 260°C.

The material CuZn39Pb2 or CuZn39Pb3 (Ms 58) may be accepted for valves and fittings body only in dry or reduced aggressive marine atmosphere (protected areas).

If the valves and fittings may be exposed to aggressive marine atmosphere or used in seawater piping systems, these alloys shall have also 0.5 to 1% Sn, becoming that way a MARINEMESSJNG (DIN 17660) or NAVALBRA8S (CZ112 as per BS2875).

The protective coating must be resistant to mechanical damage under normal operating conditions of the valves and fittings.

Instead of alloying with Sn, it is the internal and external surfaces of the valves and fittings body may be protect by nickel or any other equivalent method of protection against damage under normal operating conditions of the valves and fittings.

Resistance of the protective coating to mechanical damage should be checked during the type-testing of the valves and fittings.

**1.3.1.4** Nodular graphite cast iron may be accepted for bilge, ballast and cargo oil pipes, valves and fittings.

The use of these pipes, valves and fittings on other places as well as for other services in general in Classes II and III, will be separately considered by the *Register*.

Nodular graphite cast iron valves and fittings shall not be accepted for media with temperatures exceeding 350 °C.

Valves and fittings at fuel oil and lubricating oil tanks, collision bulkheads, ship side, bottom and generally on the shell plating below the bulkhead decks, excluding the boiler blow-down valves and related pieces for related connection to the shell plating, may be manufactured of nodular graphite cast iron having a specified minimum elongation not less than 12 % on a gauge length of  $5,65.S^{0,5}$ , where S is the actual cross-sectional area of the test piece.

For the manufacturing, testing and certification of nodular graphite cast iron see the *Rules, Part 25 – Metallic Materials*, 3.13.

**1.3.1.5** Grey cast iron valves and fittings may be accepted for cargo oil lines within cargo tanks of tankers.

Grey cast iron valves and fittings may be also used for open deck cargo lines with pressure below 1,6 MPa except for the valves and fittings of cargo piping for connection to the cargo loading and discharge hoses.

Grey cast iron pipes, valves and fittings for other service of Class III shall be separately considered by the *Register*.

Grey cast iron shall not be used for:

- .1 piping handling media having temperature above 220 °C;
- .2 piping subject to water hammer, excessive strains and vibrations;

- .3 piping installed directly on outside plating;
- .4 piping installed on ship's hull shell plating and collision bulkhead;
- .5 piping installed directly on lubricating and fuel oil tanks exposed to hydrostatic pressure.

**1.3.1.6** Lead pipes shall not be fitted in positions where they may cause the risk of flooding, if damaged.

**1.3.1.7** Plastic pipes may be admitted in shipboard piping systems. The use will be considered in relation to the intended service, the location, the operating conditions, and properties of the material, in accordance with requirements listed in 1.7.

Documentation with important details shall be submitted for approval. For Class I, Class II and any Class III in essential services (for which there are Rule requirements), the pipes, valves and their associated fittings shall be approved by the *Register*.

**1.3.1.8** Type and design of flexible joints used within the systems specified in 1.1.1 shall be approved for the service conditions and the intended application. In general, they are to comply with the requirements specified in 1.3.8.

**1.3.1.9** Plugs and threaded parts of sounding pipes on open decks shall be of bronze or brass. Use of other materials shall be separately considered by the *Register* in each particular case.

**1.3.1.10** Self-closing fittings of sounding pipes of double-bottom fuel tanks shall be corrosion resistant and so designed as to exclude spark formation.

### 1.3.2 Radii of pipe bends

**1.3.2.1** Inner radius of bend of steel and copper pipes subjected to a pressure exceeding 0,5 MPa or temperatures above 60°C, as well as bending radius of pipes with allowance for thermal expansion shall be at least 2,5 d (d = pipe outside diameter). If, in process of bending, no thinning of the pipe wall is observed, the specified radius may be reduced.

**1.3.2.2** Radius of bend of pipes operating under conditions other than those specified above may be reduced up to 1,5 d, provided machine bending is applied.

**1.3.2.3** Inner radius of bend of boiler blow off pipes shall be at least 3,5 d (d = pipe inside diameter).

**1.3.2.4** Radius of bend in 1.3.2.1, 1.3.2.2 and 1.3.2.3 means the inner, i.e. the least radius of pipe curvature after bending.

### 1.3.3 Heat treatment of pipes after bending

**1.3.3.1** Steel pipes, in general, shall be subjected to bending at the temperature of 850-1000°C with possibility of temperature reduction in the course of bending process to 750°C.

Pipes subjected to bending at the temperatures defined as above shall be treated as follows:

- .1 pipes of carbon steels, carbon-manganese and carbon-molybdenite steels need not to be heat treated.

- .2 pipes of chromium-molybdenite steel (1 Cr - 0,5 Mo) with wall thickness over 3 [mm] shall be heat treated at the temperatures of 620 - 680°C.
- .3 pipes of chromium - molybdenite steel (2,25 Cr - Mo) and chromium-molybdenite-vanadium steel (0,5 Cr - 0,5 Mo - 0,25 V) of each thickness shall be heat treated at temperatures of 650 - 720°C, except pipes with wall thickness not over 8 [mm], diameter not over 100 [mm] and minimum working temperature of 450°C which need not to be heat treated.

**1.3.3.2** If the pipes are subjected to bending at the temperatures other than those defined in 1.3.3.1, the pipes shall be heat treated prior to bending in accordance with the Table 1.3.3.2.

**Table 1.3.3.2**

Steel	Heat treatment and temperature (°C)
Carbon and carbon-manganese	Normalizing, 880 - 940
Carbon-molybdenite, (0,3 Mo)	Normalizing, 900 - 940
Chromium-molybdenite, (1 Cr-0,5 Mo)	Normalizing, 900 - 960
Chromium-molybdenite, (2,25 Cr-1 Mo)	Normalizing, 900 - 960 Tempering, 650 - 780
Chromium-molybdenite-vanadium, (0,5 Cr - 0,5 Mo - 0,25 V)	Normalizing, 930 - 980 Tempering, 670 - 720

**1.3.3.3** After cold bending, pipes with radius of bend 4 d and less shall be subjected as a rule, to heat treatment in accordance with Table 1.3.3.2.

However, pipes of carbon-molybdenite (0,3 Mo) having wall thickness over 5 mm at temperatures of 580 - 640°C, chromium - molybdenite (1 Cr - 0,5 Mo) with wall thickness of 8 [mm] at temperatures of 620 - 680°C shall be always subjected to heat treatment with tempering. Pipes of chromium - molybdenite (2,25 Cr - 1 Mo) and chromium-molybdenite-vanadium (0,5 Cr - 0,5 Mo - 0,25 V) with wall thickness over 8 [mm] and diameter over 100 [mm] at working temperature over 450°C shall be subjected to heat treatment with tempering at the temperatures of 650 - 720°C.

**1.3.3.4** Preheating prior to welding and heat treatment after welding shall be performed in accordance with requirements of the *Rules for the classification of ships, Part 26 - Welding*, 2.2 and 3.3.

### 1.3.4 Pipe wall thickness

**1.3.4.1** Wall thickness of metal pipes exposed to internal pressure shall not be less than determined by the formula (see also 1.3.4.3):

$$s = s_o + b + c \quad [\text{mm}], \quad (1.3.4.1-1)$$

where: 
$$s_o = \frac{d \cdot p}{2 \cdot \sigma_d \cdot \varphi + p} \quad [\text{mm}],$$

d – outside diameter, [mm];

p – design pressure, [MPa] (i.e., maximum working pressure and it is not to be less than the highest set pressure of any safety valve or relief valve).

For pipes containing fuel oil heated above 60°C, the design pressure is to be taken in accordance with table 1.3.4.1-4. In special cases, other than those specified by these Rules, the design pressure shall be submitted to special consideration and decision by the *Register*.

$\varphi$  – weld strength coefficient;  $\varphi = 1$  for seamless pipes and for approved welded pipes, which are considered equal to seamless pipes, if the quality of the welded seam is equal to the quality of basic material.

For all other welded pipes, value of strength coefficient shall be specially considered by the *Register*.

$b$  – allowance for bending, [mm];

Value of this allowance shall be determined in such a way that stresses in the bend due to the internal pressure do not exceed permissible stresses.

Where a precise value of thickness reduction at bending is not available, the allowance may be determined by formula:

$$b = \frac{1}{2.5} \cdot \frac{d}{R} \cdot s_o \quad [\text{mm}], \quad (1.3.4.1-2)$$

where:

$R$  – radius of pipe bend, [mm];

$c$  – corrosion allowance, [mm], to be taken:  
- for carbon steel pipes, in Table 1.3.4.1-1;  
- for non-ferrous metal pipes, in Table 1.3.4.1-2.

**Table 1.3.4.1-1**

Corrosion allowance  $c$ , for carbon steel pipes

Working medium	$c$ [mm]
1	2
Superheated steam	0.3
Saturated steam	0.8
Heating coils for water, fuel oil and cargo oil tanks	2.0
Feed water in opened circuit systems	1.5
Feed water in closed circuit systems	0.5
Blowing off the boilers	1.5
Compressed air	1.0
Hydraulic oil	0.3
Lubricating oil	0.3
Fuel oil	1.0
Cargo oil	2.0
Refrigerating media	0.3
Fresh water	0.8
Sea water	3.0

**Notes:**  
1. For pipes passing through tanks an additional corrosion allowance is to be considered according to the figures given in the Table, and depending on the external medium, in order to account for the external corrosion.

**Table 1.3.4.1-1 - continued**

Corrosion allowance  $c$ , for carbon steel pipes

- |  |
|--|
| 2. The corrosion allowance may be reduced where pipes and any integral pipe joints are protected against corrosion by means of coating, lining, etc. |
| 3. In the case of use of special alloy steel with sufficient corrosion resistance, the corrosion allowance may be reduced to zero.                   |

**Table 1.3.4.1-2**

Corrosion allowance  $c$ , for non-ferrous metal pipes

Pipe material	$c$ [mm]
1	2
Copper, brass, aluminium brass, copper-tin and similar alloys, except alloys containing lead	0.8
Copper-nickel alloys (with nickel content $\geq 10\%$ )	0.5

**Note:**  
When pipes made of special alloys with sufficient corrosion resistance are used, the corrosion allowance  $c$  can be reduced to zero.

$\sigma_d$  – permissible stress, [N/mm<sup>2</sup>].

For carbon and alloy steel pipes  $\sigma_d$  shall be taken equal to minimum of the following values:

$$\frac{R_m}{2.7}, \frac{R_{e\ell/t}}{1.8}, \frac{R_m/100000}{1.8}, \frac{R_{p\ell/t100000}}{1.0},$$

where:

$R_m$  – tensile strength, [N/mm<sup>2</sup>];

$R_{e\ell/t}$  – lower yield stress or yield stress at 0.2% elongation at design temperature, [N/mm<sup>2</sup>];

$R_{m/t100000}$  – average stress to produce rupture in 100,000 hours at design temperature, [N/mm<sup>2</sup>];

$R_{p\ell/t100000}$  – average stress to produce creep of 1% in 100,000 hours of work at design temperature, [N/mm<sup>2</sup>].

A reduction of strength limit values shall be specially considered by the *Register*.

Design temperature,  $t$ , to which permissible stresses are determined, is the maximum temperature of media inside the pipe. In special cases, the design temperature shall be specially considered by the *Register*.

Use of permissible stresses in respect to  $R_{p\ell/t100000}$  is not mandatory.

Permissible stresses for pipes of high-alloy steels shall be separately considered by the *Register*.

For copper and copper alloy pipes, the permissible stress  $\sigma_d$  shall be determined in accordance with Table 1.3.4.1-3.

In the case of pipes with negative manufacturing thickness tolerance, wall thickness,  $s_1$ , shall be determined by formula:

$$s_1 = \frac{s}{1 - \frac{a}{100}} \quad [\text{mm}] \quad (1.3.4.1-3)$$

where:

$s$  – wall thickness calculated by formula (1.3.4.1-1)

$a$  – negative tolerance of pipe thickness, per cent.

**Table 1.3.4.1-3**

Permissible stress limits for copper and copper alloys pipes,  $\sigma_a$  [N/mm<sup>2</sup>]

Pipe material	Heat treatment	Min. tensile strength [N/mm <sup>2</sup> ]	Medium design temperature, [°C]										
			50	75	100	125	150	175	200	225	250	275	300
Copper	annealed	215	41	41	40	40	34	27,5	18,5	–	–	–	–
Aluminium brass	“	325	78	78	78	78	78	51	24,5	–	–	–	–
Copper-nickel alloy 95/5 and 95/10	“	275	68	68	67	65,5	64	62	59	56	52	48	44
Copper-nickel alloy 70/30	“	365	81	79	77	73	73	71	69	67	65,5	64	62

**Notes:**  
1. Intermediate values shall be determined by linear interpolation.  
2. For materials which are not included in the Table permissible stresses shall be separately considered by the Register.

**Table 1.3.4.1-4**

Definition of the design pressure for fuel oil systems

Working pressure \ Working temperature	T ≤ 60°C	T > 60°C
P ≤ 0,7 MPa	0,3 MPa or max. working pressure, whichever is the greater	0,3 MPa or max. working pressure, whichever is the greater
P > 0,7 MPa	max. working pressure	1,4 MPa or max. working pressure, whichever is the greater

**1.3.4.2** Steam pipes with an outside diameter of 80 mm and over conveying superheated steam at a temperature of 350°C and over shall be calculated for stresses caused by thermal expansions, and their flanged joints, for strength and tightness.

Calculation of stresses in steam piping caused by thermal expansion should comply with the requirements of 13.6.

**1.3.4.3** The wall thickness of steel, copper and copper alloy pipes shall not, in any case, be taken less than indicated in Table 1.3.4.3.

**1.3.5 Protection of piping against excessive pressure**

**1.3.5.1** Pipes in which pressure may be developed in excess of the design pressure shall be fitted with arrangements which prevent the pressure rising above design pressure.

Open escape of fuel oil and lubricating oil from safety valves is not permitted.

**1.3.5.2** Where provision is made for a reducing valve on the pipeline, a pressure gauge and a safety valve shall be installed on the lower pressure side. An arrangement for by-passing reducing valve is allowed.

**Table 1.3.4.3**

Minimum permissible wall thickness pipes, (mm)

Pipes											
Nominal size	Outside diameter	Steel							Austenitic stainless steel	Copper	Copper alloys
		A	B	C	D	E	F				
1	2	3	4	5	6	7	8	9	10	11	
	8,0	1,0	–	–	–	–	–	–	–	–	
	8,0	1,2	–	–	–	–	–	–	1,0	0,8	
6	10,2	1,6	–	–	–	–	–	1,0	1,0	0,8	
	12,0	1,6	–	–	–	–	–	1,0	1,2	1,0	
8	13,5	1,8	–	–	–	–	–	1,0	1,2	1,0	
	16,0	1,8	–	–	–	–	–	1,0	1,2	1,0	
10	17,2	1,8	–	–	–	–	–	1,0	1,2	1,0	
	19,3	1,8	–	–	–	–	–	1,0	1,2	1,0	
	20,0	2,0	–	–	–	–	–	1,0	1,2	1,0	
15	21,3	2,0	–	3,2	–	3,2	2,6	1,6	1,2	1,0	
	25,0	2,0	–	3,2	–	3,2	2,6	1,6	1,5	1,2	

**Table 1.3.4.3 - continued**  
Minimum permissible wall thickness of pipes, (mm)

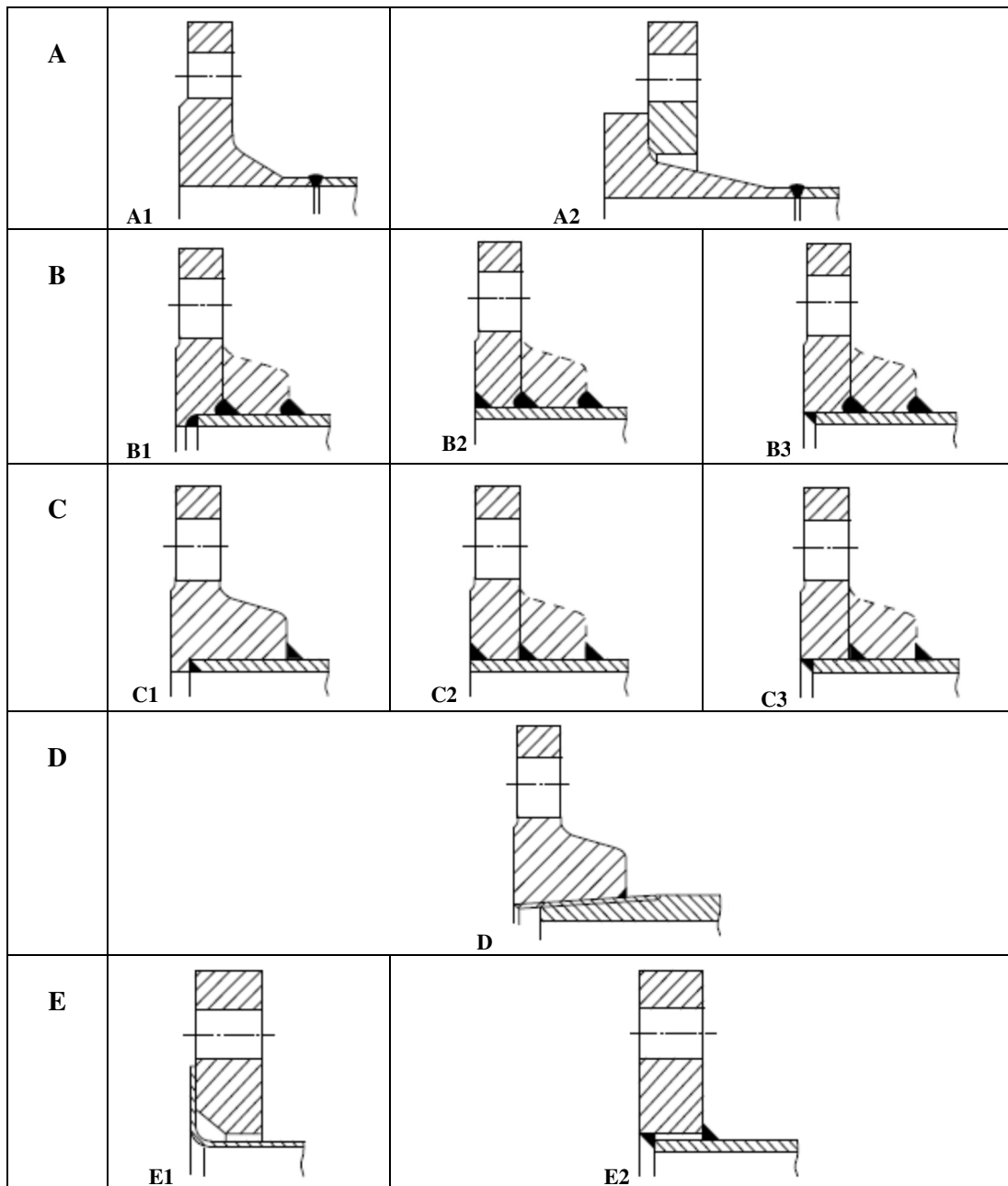
Pipes											
Nominal size	Outside diameter	Steel							Austenitic stainless steel	Copper	Copper alloys
		A	B	C	D	E	F				
1	2	3	4	5	6	7	8	9	10	11	
20	26,9	2,0	–	3,2	–	3,2	2,6	1,6	1,5	1,2	
	30,0	2,0	–	3,2	–	4,0	3,2	1,6	1,5	1,2	
25	33,7	2,0	–	3,2	–	4,0	3,2	1,6	1,5	1,2	
	38,0	2,0	4,5	3,6	6,3	4,0	3,2	1,6	1,5	1,2	
32	42,4	2,0	4,5	3,6	6,3	4,0	3,2	1,6	1,5	1,2	
	44,5	2,0	4,5	3,6	6,3	4,0	3,2	1,6	1,5	1,2	
40	48,3	2,3	4,5	3,6	6,3	4,0	3,2	1,6	2,0	1,5	
	51,0	2,3	4,5	4,0	6,3	4,5	3,6	1,6	2,0	1,5	
	54,0	2,3	4,5	4,0	6,3	4,5	3,6	1,6	2,0	1,5	
	57,0	2,3	4,5	4,0	6,3	4,5	3,6	1,6	2,0	1,5	
50	60,3	2,3	4,5	4,0	6,3	4,5	3,6	2,0	2,0	1,5	
	63,5	2,3	4,5	4,0	6,3	5,0	3,6	2,0	2,0	1,5	
	70,0	2,6	4,5	4,0	6,3	5,0	3,6	2,0	2,0	1,5	
65	76,1	2,6	4,5	4,5	6,3	5,0	3,6	2,0	2,0	1,5	
	82,5	2,6	4,5	4,5	6,3	5,6	4,0	2,0	2,0	1,5	
80	88,9	2,9	4,5	4,5	7,1	5,6	4,0	2,0	2,5	2,0	
90	101,6	2,9	4,5	4,5	7,1	6,3	4,0	2,0	2,5	2,0	
	108,0	2,9	4,5	4,5	7,1	7,1	4,5	2,0	2,5	2,0	
100	114,3	3,2	4,5	4,5	8,0	7,1	4,5	2,3	2,5	2,0	
	127,0	3,2	4,5	4,5	8,0	8,0	4,5	2,3	2,5	2,0	
	133,0	3,6	4,5	4,5	8,0	8,0	5,0	2,3	3,0	2,5	
125	139,7	3,6	4,5	4,5	8,0	8,0	5,0	2,3	3,0	2,5	
	152,4	4,0	4,5	4,5	8,8	8,8	5,6	2,3	3,0	2,5	
	159,0	4,0	4,5	4,5	8,8	8,8	5,6	2,3	3,0	2,5	
150	168,3	4,0	4,5	4,5	8,8	8,8	5,6	2,3	3,0	2,5	
	177,8	4,5	5,0	5,0	8,8	–	–	2,3	3,0	2,5	
175	193,7	4,5	5,4	5,4	8,8	–	–	2,3	3,5	3,0	
200	219,1	4,5	5,9	5,9	8,8	–	–	2,6	3,5	3,0	
225	244,6	5,0	6,3	6,3	8,8	–	–	2,6	3,5	3,0	
	267,0	5,0	6,3	6,6	8,8	–	–	2,6	3,5	3,0	
250	273,0	5,0	6,3	6,3	8,8	–	–	2,9	4,0	3,5	
	298,5	5,6	6,3	6,3	8,8	–	–	2,9	4,0	3,5	
300	323,9	5,6	6,3	6,3	8,8	–	–	3,6	4,0	3,5	
350	355,6	5,6	6,3	6,3	8,8	–	–	3,6	4,0	3,5	
	368,0	5,6	6,3	6,3	8,8	–	–	3,6	4,0	3,5	
400	406,4	6,3	6,3	6,3	8,8	–	–	3,6	4,0	3,5	
	419,0	6,3	6,3	6,3	8,8	–	–	4,0	4,0	3,5	
450	457,2	6,3	6,3	6,3	8,8	–	–	4,0	4,0	3,5	
	508,0	–	–	–	–	–	–	4,0	4,5	4,0	

**Notes of Table 1.3.4.3:**

Columns **A**, **B**, **C** and **D** in the table apply to the following services:

- A** Pipes in general.
- B** Vent, overflow and sounding pipes for integral tanks.
- C** Bilge, ballast and sea water pipes.
- D** Bilge, ballast, vent, overflow and sounding pipes passing through fuel tanks;  
Bilge, vent, overflow, sounding and fuel pipes passing through ballast tanks.
- E** Piping of CO<sub>2</sub> fire extinguishing system - from cylinders to discharge valves.
- F** Piping of CO<sub>2</sub> fire extinguishing system - From discharge valves to discharge nozzles.





**Fig. 1.3.7.2-2**  
Examples of flange attachments

**NOTE:** For type D, the pipe and flange are to be screwed with a tapered thread and the diameter of the screw portion of the pipe over the thread is not to be appreciably less than the outside diameter of the unthreaded pipe. For certain types of thread, after the flange has been screw hard home, the pipe is to be expanded into the flange.

**1.3.7.1 Welded connections**

Welding and non-destructive testing of welds are to be carried out in accordance and requirements of *Register*.

- .1 But welded joints  
Butt welded joints shall be of full penetration type generally with or without special provision for a high quality of root side \*.

Butt welded joints with special provision for a high quality of root side may be used for piping of any Class, any outside diameter.

Butt welded joints without special provision for a high quality of root side may be used for piping systems of Class II and III irrespective of outside diameter.

**\* NOTE:** The expression “special provision for a high quality of root side” means that butt welds were accomplished as double welded or by use of a backing ring or inert gas back-up on first pass, or other similar methods accepted by the *Register*.

- .2 Slip-on sleeve and socket welded joints  
Slip-on sleeve and socket welded joints are to have sleeves, sockets and weldments of adequate dimensions conforming to *Register Rules* or recognized Standard.  
Slip-on sleeve socket welded joints may be used in Class III systems, any outside diameter.  
In particular cases, slip-on sleeve and socket welded joints may be allowed by *Register* for piping systems Class I and II having outside diameter ≤ 88.9 mm except for piping systems conveying toxic media or services where fatigue, severe erosion or crevice corrosion is expected to occur.

**1.3.7.2 Flange connections**

- .1 The dimensions and configuration of flanges and bolts are to be chosen in accordance with recognized standards.  
Gaskets are to be suitable for the media being conveyed under design pressure and temperature conditions and their dimensions and configuration are to be in accordance with recognised standards.  
For non-standard flanges the dimensions of flanges and bolts are to be subject to special consideration.
- .2 Examples of flange attachments are shown in 1.3.7.2-2. However, other types of flange attachments may be considered by *Register* in each particular case.
- .3 Flange attachments are to be in accordance with national or international standards that

are applicable to the piping system and are to recognized the boundary fluids, design pressure and temperature conditions, external or cyclic loading and location, as shown in table 1.3.7.2-3.

**1.3.7.3 Slip-on threaded joints**

Slip-on threaded joints having pipe threads where pressure-tight joints are made on the threads with parallel or tapered threads, shall comply with requirements of a recognized national and/or international standard \*.

Slip-on threaded joints may be used for outside diameters as stated below except for piping systems conveying toxic or flammable media or services where fatigue, severe erosion or crevice corrosion is expected to occur.

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

Threaded joints in CO<sub>2</sub> system shall be allowed only inside protected spaces and in CO<sub>2</sub> cylinder rooms.

Threaded joints for direct connectors of pipe lengths with tapered thread are to be allowed for:

- a) Class I, outside diameter not more than 33.7 mm,
- b) Class II and Class III, outside diameter not more than 60.3 mm.

Threaded joints with parallel thread are to be allowed for Class III, diameter not more than 60.3 mm.

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

**\* NOTE:** Standards such as ASME B31.1 and ASME B31.3 may be referenced for the purpose.

**Table 1.3.7.2-3**  
Application of flange connections depending upon the class of piping and kind of fluids

Class of piping	Toxic media		Steam		Lubrication and fuel oil	Other media	
	p [MPa]	Flange type	t [°C]	Flange type	Flange type	t [°C]	Flange type
I	> 1	A	> 400	A	A - B	> 400	A
	≤ 1	A - B	≤ 400	A - B <sup>1)</sup>		≤ 400	A - B
	any	A - B					
II	–	A - B - C	> 250	A - B - C	A - B - C <sup>3)</sup>	> 250	A - B - C
			≤ 250	A - B - C - D		≤ 250	A - B - C - D - E
III	–	–	–	A - B - C - D	A - B - C - E	–	A - B - C - D - E <sup>2)</sup>

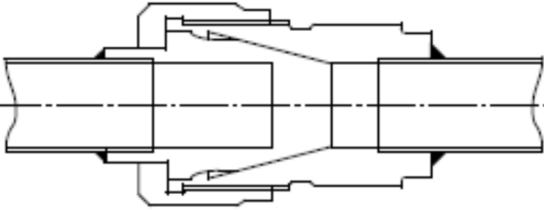
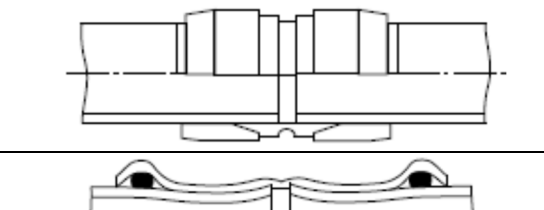
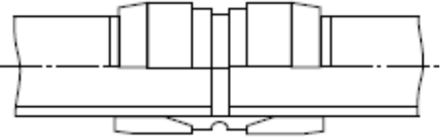
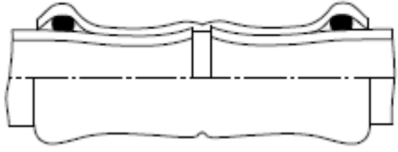
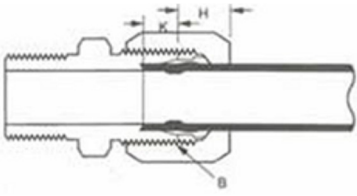
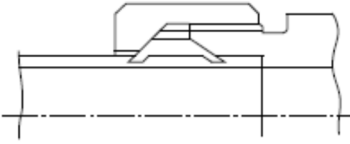
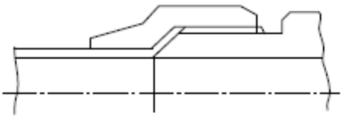
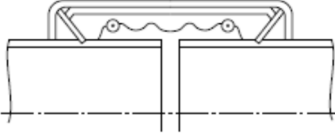
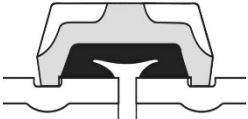
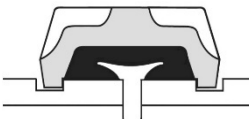
**Notes:**  
 1. Type B for outside diameter not more than 150 mm, only.  
 2. Type E for water pipes and open ended lines, only.  
 3. Type C for oil pipes with t < 100°C and p < 1,6 MPa, only.

**1.3.7.4 Mechanical joints**

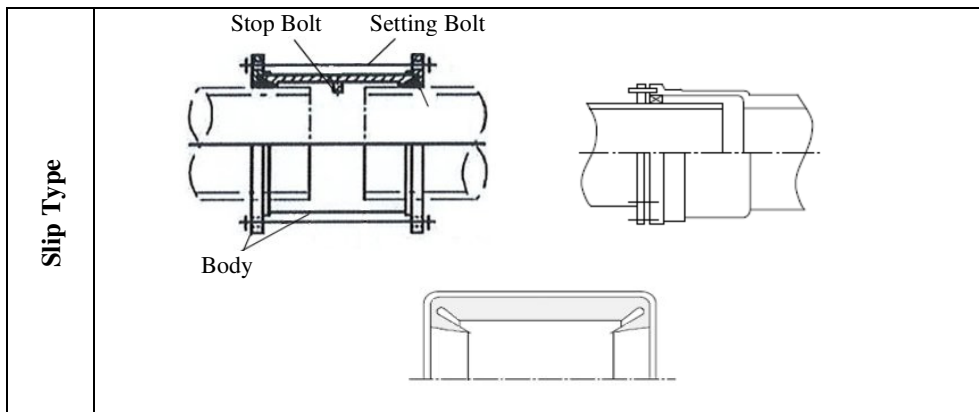
Due to the great variations in design and configuration of mechanical joints, no specific recommendation regarding calculation method for theoretical strength calculations is given in these requirements. The Type Approval is to be based on the results of testing of the actual joints.

These requirements are applicable to pipe unions, compression couplings, slip-on joints as shown in Fig. 1.3.7.4. Similar joints complying with these requirements may be acceptable.

- .1 Mechanical joints including pipe unions, compression couplings, slip-on joints and similar joints are to be of approved type for the service conditions and the intended application. Type approval will be performed in accordance with the provision of 1.10 (criterion from *IACS UR P2.11*).
- .2 Where the application of mechanical joints results in reduction in pipe wall thickness due to the use of bite type rings or other structural elements, this is to be taken into account in determining the minimum wall thickness of the pipe to withstand the design pressure.
- .3 Materials of mechanical joints is to be compatible with the piping material and internal and external media.
- .4 Mechanical joints are to be tested where applicable, to a burst pressure of 4 times the design pressure.  
For design pressures above 200 bar the required burst pressure will be specially considered by *Register*.
- .5 Where appropriate, mechanical joints are to be of fire resistant type as required by Table 1.3.7.4-10.
- .6 Mechanical joints, which in the event of damage could cause fire or flooding, are not to be used in piping sections directly connected to the ship's side below the bulkhead deck of passenger ships and freeboard deck of cargo ships or tanks containing flammable fluids.
- .7 The number of mechanical joints in flammable fluid systems is to be kept to a minimum. In general, flanged joints conforming to recognised standards are to be used.
- .8 Piping in which a mechanical joint is fitted is to be adequately adjusted, aligned and supported. Supports or hangers are not to be used to force alignment of piping at the point of connection.
- .9 Slip-on joints are not to be used in pipelines in cargo holds, tanks, and other spaces which are not easily accessible (refer to MSC/Circ.734), except that these joints may be permitted in tanks that contain the same media.  
Usage of slip type slip-on joints as the main means of pipe connection is not permitted except for cases where compensation of axial pipe deformation is necessary.
- .10 Applications of mechanical joints and their acceptable use for each service is indicated in Table 1.3.7.4-10; dependence upon the Class of piping and pipe dimensions is indicated in Table 1.3.7.4-10a.  
In particular cases, size in excess of those mentioned above may be accepted by *Register* if in compliance with a recognized national and/or international standard.
- .11 Mechanical joints are to be tested in accordance with a program approved by *Register*, which is to include at least the following:
  - .1 leakage test
  - .2 vacuum test (where necessary)
  - .3 vibration (fatigue) test
  - .4 fire endurance test (where necessary)
  - .5 burst pressure test
  - .6 pressure pulsation test (for Class I and II mandatory, for Class III where necessary)
  - .7 assembly test (where necessary)
  - .8 pull out test (where necessary)
- .12 The installation of mechanical joints is to be in accordance with the manufacturer's assembly instructions. Where special tools and gauges are required for installation of the joints, these are to be supplied by the manufacturer.

<b>Pipe Unions</b>	Welded and Brazed Types	
		
<b>Compression Couplings</b>	Swage Type	
	Press Type	
		
	Bite Type	
	Flared Type	
<b>Slip-on Joints</b>	Grip Type	
	Machine Grooved type	<div style="display: flex; justify-content: space-around; align-items: center;">   </div> <div style="display: flex; justify-content: space-around; margin-top: 5px;"> <span>Roll Groove</span> <span>Cut Groove</span> </div>

**Fig. 1.3.7.4**  
 Examples of mechanical joints



**Fig. 1.3.7.4**  
Examples of mechanical joints

The following table indicates systems where the various kinds of joints may be accepted. However, in all cases, acceptance of the joint type is to be subject to approval for the intended application, and subject to conditions of the approval and applicable Rules. Further, relevant statutory requirements must be taken into consideration. In cases exposure time (tr) is greater than 30 minutes the dry-wet test conditions are 8 minutes dry and, accordingly, the wet period tr - 8 min.

**Table 1.3.7.4-10**

Systems		Kind of connections			Classification of pipe system	Fire endurance test condition <sup>7</sup>
		Pipe Unions	Compression Couplings	Slip-on Joints		
<i>Flammable fluids (Flash point ≤ 60°C)</i>						
1	Cargo oil lines <sup>1</sup>	+	+	+	dry	30 min dry (*)
2	Crude oil washing lines <sup>1</sup>	+	+	+	dry	
3	Vent lines <sup>3</sup>	+	+	+	dry	
<i>Inert gas</i>						
4	Water seal effluent lines	+	+	+	wet	30 min wet (*)
5	Scrubber effluent lines	+	+	+	wet	30 min wet (*)
6	Main lines <sup>1&amp;2</sup>	+	+	+	dry	30 min dry (*)
7	Distribution lines <sup>1</sup>	+	+	+	dry	30 min dry (*)
<i>Flammable fluids (Flash point &gt; 60°C)</i>						
8	Cargo oil lines <sup>1</sup>	+	+	+	dry	30 min dry (*)
9	Fuel oil lines <sup>2&amp;3</sup>	+	+	+	wet	30 min wet (*)
10	Lubricating oil lines <sup>2&amp;3</sup>	+	+	+	wet	
11	Hydraulic oil <sup>2&amp;3</sup>	+	+	+	wet	
12	Thermal oil <sup>2&amp;3</sup>	+	+	+	wet	
<i>Sea water</i>						
13	Bilge lines <sup>4</sup>	+	+	+	dry/wet	8 min dry + 22 min wet (*)
14	Permanent water filled fire extinguishing systems, e.g. fire main, sprinkler systems <sup>3</sup>	+	+	+	wet	30 min wet (*)
15	Non-permanent water filled fire extinguishing systems, e.g. foam, drencher systems and fire main <sup>3</sup>	+	+	+	dry/wet	8 min dry + 22 min wet (*) For foam systems FSS Code Chapter 6 to be observed
16	Ballast system <sup>4</sup>	+	+	+	wet	30 min wet (*)
17	Cooling water system <sup>4</sup>	+	+	+	wet	30 min wet (*)
18	Tank cleaning services	+	+	+	dry	Fire endurance test not required

Table 1.3.7.4-10 - continued

Systems		Kind of connections			Classification of pipe system	Fire endurance test condition <sup>7</sup>
		Pipe Unions	Compression Couplings	Slip-on Joints		
19	Non-essential systems	+	+	+	dry dry/wet wet	Fire endurance test not required
<i>Fresh water</i>						
20	Cooling water system <sup>4</sup>	+	+	+	wet	30 min wet (*)
21	Condensate return <sup>4</sup>	+	+	+	wet	30 min wet (*)
22	Non-essential system	+	+	+	dry dry/wet wet	Fire endurance test not required
<i>Sanitary/Drains/Scuppers</i>						
23	Deck drains (internal) <sup>5</sup>	+	+	+	dry	Fire endurance test not required
24	Sanitary drains	+	+	+	dry	
25	Scuppers and discharge (overboard)	+	+	-	dry	
<i>Sounding/Vent</i>						
26	Water tanks/Dry spaces	+	+	+	dry, wet	Fire endurance test not required
27	Oil tanks (f.p. > 60°C) <sup>2&amp;3</sup>	+	+	+	dry	
<i>Miscellaneous</i>						
28	Starting/Control air <sup>4</sup>	+	+	-	dry	30 min dry (*)
19	Service air (non-essential)	+	+	+	dry	Fire endurance test not required
30	Brine	+	+	+	wet	
31	CO <sub>2</sub> system (outside protected space)	+	+	-	dry	30 min dry (*)
32	CO <sub>2</sub> system (inside protected space)	+	+	-	dry	Mechanical joints shall be constructed of materials with melting point above 925°C. (FSS Code Chapter 5)
33	Steam	+	+	+ <sup>6</sup>	wet	Fire endurance test not required

**Abbreviations:**

- + Application is allowed
- Application is not allowed
- \* Fire endurance test as specified in 1.10.5.5.6

**Footnotes Table 1.3.7.4-10 - Fire resistance capability**

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

1. Fire endurance test shall be applied when mechanical joints are installed in pump rooms and open decks.
2. Slip on joints are not accepted inside machinery spaces of category A or accommodation spaces. May be accepted in other machinery spaces provided the joints are located in easily visible and accessible positions (refer to MSC/Circ.734).
3. Approved fire resistant types except in cases where such mechanical joints are installed on open decks, as defined in SOLAS II-2/Reg. 9.2.3.3.2.2(10) and not used for fuel oil lines.
4. Fire endurance test shall be applied when mechanical joints are installed inside machinery spaces of category A.

**Footnotes Table 1.3.7.4-10 - General**

5. Only above bulkhead deck of passenger ships and freeboard deck of cargo ships.
6. Slip type slip-on joints as shown in Fig.1.3.7.4. May be used for pipes on deck with a design pressure of 10 bar or less.
7. If a connection has passed the "30 min dry" test, it is considered suitable also for applications for which the "8 min dry+22 min wet" and/or "30 min wet" tests are required. If a connection has passed the "8 min dry+22 min wet" test, it is considered suitable also for applications for which the "30 min wet" test is required.

**Table 1.3.7.4-10a**  
Application of mechanical joints depending upon the class of piping

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

**Abbreviations:**

- + Application is allowed
- Application is not allowed

**1.3.8 Flexible hoses (IACS UR P2.12)**

Except otherwise specified, the requirements of this regulation are to apply generally to any design of flexible pipe segments for piping systems stated in 1.1.1, which can be recognised by terms such as “flexible hose” or “Flexible pipe” made of metallic or non-metallic material.

Those of non-metallic materials are to comply also with the requirements of *Rules for the classification of ships, Part 24 - Non-metallic materials, Section 11*.

**1.3.8.1 Terms and Definitions**

- .1 Flexible hose - except otherwise specified, for the purpose of this regulation it generally means any flexible segment of the pipeline, described by terms such as “flexible hose” or “Flexible pipe” made of metallic or non-metallic material.
- .2 Flexible hose assembly – short length of metallic or non-metallic hose normally with prefabricated end fittings ready for installation.

**Note:** Flexible hose assemblies for essential services or containing either flammable or toxic media are not to exceed 1.5 m in length.

**1.3.8.2 Scope**

- .1 The requirements 1.3.8.3 to 1.3.8.6 apply to flexible hoses of metallic or non-metallic material intended for a permanent connection between a fixed piping system and items of machinery. The requirements may also be applied to temporary connected flexible hoses or hoses of portable equipment.
- .2 Flexible hose assemblies as defined in 1.3.8.1.2 may be accepted for use in oil fuel, lubricating, hydraulic and thermal oil systems, fresh water and sea water cooling systems, compressed air systems, bilge and ballast systems, and Class III steam

systems where they comply with 1.3.8.3 to 1.3.8.6. Flexible hoses in high pressure fuel oil injection systems are not to be accepted.

- .3 These requirements for flexible hose assemblies are not applicable to hoses intended to be used in fixed fire extinguishing systems.

**1.3.8.3 Design and construction**

- .1 Flexible hoses are to be designed and constructed in accordance with recognised National or International standards acceptable to *Register*. Flexible hoses constructed of rubber materials and intended for use in bilge, ballast, compressed air, oil fuel, lubricating, hydraulic and thermal oil systems are to incorporate a single, double or more, closely woven integral wire braid or other suitable material reinforcement. Flexible hoses of plastics materials for the same purposes, such as Teflon or Nylon, which are unable to be reinforced by incorporating closely woven integral wire braid are to have suitable material reinforcement as far as practicable. Where rubber or plastics materials hoses are to be used in oil supply lines to burners, the hoses are to have external wire braid protection in addition to the reinforcement mentioned above. Flexible hoses for use in steam systems are to be of metallic construction.
- .2 Flexible hoses are to be complete with approved end fittings in accordance with manufacturer’s specification. The end connections that do not have a flange are to comply with 1.3.7.4 as applicable and each type of hose/fitting combination is to be subject to prototype testing to the same standard as that required by the hose with

- particular reference to pressure and impulse tests.
- .3 The use of hose clamps and similar types of end attachments is not acceptable for flexible hoses in piping systems for steam, flammable media, starting air systems or for sea water systems where failure may result in flooding. In other piping systems, the use of hose clamps may be accepted where the working pressure is less than 5 bar and provided there are double clamps at each end connection.
  - .4 Flexible hose assemblies intended for installation in piping systems where pressure pulses and/or high levels of vibration are expected to occur in service, are to be designed for the maximum expected impulse peak pressure and forces due to vibration. The tests required by 1.3.8.5 are to take into consideration the maximum anticipated in-service pressures, vibration frequencies and forces due to installation.
  - .5 Flexible hose assemblies constructed of non-metallic materials intended for installation in piping systems for flammable media and sea water systems where failure may result in flooding, are to be of fire-resistant type except in cases where such hoses are installed on open decks, as defined in Regulation 9.2.3.3.2.2(10) of SOLAS Chapter II-2 as amended by IMO resolution up to MSC.421(98) and not used for fuel oil lines. Fire resistance is to be demonstrated by testing to ISO 15540:2016 and ISO 15541:2016.
  - .6 Flexible hose assemblies are to be selected for the intended location and application taking into consideration ambient conditions, compatibility with fluids under working pressure and temperature conditions consistent with the manufacturer's instructions and any requirements of *Register*.

#### 1.3.8.4 Installation

- .1 In general, flexible hoses are to be limited to a length necessary to provide for relative movement between fixed and flexibly mounted items of machinery/equipment or systems.
- .2 Flexible hose assemblies are not to be installed where they may be subjected to torsion deformation (twisting) under normal operating conditions.
- .3 The number of flexible hoses, in piping systems mentioned in 1.3.8.2.2 is to be kept to minimum and to be limited for the purpose stated in 1.3.8.2.1.
- .4 Where flexible hoses are intended to be used in piping systems conveying flammable fluids that are in close proximity of heated surfaces the risk of ignition due to failure of the hose assembly and subsequent release of fluids is to be mitigated as

far as practicable by the use of screens or other similar protection to the satisfaction of *Register*.

- .5 Flexible hoses are to be installed in clearly visible and readily accessible locations.
- .6 The installation of flexible hose assemblies is to be in accordance with the manufacturer's instructions and use limitations with particular attention to the following:
  - Orientation
  - End connection support (where necessary)
  - Avoidance of hose contact that could cause rubbing and abrasion
  - Minimum bend radii

#### 1.3.8.5 Tests

The flexible hose assemblies are to be tested for Type approval and permanently marked by the manufacturer in accordance with the provision of 1.11 (criterion from *IACS UR P2.12.5*).

#### 1.3.9 Welding and non-destructive tests of welded joints

**1.3.9.1** Non-destructive tests of welded joints shall be made in accordance with the *Rules for the classification of ships, Part 26 - Welding*, Sections 2 and 3.

#### 1.3.10 Insulation of pipelines

**1.3.10.1** Insulation of pipelines shall comply with the requirements of the *Rules for the classification of ships, Part 7 - Machinery installations*, 1.11.9.

### 1.4 PIPE VALVES AND FITTINGS

#### 1.4.1 Construction

**1.4.1.1** Valves and fittings are normally to be built in accordance with a recognised standard. Otherwise, they are subject to special consideration for approval by the *Register*.

Threaded covers may be used for valves of diameter up to 32 mm inclusive, and shall be reliably secured.

Nut of the cock plug shall be protected against spontaneous unscrewing.

**1.4.1.2** Valves and fittings with remote control shall be also provided with local manual control.

The remote control system and means of local operation are to be independent, so provided that opening and/or closing of the valves by local manual control shall not render remote control system inoperable.

For shipside valves and valves on the collision bulkhead, the means for local manual operation are to be permanently attached.

The valves provided with remote control system shall be so constructed that, in case of failure of the remote control system the valves remain, or automatically return, in a position that will not bring the ship into dangerous situation.

Unless otherwise specified, indicators are to be provided on the remote controls to show whether the valves are open or closed.

For submerged valves in ballast, cargo, or other tanks where accepted by the *Register*, local manual operation may be by extended spindle or portable hand pump.

The manual operation by hand pump is to have the control lines to each submerged valve provided with the quick coupling connections, as close to the valve actuator as practicable, to allow easy connection of the hand pump. For shipside valves and valves on the collision bulkhead, the hand pump is to be permanently attached and fitted to the quick coupling connection. For other valves, not less than two portable hand pumps are to be provided.

**1.4.1.3** Compressed air shall not be used as energy source in remote control systems for the valves and fittings installed in cargo tanks.

**1.4.1.4** Valves and fittings in piping systems are to be compatible with the pipes to which they are attached in respect of their strength (see 1.3.4.1-1 for design pressure) and are to be suitable for effective operation at the maximum working pressure and temperature they will experience in service.

**1.4.1.5** If the body or some other important part of the armature is made of several parts, such as housing separately and flanges separately and are joined by threaded, the connections shall not be secured against loosening by Loctite or other similar means. The connections shall be performed by tapered threads, as shown in Figure 1.3.7.2.

Connecting of the ball valves body from several pieces may be accepted by bolting or other suitable way, provided that metal to metal sealing was ensured.

#### **1.4.2 Marking of valves and fittings**

**1.4.2.1** Shut-off valves and fittings shall be provided with conspicuous name plates bearing legible inscriptions specifying their purpose.

**1.4.2.2** Remote control system shall have, in the control stations, a fixed nameplates specifying their purpose and indicators showing their open or closed positions.

Where the remote control is intended only for closing the valves and fittings, such indicators may be omitted.

#### **1.4.3 Arrangement and installation of valves and fittings**

**1.4.3.1** Valves and fittings on watertight bulkheads and tanks shall be secured by studs screws into reinforced steel flange welded to the bulkhead and tank. The thread stud holes shall not be deeper than the thickness of welded flange.

It is permitted to install short pipes welded to the flanges between valves and bulkheads or between valves and tanks. These shall have substantial thickness, not less than specified in Table 1.3.4.3-column D.

For ships of less than 500 gross tonnage navigating in restricted navigation areas 5 to 8, other securing means may be admitted, subject to special consideration by the *Register*, namely in the case of small size valves and fittings.

**1.4.3.2** Valve chests and manual-controlled valves shall be placed in easy accessible places.

Fuel oil system valve drives, if valves are located in the engine room, shall be fitted on easy accessible places, above floor plating.

**1.4.3.3** Instruments for control and measurement in fuel oil and lubricating oil systems shall be provided with valves or cocks as to be separated from pipeline. Sensitive parts of thermometers shall be protected by solid sleeves.

**1.4.3.4** Shut-off valves shall be fitted where necessary to isolate pumps, heat exchangers, pressure vessels, etc., from the rest of the piping system when necessary, in particular to allow the isolation of duplicate components without interrupting the fluid circulation, as well as for survey or repair purposes.

## **1.5 OPENINGS AND FITTINGS IN SHELL PLATING**

### **1.5.1 General**

**1.5.1.1** Unless instructed otherwise, the requirements under this head shall be applied in conjunction with the applicable requirements of Section 16.

**1.5.1.2** No part of fittings installed on shell plate below the bulkhead deck, as well as of the bottom fittings, shall be made of materials which can readily be deteriorated in the event of fire.

**1.5.1.3** Spindles and closing parts of the bottom and shell plate fittings shall be manufactured of materials resistant to the corroding action of sea water.

**1.5.1.4** The gaskets made of lead or of materials, which are subject to destruction in the event of fire, are not to be used for shell plate fitting connections.

### **1.5.2 Openings and fittings in shell plating**

**1.5.2.1** Number of openings in the shell plating shall be kept to a minimum. Therefore, as far as practicable, the discharge pipelines shall be connected to common discharges.

**1.5.2.2** Location of sea inlet and discharge openings in the ship's shell plating shall be such as to prevent:

- .1 sewage, bilge, ash and other wastes being sucked by sea water pumps;
- .2 sewage and water discharged shall not be allowed to pass into the ship's spaces through the side scuttles and into the lifeboats and liferafts when launching.

Where it is impracticable to comply with requirement .2, discharge openings shall be fitted with appropriate arrangements which prevent discharged water from penetrating into the ship's spaces, lifeboats and liferafts.

**1.5.2.3** As a rule, the discharge valves at the shall plating shall be of non-return shut-off type.

Where this is impracticable, use of other type of valves and valves arrangement on the shell plating will be specially considered by *Register*.

In any event, the butterfly valves without flanges are not to be used for water inlets or overboard discharges below water line unless provisions are made to allow disassembling at sea of the pipes served by these valves without any risk of flooding.

**1.5.2.4** Overboard discharges (except those specified in 1.5.2.12), leading from the spaces below the bulkhead deck of passenger ships and the freeboard deck of cargo ships or from closed superstructures or deckhouses on the freeboard deck (see *Rules for the classification of ships, Part 3 - Hull Equipment*, 7.5.1.2), which have or may have open ends in these spaces, as a rule, shall be provided with one non-return valve fitted with positive means of closing capable of being remotely closed from a readily accessible place situated above the bulkhead deck of passenger ships and above the freeboard deck of cargo ships.

Instead of one non-return valve with positive means of closing remotely controlled, provisions may be made for one non-return valve and one shut-off valve capable of being remotely operated from a position above the bulkhead deck or freeboard deck as defined in 16.2.2.

The valve remote controls shall always be readily accessible and provided with an indicator: "Closed" or "Open".

Overboard discharges led through the shell from enclosed superstructures used for the carriage of cargo shall comply with 16.2.8.

**1.5.2.5** Sanitary drainage and scuppers positive closing valves led overboard may be operated locally, if such valves are placed on shell plating in the manned engine room together with a non-return valve inboard. See also 16.2.4.

**1.5.2.6** Where the vertical distance from the summer load line (from the summer timber waterline in ships with timber freeboard) to the inboard end of the discharge pipe exceeds 0,01 of the ship's length the discharge pipe may be fitted with two non-return valves without positive means of closing, provided that one valve is installed at the shell and the second above the deepest loadline in sea water assigned to that ship, in a position readily accessible under all service conditions. See also 16.2.1.

Where a shut-off valve is installed between these non-return valves, the second non return valve need not be fitted above the deepest load line in sea water allowed for that ship.

**1.5.2.7** Where the vertical distance from the summer load line (from the summer timber line for ships with timber freeboard) to the inboard end of the discharge pipe exceeds 0,02 of the ship's length the discharge opening may have only one non-return valve, without positive means of closing as defined in 16.2.1.

**1.5.2.8** In ships which are to comply with the requirements for subdivision in damaged condition, one non-return valve is permitted at the shell, if the distance from the inboard end of the discharge pipe to the damaged waterline exceeds 0,3 [m], as calculated for the worst conditions of flooding.

**1.5.2.9** The specified requirements for non-return valves do not apply to overboard discharge openings which shall be closed while at sea (e.g. openings in top side ballast tanks for drainage by gravity). See also 16.2.6.

**1.5.2.10** For ships of less than 500 gross tonnage navigating in restricted areas 5 to 8 overboard discharges from spaces situated on freeboard deck and below it may be provided with only one non-return shut-off valve with local control.

**1.5.2.11** Scuppers and drain pipes led overboard from open decks and spaces, except pipes specified in 1.5.2.4, if are leading to outer shell plating lower than 450 [mm] below freeboard deck, or for less than 600 [mm] above summer load waterline, shall be fitted with non-return valves at the shell plating as defined in 16.2.10. Wall thickness of scuppers and drain shall not be less than those indicated in Table 1.3.4.3, column 4. See also 16.3.

Non-return valves may be omitted if pipe thickness ("s") for outside diameter ("D") of the pipes below freeboard deck and closed superstructures is not less than:

- for  $D \leq 80,0$  [mm] -  $s = 7,0$  [mm]
- for  $D = 180,0$  [mm] -  $s = 10,0$  [mm]
- for  $D \geq 220,0$  [mm] -  $s = 12,5$  [mm]

Intermediate values are determined by linear interpolation.

For ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8, including the yachts in general, the *Register* may also permit the use of austenitic stainless steel pipes for scuppers and drain pipes fitted directly to the shell below freeboard deck and closed superstructures, subject to the following condition:

- a) Wall thickness ("s") for outside diameter ("D") of the pipes shall not be less than listed below:
  - for  $D \leq 88,9$  [mm] -  $s = 4,0$  [mm]
  - for  $D > 88,9$  [mm] - subject to special consideration by the *Register*.
- b) Suitable reinforcement to the satisfaction of *Register* shall be provided against possible mechanical damage of the shell connection, for example by three radial brackets welded to the structure.

**1.5.2.12** Sea water inlet and discharge valves situated on shell plating in manned machinery spaces, which are in connection with the operation of machinery, may be controlled locally. The controls shall be easily accessible and fitted with an indicator showing whether the valves are open or closed. See also 16.2.9.

See 1.5.2.14 for such valves in unattended machinery spaces.

**1.5.2.13** For bottom inlet fittings the means for operating is to be located in readily accessible places and shall be fitted with an indicator showing whether the valves are "Closed" or "Open".

In passenger ships, these means shall be located above the floor plating of machinery spaces.

In cargo ships, these means are recommended to be located above the floor plating of machinery spaces.

**1.5.2.14** The location of the controls of any valve serving a sea inlet, a discharge below the waterline or a bilge injection system shall be so sited as to allow adequate time for operation in case of influx of water to the space, having regard to the time likely to be required in order to reach and operate such controls.

A calculation should be carried out to show that the time taken from alarm activation plus the time to reach and fully close manually operated or powered valves is less than the time taken for the influx of water to reach the control without submergence of the platform on which the person is operating the valve.

The time it will take to reach and close the sea valves should be determined by multiplying the inverse of the nominal speed of travel of a person onboard (1.0 m/sec based on the values taken from MSC/Circ.1238, which supersedes MSC/Circ.1033) times the distance to be travelled from the platform in way of manually operated valves (or the actuator for valves controlled by stored mechanical energy) to either:

- .1 the highest position of the control room for an ER under continuous manned supervision; or
- .2 from the navigation bridge for an unmanned machinery space.

The time it takes for the influx of water into the ER should be determined based on the fluid dynamic principles contained in MSC.245(83) applied to a breach in the largest diameter seawater line in the lowest and highest locations in the machinery space and the valve associated with that seawater line.)

In the event calculations are not available, 10 minutes shall be regarded as adequate time for operation unless the Flag State Administration expressly provided otherwise.

If the level to which the space could become flooded with the ship in the fully loaded condition so requires, arrangements shall be made to operate the controls from a position above such level.

The requirements of this regulation are not applicable to valves serving an emergency bilge system provided that the emergency bilge suction piping is:

- fitted with a normally closed non-return valve with positive means of closing;
- located inboard of a shell valve that is fitted with the control arrangements required by this regulation.

**1.5.2.15** As a rule, bottom and side fittings shall be attached to welded pads and shall be approved by the *Register*.

The fittings are allowed to be installed on pipes welded to the shell plating, provided that the latter are of rigid construction and of minimum length and shall be approved by the *Register*.

Thickness of the pipes shall not be less than the thickness indicated in 1.5.2.11.

The stud holes shall not penetrate the shell plating but shall be only within the welded pads.

**1.5.2.16** In ships with ice strengthening, the fittings above the load waterline shall have the heating facilities.

### 1.5.3 Sea water inlets

**1.5.3.1** Unless otherwise specified, the number of sea inlets is to be as stated in 10.2.

**1.5.3.2** The sea inlets are to comply also with the applicable requirements specified in other part of the Rules, for example such as *Rules for the classification of ships, Part 17 - Fire protection* for firefighting systems.

**1.5.3.3** The sea inlets are to be fitted with readily accessible valves between the pipes and the shell plating or between the pipes and fabricated sea inlet water boxes attached to the shell plating. In machinery spaces the valves may be controlled locally and provided with indicators as required in 1.5.2.13.

**1.5.3.4** Sea inlet and discharge valves are to comply with 1.4 and 1.5.4.

**1.5.3.5** In general, the sea inlets are to be so designed and arranged as to limit turbulence and to avoid the admission of air due to motion of the ship.

**1.5.3.6** Shell openings on the sea inlet water boxes are to be fitted with protecting gratings complying with 1.5.5. The inside of the boxes shall be accessible through the removable grating or manholes located above the deepest load line.

**1.5.3.7** Provisions are to be made for cleaning sea inlet gratings, with the steam or compressed air arrangement. Cleaning pipes shall be provided with non-return shut-off valves.

The steam or compressed air pressure in cleaning system shall not exceed 0,5 MPa. In any case the sea inlet water boxes, distance pieces and fitted valves are to be so constructed as to withstand the maximum pressure to which they may be exposed during cleaning operation.

**1.5.3.8** The sea inlet water boxes are to be provided with suitable vent pipe extended above the main deck. It shall be possible to close the vent pipe to facilitate effective cleaning of sea inlet gratings.

**1.5.3.9** For ships navigating in Polar waters and Ice class ships, see *Rules for the classification of ships, Part 29 - Polar class ships and Ice class ships*, 8.14.

### 1.5.4 Valves and fittings in shell plating

**1.5.4.1** All sea inlet and overboard discharge pipes shall be fitted with easily accessible valves or cocks secured direct to the shell or sea chests.

**1.5.4.2** If it is impractical to fit the valves or cocks directly to the shell or sea chest, distance pieces of steel may be accepted. These shall be made as short, rigid constructions, and thickness shall not be less than given in 1.5.2.11.

The distance piece shall extend through the shell plating or sea chest, and shall be welded on both sides or with full penetration welding.

**1.5.4.3** The valves or cocks and short distance pieces fitted to shell plating are generally considered Class II equipment and have to be approved by the *Register*. See Table 17.1.3 and Table 1.2.2, Note 7.

**1.5.4.4** All outlets and sea inlet valves shall be fitted to the shell in such a way that piping inboard of the valves may be disconnected without interfering with the watertight integrity of the shell.

The controls shall comply with 1.5.2.12 and 1.5.2.14 as applicable.

**1.5.4.5** As a rule, valves or cocks shall be **secured by studs** screwed in heavy pads welded to the shell or sea chests plating. The stud holes shall not penetrate the shell or sea chests plating but shall be only within the welded pads.

Other securing means may be admitted, subject to special consideration by the Register, namely in the case of small size valves.

**1.5.4.6** The use of butterfly valves will be specially considered by the Register. In any event, butterfly valves not fitted with flanges are not to be used for water inlets unless provisions are made to allow disassembling at sea of the pipes served by these valves without any risk of flooding.

**1.5.4.7** The body of valves and fittings in shell plating below the bulkhead deck is to be of steel, bronze or other approved ductile material. Ordinary cast iron or similar materials are not acceptable. See also 1.3.1.4.

Spindles and closing parts shall be of materials resistant to the corroding action of sea water. See also 1.5.1.3.

**1.5.4.8** Ship side valves serving piping systems made of plastics are to comply with the applicable requirements in 1.7.

## 1.5.5 Gratings

**1.5.5.1** Shell openings on the sea inlet water boxes are to be fitted with protecting gratings. Hole diameters and slot widths on gratings shall be approximately 20 [mm].

**1.5.5.2** Gratings are to have a free flow area not less than twice the total section of the pipes connected to the sea inlet water box.

**1.5.5.3** For ships navigating in Polar waters and Ice class ships, see also *Rules for the classification of ships, Part 29 - Polar class ships and Ice class ships*, 8.14.2.

**1.5.5.4** When gratings are secured by means of screws with a countersunk head, the tapped holes provided for such screws are not to pass through the plating or doubling plates outside distance pieces or chests.

**1.5.5.5** Screws used for fixing gratings are not to be located in the corners of openings in the hull or of doubling plates.

**1.5.5.6** On large sea inlets, the screws used for fixing the gratings are to be locked and protected from corrosion.

**1.5.5.7** Where the in-water surveys are intended, suitable means should be provided to enable the diver to confirm that the sea suction openings are clear.

Hinged sea suction grids will facilitate this operation, preferably with revolving weight balance or with a counter weight, and secured with bolts practical for dismantling and fitting while the ship is afloat.

## 1.5.6 Ship side connections for blow-down of boilers

**1.5.6.1** Blow-down pipes of boilers are to be provided with cocks or valves placed as near the end of the pipes as possible, while remaining readily accessible and located above the engine room floor.

**1.5.6.2** Blow-down valves are to be so designed that it is easy to ascertain whether they are open or shut. Where cocks are used, the control keys are to be such that they cannot be

taken off unless the cocks are shut. Where valves are used, the control-wheels are to be permanently fixed to the spindle.

**1.5.6.3** A protection ring is to be fitted on the shell plating, outside, at the end of the blow-down pipes. The spigot shall terminate flush with the outer side of the ring.

## 1.6 PIPES ROUTING

### 1.6.1 Pipes routing through watertight and fire-resisting structures

**1.6.1.1** The number of pipe penetrations in watertight subdivisions is to be kept to a minimum compatible with the design and proper operation of the ship. Where penetrations are necessary, arrangements are to be made to maintain the watertight integrity.

Unless otherwise specified, the pipelines passing through the main watertight bulkheads, as a rule, shall be situated at a distance from the ship's side of at least 1/5 of the ship's breadth (see 2.3.6 and 1.6.7).

Depending of the type of ship, this criterion shall be a subject to subdivision and damage stability requirements in relevant Section of the *Rules for the classification of ships, Part 5 - Subdivision*.

Where this requirement is impracticable, measures shall be taken to prevent the spread of sea water beyond the damaged compartment into other watertight compartments and tanks, in the event of damage to the ship's hull and deterioration of the pipes.

### 1.6.1.2 Passage through the collision bulkhead

- .1 Except as provided in paragraph .2 below, the collision bulkhead may be pierced below the bulkhead deck of passenger ships and the freeboard deck of cargo ships by not more than one pipe for dealing with fluid in the forepeak tank, provided that the pipe is fitted with a remotely controlled valve capable of being operated from above the bulkhead deck of passenger ships and the freeboard deck of cargo ships. The valve shall be normally closed. If the remote control system should fail during operation of the valve, the valve shall close automatically or be capable of being closed manually from a position above the bulkhead deck of passenger ships and the freeboard deck of cargo ships. The valve shall be located at the collision bulkhead on either the forward or aft side, provided the space on the aft side is not a cargo space.

The Flag State Administration may also have additional requirements.

- .2 If the forepeak is divided to hold two different kinds of liquids the Register may allow the collision bulkhead to be pierced below the bulkhead deck of passenger ships and the freeboard deck of cargo ships by two pipes, each of which is fitted as required by paragraph .1 above, provided the Register is satisfied that there is no

practical alternative to the fitting of such a second pipe and that, having regard to the additional subdivision provided in the forepeak, the safety of the ship is maintained.

The Flag state Administration may also have additional requirements.

**.3** The valves fitted on collision bulkhead below the bulkhead deck are to be of steel, bronze or other approved ductile material. Valves of ordinary cast iron or similar material are not acceptable.

**.4** The required valve control from above the bulkhead deck is not mandatory for ships other than passenger ships with restricted areas of navigation 5 to 8, which need not to comply with the requirements for subdivision in damaged condition, provided that related pipeline is not passing through cargo holds and fuel tanks.

**1.6.1.3** The pipes used for watertight passages of metallic pipes below the bulkhead deck and pipe connections fitted to the tanks shall have substantial thickness, not less than specified in Table 1.3.4.3-column D.

**1.6.1.4** Where the pipelines pass through watertight bulkheads, decks and other watertight structures, suitable bulkhead pieces (bushes) flanges or other similar arrangements shall be used to ensure the watertightness of the structure concerned.

Holes for bolts are not to penetrate the watertight bulkhead or deck but they must end in welded pads. Where welded connections are used, they are to be welded on both sides of the bulkhead or deck.

Gaskets of lead or other heat sensitive materials which may impair the watertight integrity of the bulkheads or decks in the event of fire are not permitted.

For passenger ships, the additional requirements specified in the *Rules for the classification of ships, Part 3 - Hull Equipment, 7.12.2* shall be complied with. For passenger ships of less than 500 GT navigating in restricted navigation areas 5 to 8, unless Flag State Administration expressly provided otherwise, the application of these additional requirements is subject to special consideration by the *Register* in each particular case.

**1.6.1.5** Where plastic pipes pass through watertight bulkheads or decks, the watertight integrity of the bulkhead or deck is to be maintained. The arrangements are to be made in compliance with 1.7.6.7.

**1.6.1.6** Where it is necessary to penetrate the fire-resisting bulkheads or decks, the requirements of the *Rules for the classification of ships, Part 17 - Fire Protection, 9.3* shall be complied with.

**1.6.1.7** Where plastic pipes pass through the bulkhead or deck which is also a fire division, the arrangements are to be made to ensure that the fire endurance is not impaired and fitted with suitable valves in compliance with 1.7.6.7.

**1.6.1.8** Depending of the subdivision and damage stability requirements in relevant Section of the *Rules for the classification of ships, Part 5 - Subdivision*, the bulkheads and decks forming watertight boundaries may be fitted with

suitable cross-flooding pipelines and particular fittings for equalization of the ship in case of unsymmetrical flooding.

Where controls to cross-flooding fittings are provided, they shall be operable from above the bulkhead deck. These fittings together with their controls shall be acceptable to the Administration.

## 1.6.2 Pipes routing in tanks

**1.6.2.1** For routing of pipes, following general requirements, inter alia, are to be complied with:

- .1 In general, the passage of pipes through tanks, when permitted shall include special arrangements such as reinforced thickness or tunnels. It applies particularly for the fuel oil pipes, bilge pipes, ballast pipes, air vent pipes, sounding pipes, overflow pipes, scuppers and sanitary discharges. Junctions of pipes inside tanks are to be made by welding or flange connections.
- .2 Drinking water and feed water pipes shall not be led without tunnel through fuel and lubricating oil storage tanks.
- .3 Fuel oil and lubrication oil pipes shall not pass through drinking water and feed water tanks unless they are led in oiltight tunnels, forming part of the tank structure.
- .4 Sea water and lubricating oil pipes, as well as air overflow and sounding pipes are allowed to be led through fuel oil storage tanks if seamless pipes without detachable joints inside such tanks are used. Where detachable joints cannot be avoided, they shall be flange connections with gaskets resistant to oil.

**1.6.2.2** Where no tunnels are used in leading pipes through tanks and where compensation of thermal expansion is required, bends of the pipes themselves shall be made inside the tank.

Where pipes are led through tunnels, it is recommended that the thermal compensators be situated outside the tunnel.

**1.6.2.3** Leading of pipes through tanks in oil tankers shall comply with requirements stated in 4.2.

## 1.6.3 Pipes routing in cargo holds and other spaces

**1.6.3.1** Pipes shall be secured in a way as not to interfere with the stresses from thermal expansion, undue deformations of ship structure and vibrations.

**1.6.3.2** Pipes passing through cargo holds, chain lockers and other spaces in which they are subject to mechanical damage shall be adequately protected.

**1.6.3.3** Fuel, steam and water piping as well as pressure pipes of hydraulic drives, with the exception of bilge pipes, are, as a rule, not allowed in dry cargo holds.

In exceptional cases, which are subject to special consideration by the *Register*, these pipes may be allowed

provided they are led in tunnels, or where the pipes employed are of increased thickness and protected by strong steel casings.

**1.6.3.4** Steam piping shall not be led through paint rooms, lantern rooms or other spaces intended for carriage of readily flammable materials.

**1.6.3.5** Where hot pipes pierce bulkheads made of combustible materials, provision shall be made for structural measures preventing bulkheads from being affected by increased temperature.

**1.6.3.6** Fuel oil piping shall not be led through accommodation and service spaces. An exception can be made for fuel oil pipelines of the emergency diesel-generator, and also for filling pipes which are allowed to be led through the sanitary spaces, provided the pipes used have a thickness of not less than 5 mm and no detachable joints are employed.

**1.6.3.7** Pipes intended for carrying hot media and having considerable longitudinal extension shall have thermal compensators or as many bends as will provide adequate self-compensation of the pipeline.

Internal radii of bending shall not be less than specified in 1.3.2.

**1.6.3.8** Piping of all systems and ventilation ducts shall, where necessary, be fitted with suitable arrangements to permit drainage or blowing-off the working medium or condensates.

Structural measures shall be taken to protect the hull and equipment from adverse effect of the agents discharged.

#### **1.6.4 Pipes routing in refrigerated cargo spaces**

**1.6.4.1** No pipes shall be led through refrigerated cargo spaces unless they are intended to serve these spaces. Where leading of such pipes cannot be avoided, they shall be carefully insulated. This requirement equally applies to air and sounding pipes too. In these spaces pipes shall not have sections in which water may collect and freeze.

**1.6.4.2** Leading of pipes of fire-fighting systems shall comply with the requirements of the *Rules for the classification of ships, Part 17 - Fire Protection*, 3.2.2.1.3.

#### **1.6.5 Pipes routing in vicinity of electrical and radio equipment**

**1.6.5.1** Pipes routing subjected to pressure is not allowed above or behind main and emergency switchboards nor the control panels of essential machinery and equipment.

Pipes routing from the front and side of the switchboard and control panel is allowed at a distance of at least 500 [mm], provided that these pipelines, for a length of 1500 [mm] from the switchboard or control panel, have no detachable joints or that flanged joints are fitted with protecting casings.

**1.6.5.2** Pipes routing through special electrical spaces (see *Rules for the classification of ships, Part 12 - Electrical Equipment*, 2.8) and also through accumulator battery rooms

is not allowed. Exception is made for carbon dioxide fire smothering pipes and those serving electrical equipment installed in these spaces.

**1.6.5.3** Pipes routing through space containing the gyrocompass is not allowed, with the exception of pipes used for cooling the gyrocompass.

**1.6.5.4** Pipes routing through radio room is not allowed.

#### **1.6.6 Pipes routing in unattended machinery spaces**

**1.6.6.1** Joints of pipelines of Class I conveying fuel and lubricating oil shall be welded. Detachable joints are permitted to be used but their number shall be kept to a minimum; in this case, protective casings shall be provided in the places where detachable joints are fitted.

#### **1.6.7 Prevention of progressive flooding**

##### **1.6.7.1 Principle**

- .1 In order to comply with the subdivision and damage stability requirements specified in Pt 5, provision is to be made to prevent any progressive flooding of a dry compartment served by any open-ended pipe, in the event that such pipe is damaged or broken in any other compartment by collision or grounding.
- .2 For this purpose, if pipes are situated within assumed flooded compartments, arrangements are to be made to ensure that progressive flooding cannot thereby extend to compartments other than those assumed to be flooded for each case of damage. However, *Register* may permit minor progressive flooding if it is demonstrated that its effects can be easily controlled and the safety of the ship is not impaired.

##### **1.6.7.2 Extent of damage**

For the definition of the assumed transverse extent of damage, depending of the type of ship, reference is to be made to relevant Section in *Rules for the classification of ships, Part 5 - Subdivision*.

##### **1.6.7.3 Piping arrangement**

- .1 The assumed transverse extent of damage is not to contain any pipe with an open end in a compartment located outside this extent, except where the section of such pipe does not exceed 710 mm<sup>2</sup>.  
Where several pipes are considered, the limit of 710 mm<sup>2</sup> applies to their total section.
- .2 Where the provisions of item .1 cannot be fulfilled, and after special examination by *Register*, pipes may be situated within the assumed transverse extent of damage penetration, provided that:
  - either a closable metallic valve operable from above the bulkhead deck is

- fitted at each penetration of a watertight subdivision and secured directly on the bulkhead, or
- a closable **metallic** valve operable from above the bulkhead deck is fitted at each end of the pipe concerned, the valves and their control system being inboard of the assumed extent of damage, or
  - an automatic non-return **metallic** valve is fitted to the pipe concerned, the valve being inboard of the assumed extent of damage, or
  - the tanks to which the pipe concerned leads are regarded in the damage stability calculations as being flooded when damage occurs in a compartment through which the pipe passes.
- **Additionally**, for penetrations of plastic pipes through watertight subdivisions, arrangement is to comply with requirements of 1.7.6.7.
- .3 Valves required to be operable from above the bulkhead deck are to be fitted with an indicator to show whether the valve is open or shut.
- .4 Where the valve is remote controlled by other than mechanical means, and where the remote control system is located, even partly, within the assumed extent of damage penetration, this system is to be such that the valve is automatically closed by loss of power.
- .5 Air and overflow pipes are to be so arranged as to prevent the possibility of flooding of other tanks in other watertight compartments in the event of any one tank being flooded.
- This arrangement is to be such that in the range of positive residual righting levers beyond the angle of equilibrium stage of flooding, the progressive flooding of tanks or watertight compartments other than that flooded does not occur.

## 1.7 APPLICATION OF PLASTIC PIPES ON SHIPS

(This Head addresses the provisions of IMO Res. A753(18), as amended by IMO Res. MSC.313(88) and MSC.399(95), including the *IACS UR P4*)

### 1.7.1 Terms and Definitions

- .1 **Plastic(s)** - means both thermoplastic and thermosetting plastic materials with or without reinforcement, such as PVC and fiber reinforced plastics - FRP. Plastic includes synthetic rubber and materials of similar thermo/mechanical properties.
- .2 **Pipes/piping systems** - means those made of plastic(s) and include the pipes, fittings, system joints, method of joining and any internal or external liners, coverings and

- coatings required to comply with the performance criteria.
- .3 **Joint** - means the location at which two pieces of pipe or a pipe and a fitting are connected together. The joint may be made by adhesive bonding, laminating, welding, flanges, and mechanical joints according to Fig. 1.3.7.4.
- .4 **Fittings** - means bends, elbows, fabricated branch pieces etc. of plastic materials.
- .5 **Nominal pressure** - means the maximum permissible working pressure, which should be determined in accordance with the requirements in 1.7.3.1.
- .6 **Design pressure** - means the maximum working pressure which is expected under operation conditions or the highest set pressure of any safety valve or pressure relief device on the system, if fitted.
- .7 **Fire endurance** - means the capability of piping to maintain its strength and integrity (i.e. capable of performing its intended function) for some predetermined period of time while exposed to fire.
- .8 **Essential to the safety of ship** - means all piping systems that in event of failure will pose a threat to personnel and the ship\*.
- .9 **Essential services** - are those services essential for propulsion and steering and safety of the ship as specified in the *Rules for the classification of ships, Part 12 - Electrical Equipment*, 1.2.5.

**NOTE:** \* Examples for piping systems essential to the safety are provided by Table 1.7.4.1 "Fire Endurance Requirement Matrix".

### 1.7.2 Scope

- .1 These requirements are applicable to plastic pipes/piping systems on ships, including pipe joints and fittings, made predominantly of other material than metal.
- .2 The use of mechanical joints approved for the use in metallic piping systems only are not permitted.
- .3 Piping systems intended for non-essential services are to meet only the requirements of recognized standards and 1.7.3.1.3 b), 1.7.4.2, 1.7.5.2 to 1.7.5.7 and 1.7.6 of this Section.

### 1.7.3 General Requirements

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

#### 1.7.3.1 Strength

- .1 The strength of the pipes is to be determined by a hydrostatic test failure pressure of a pipe specimen under the standard conditions: atmospheric pressure equal to 100 kPa, relative humidity 30%,

environmental and carried fluid temperature 298 kPa (25° C).

- .2 The strength of fittings and joints is to be not less than that of the pipes.
- .3 The nominal pressure is to be determined from the following conditions:
  - a) INTERNAL PRESSURE - for an internal pressure the following is to be taken whichever is smaller: the following is to be taken whichever is smaller:

$$p_{n,int} \leq \frac{P_{sth}}{4}, \quad \text{or} \quad p_{n,int} \leq \frac{P_{lth}}{2.5}$$

where:

$P_{sth}$  = short-term hydrostatic test pipe failure pressure;

$P_{lth}$  = long-term hydrostatic test pipe failure pressure (> 100,000 h)

- b) EXTERNAL PRESSURE - (for any installation which may be subject to vacuum conditions inside the pipe or a head of liquid acting on the outside of the pipe; and for any pipe installation required to remain operational in case of flooding damage, as per SOLAS II-1/8-1, as amended, or for any pipes that would allow progressive flooding to other compartments through damaged piping or through open ended pipes in the compartments).

For an external pressure:

$$p_{n,ext} \leq \frac{P_{col}}{3}$$

where:

$p_{col}$  = pipe collapse pressure.

In no case is the pipe collapse pressure to be less than 3 bar.

The maximum working external pressure is a sum of the vacuum inside the pipe and a head of liquid acting on the outside of the pipe.

- .4 Notwithstanding the requirements of 3 a) or 3 b) above as applicable, the pipe or pipe layer minimum wall thickness is to follow recognized standards. In the absence of standards for pipes not subject to external pressure, the requirements of 3 b) above are to be met.
- .5 The maximum permissible working pressure is to be specified with due regard for maximum possible working temperatures in accordance with Manufacturer's recommendations.

### 1.7.3.2 Axial Strength

- .1 The sum of the longitudinal stresses due to pressure, weight and other loads is not to exceed the allowable stress in the longitudinal direction.
- .4 In the case of fiber reinforced plastic pipes, the sum of the longitudinal stresses is not to exceed half of the nominal

circumferential stress derived from the nominal internal pressure condition (see 1.7.3.1).

### 1.7.3.3 Impact Resistance

- .1 Plastic pipes and joints are to have a minimum resistance to impact in accordance with recognized national or international standards.
- .2 After the test the specimen is to be subjected to hydrostatic pressure equal to 2.5 times the design pressure for at least 1 hour.

### 1.7.3.4 Temperature

- .1 The permissible working temperature depending on the working pressure is to be in accordance with Manufacturer's recommendations, but in each case it is to be at least 20°C lower than the minimum heat distortion/deflection temperature of the pipe material, determined according to ISO 75-2:2013 method A, or equivalent, e.g. ASTM D648-18.
- .2 The minimum heat distortion/deflection temperature is to be not less than 80°C.

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

### 1.7.4.1 Fire Endurance

- .1 Pipes and their associated joints and fittings whose integrity is essential to the safety of ships, including plastic piping required by SOLAS II-2/21.4 to remain operational after a fire casualty, are required to meet the minimum fire endurance requirements of Appendix 1 or 2, as applicable, of IMO Res A.753(18), as amended by IMO Resolutions MSC. 313(88) and MSC.399(95).
- .2 Unless instructed otherwise by the Flag Administration, fire endurance tests are to be carried out with specimen representative for pipes, joints and fittings<sup>1</sup>:
  - a) Pipes:
    - for sizes with outer diameter <200 mm the minimum outer diameter and wall thickness<sup>2</sup>;
    - for sizes with outer diameter ≥200 mm one test specimen for each category of t/d (D = outer diameter, t = structural wall thickness). A scattering of ±10% for t/D is regarded as the same group. Minimum size approved is equal to the diameter of specimen successfully tested.
  - b) Joints:
    - Each type of joint applicable for applied fire endurance level tested on pipe to pipe specimen.

- .3 Means are to be provided to ensure a constant media pressure inside the test specimen during the fire test as specified in Appendix 1 or 2 of the IMO Resolution A.753(18), as amended by IMO Resolutions MSC.313(88) and MSC.399(95). During the test it is not permitted to replace media drained by fresh water or nitrogen.
- .4 Depending on the capability of a piping system to maintain its strength and integrity, there exist three different levels of fire endurance for piping systems.
- a) *Level 1.* Piping having passed the fire endurance test specified in Appendix 1 of IMO Resolution A.753(18), as amended by IMO Resolutions MSC.313(88) and MSC.399(95) for a duration of a minimum of one hour without loss of integrity in the dry condition is considered to meet level 1 fire endurance standard (L1).  
*Level 1W* – Piping systems similar to Level 1 systems except these systems do not carry flammable fluid or any gas and a maximum 5% flow loss in the system after exposure is acceptable (L1W).
- b) *Level 2.* Piping having passed the fire endurance test specified in Appendix 1 of IMO Resolution A.753(18), as amended by IMO Resolutions MSC.313(88) and MSC.399(95) for a duration of a minimum of 30 minutes in the dry condition is considered to meet level 2 fire endurance standard (L2). *Level 2W* – Piping systems similar to Level 2 systems except a maximum 5% flow loss in the system after exposure is acceptable (L2W).
- c) *Level 3.* Piping having passed the fire endurance test specified in Appendix 2 of IMO Res. A.753(18) as amended by IMO Resolutions MSC.313(88) and MSC.399(95) for duration of a minimum of 30 minutes in the wet condition is considered to meet level 3 fire endurance standard (L3).
- .5 Permitted uses of piping depending on fire endurance, location and piping system is given in Table 1.7.4.1 “Fire Endurance Requirement Matrix”.
- .6 For Safe Return to Port purposes (SOLAS II-2/21.4), plastic piping can be considered to remain operational after a fire casualty if the plastic pipes and fittings have been tested to L1 standard.

**Notes:**

1. A test specimen incorporating several components of a piping system may be tested in a single test.
2. Test conditions are most demanding for minimum wall thickness and thus larger wall thickness is covered. A key factor determining the fire performance of a pipe component variant is the thickness-to-diameter ( $t/D$ ) ratio and whether it is larger or smaller than

that of the variant which has been fire-tested. If fire-protective coatings or layers are included in the variant used in the fire test, only variants with the same or greater thickness of protection, regardless of the ( $t/D$ ) ratio, shall be qualified by the fire test.

**1.7.4.2 Flame spread**

- .1 All pipes, except those fitted on open decks and within tanks, cofferdams, pipe tunnels, and ducts if separated from accommodation, permanent manned areas and escape ways by means of an A class bulkhead are to have low surface flame spread characteristics not exceeding average values listed in Appendix 3 of IMO Resolution A.753(18), as amended by IMO Resolutions MSC.313(88) and MSC.399(95).
- .2 Surface flame spread characteristics are to be determined using the procedure given in the 2010 FTP Code, Annex 1, Part 5, with regard to the modifications due to the curvilinear pipe surfaces as also listed in Appendix 3 of IMO Res. A.753(18), as amended by IMO Resolutions MSC.313(88) and MSC.399(95).
- .3 Surface flame spread characteristics may also be determined using the text test procedures given in ASTM D635-18, or in other national equivalent standards. Under the procedure of ASTM D635-18 a maximum burning rate of 60 mm/min applies. In case of adoption of other national equivalent standards, the relevant acceptance criteria are to be defined.

**1.7.4.3 Fire protection coatings**

- .1 Where a fire protective coating of pipes and fittings is necessary for achieving the fire endurance level required, it is to meet the following requirements:
  - a) The pipes are generally to be delivered from the manufacturer with the protective coating on.
  - b) The fire protection properties of the coating are not to be diminished when exposed to salt water, oil or bilge slops. It is to be demonstrated that the coating is resistant to products likely to come into contact with the piping.
  - c) In considering fire protection coatings, such characteristics as thermal expansion, resistance against vibrations, and elasticity are to be taken into account.
  - c) The fire protection coatings are to have sufficient resistance to impact to retain their integrity.

**1.7.4.4 Electrical Conductivity**

- .1 Where electrical conductivity is to be ensured, the resistance of the pipes and fittings is not to exceed  $1 \times 10^5$  Ohm/m.

**Table 1.7.4.1-1**

Fire Endurance Requirement Matrix

ABBREVIATIONS	
L1	Fire endurance test (appendix 1 of IMO Resolution A.753(18), as amended by IMO Resolutions MSC.313(88) and MSC.399(95)) in dry conditions, 60 min
L1W	Fire endurance test (section 1.7.4.1.2)
L2	Fire endurance test (appendix 1 of IMO Resolution A.753(18), as amended by IMO Resolutions MSC.313(88) and MSC.399(95)) in dry conditions, 30 min
L2W	Fire endurance test (section 1.7.4.1.2)
L3	Fire endurance test (appendix 2 of IMO Resolution A.753(18), as amended by IMO Resolutions MSC.313(88) and MSC.399(95)) in wet conditions, 30 min
0	No fire endurance test required
NA	Not applicable
X	Metallic materials having a melting point greater than 925 °C

**Table 1.7.4.1-2**

LOCATION DEFINITIONS		
Loc.	Definition	Description
A	Machinery spaces of category A	Machinery spaces of category A as defined in the <i>Rules, Part 7 – Machinery Installation</i> , 1.2.5.
B	Other machinery spaces and pump rooms	Spaces, other than category A machinery spaces and cargo pump rooms, containing propulsion machinery, boilers, fuel oil units, steam and internal combustion engines, generators, and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air-conditioning machinery, and similar spaces, and trunks to such spaces.
C	Cargo pump rooms	Spaces containing cargo pumps and entrances and trunks to such spaces.
D	Ro/Ro cargo holds	Ro-Ro cargo spaces and special category spaces as defined in 3.1.2.41 & 46 of the <i>Rules Part 17 – Fire Protection</i> .
E	Other dry cargo holds	All spaces other than ro-ro cargo holds used for non-liquid cargo and trunks to such spaces.
F	Cargo Tanks	All spaces used for liquid cargo and trunks to such spaces.
G	Fuel oil Tanks	All spaces used for fuel oil (excluding cargo tanks) and trunks to such spaces.
H	Ballast water tanks	All spaces used for ballast water and trunks to such spaces.
I	Cofferdams, void spaces, pipe tunnel and ducts	Cofferdams and voids are those empty spaces between two bulkheads separating two adjacent compartments.
J	Accommodation service and control spaces	Accommodation spaces, service spaces and control stations as defined in 3.1.2.1; 45 & 18 of the <i>Rules Part 17 – Fire Protection</i> .
K	Open decks	Open deck spaces as defined in 9.2.2.3.2(5) of the <i>Rules Part 17 – Fire Protection</i> .

**Table 1.7.4.1-3**

INERT GAS												
No.	Piping system	A	B	C	D	E	F	G	H	I	J	K
1	Cargo lines	NA	NA	L1	NA	NA	0	NA	0 <sup>(10)</sup>	0	NA	L1 <sup>(2)</sup>
2	Crude oil washing lines	NA	NA	L1	NA	NA	0	NA	0 <sup>(10)</sup>	0	NA	L1 <sup>(2)</sup>
3	Vent lines	NA	NA	NA	NA	NA	0	NA	0 <sup>(10)</sup>	0	NA	X

**Table 1.7.4.1-4**

INERT GAS												
No.	Piping system	A	B	C	D	E	F	G	H	I	J	K
4	Water seal effluent line	NA	NA	0 <sup>(1)</sup>	NA	NA	0 <sup>(1)</sup>	0 <sup>(1)</sup>	0 <sup>(1)</sup>	0 <sup>(1)</sup>	NA	0
5	Scrubber effluent line	0 <sup>(1)</sup>	0 <sup>(1)</sup>	NA	NA	NA	NA	NA	0 <sup>(1)</sup>	0 <sup>(1)</sup>	NA	0
6	Main line	0	0	L1	NA	NA	NA	NA	NA	0	NA	L1 <sup>(6)</sup>
7	Distribution lines	NA	NA	L1	NA	NA	0	NA	NA	0	NA	L1 <sup>(2)</sup>

Table 1.7.4.1-5

LIQUIDS (flash point > 60°C)												
No.	Piping system	A	B	C	D	E	F	G	H	I	J	K
8	Cargo line	X	X	L1	X	X	NA <sup>(3)</sup>	0	0 <sup>(10)</sup>	0	NA	L1
9	Fuel oil	X	X	L1	X	X	NA <sup>(3)</sup>	0	0	0	L1	L1
10	Lubricating	X	X	L1	X	X	NA	NA	NA	0	L1	L1
11	Hydraulic oil	X	X	L1	X	X	0	0	0	0	L1	L1

Table 1.7.4.1-6

SEAWATER <sup>(1)</sup>												
No.	Piping system	A	B	C	D	E	F	G	H	I	J	K
12	Bilge main and branches	L1 <sup>(7)</sup>	L1 <sup>(7)</sup>	L1	X	X	NA	0	0	0	NA	L1
13	Fire main and water spray	L1	L1	L1	X	NA	NA	NA	0	0	X	L1
14	Foam system	L1W	L1W	L1W	NA	NA	NA	NA	NA	0	L1W	L1W
15	Sprinkler system	L1W	L1W	L3	X	NA	NA	NA	0	0	L3	L3
16	Ballast	L3	L3	L3	L3	X	0 <sup>(10)</sup>	0	0	0	L2W	L2W
17	Cooling water, essential services	L3	L3	NA	NA	NA	NA	NA	0	0	NA	L2W
18	Tank cleaning services, fixed machines	NA	NA	L3	NA	NA	0	NA	0	0	NA	L3 <sup>(2)</sup>
19	Non-essential systems	0	0	0	0	0	NA	0	0	0	0	0

Table 1.7.4.1-7

FRESHWATER												
No.	Piping system	A	B	C	D	E	F	G	H	I	J	K
20	Cooling water, essential services	L3	L3	NA	NA	NA	NA	0	0	0	L3	L3
21	Condensate return	L3	L3	L3	0	0	NA	NA	NA	0	0	0
22	Non-essential systems	0	0	0	0	0	NA	0	0	0	0	0

Table 1.7.4.1-8

SANITARY / DRAINS / SCUPPERS												
No.	Piping system	A	B	C	D	E	F	G	H	I	J	K
23	Deck drains (internal)	L1W <sup>(4)</sup>	L1W <sup>(4)</sup>	NA	L1W <sup>(4)</sup>	0	NA	0	0	0	0	0
24	Sanitary drains (internal)	0	0	NA	0	0	NA	0	0	0	0	0
25	Scuppers and discharges (over-board)	0 <sup>(1,8)</sup>	0 <sup>(1,8)</sup>	0 <sup>(1,8)</sup>	0 <sup>(1,8)</sup>	0 <sup>(1,8)</sup>	0	0	0	0	0 <sup>(1,8)</sup>	0

Table 1.7.4.1-9

SOUNDING / AIR												
No.	Piping system	A	B	C	D	E	F	G	H	I	J	K
26	Water tanks/dry spaces	0	0	0	0	0	0 <sup>(10)</sup>	0	0	0	0	0
27	Oil tanks (flash point > 60°C)	X	X	X	X	X	X <sup>(3)</sup>	0	0 <sup>(10)</sup>	0	X	X

Table 1.7.4.1-10

MISCELLANEOUS												
No.	Piping system	A	B	C	D	E	F	G	H	I	J	K
28	Control air	L1 <sup>(5)</sup>	L1 <sup>(5)</sup>	L1 <sup>(5)</sup>	L1 <sup>(5)</sup>	L1 <sup>(5)</sup>	NA	0	0	0	L1 <sup>(5)</sup>	L1 <sup>(5)</sup>
29	Service air (non-essential)	0	0	0	0	0	NA	0	0	0	0	0
30	Brine	0	0	NA	0	0	NA	NA	NA	0	0	0
31	Auxiliary low pressure steam (≤ 7 bar)	L2W	L2W	0 <sup>(9)</sup>	0 <sup>(9)</sup>	0 <sup>(9)</sup>	0	0	0	0	0 <sup>(9)</sup>	0 <sup>(9)</sup>
32	Central vacuum cleaners	NA	NA	NA	0	NA	NA	NA	NA	0	0	0
33	Exhaust Gas Cleaning System Effluent Line	L3 <sup>(1)</sup>	L3 <sup>(1)</sup>	NA	NA	NA	NA	NA	NA	0	L3 <sup>(1,11)</sup> NA	0
34	Urea Transfer/Supply System (SCR installations)	L1 <sup>(12)</sup>	L1 <sup>(12)</sup>	NA	NA	NA	NA	NA	NA	0	L3 <sup>(11)</sup> NA	0

Table 1.7.4.1-11

FOOTNOTES	
1	Where non-metallic piping is used, remotely controlled valves to be provided at ship's side (valve is to be controlled from outside space).
2	Remote closing valves to be provided at the cargo tanks.
3	When cargo tanks contain liquids with flash point >60 C, "0" may replace "NA" or "X".
4	For drains serving only the space concerned, "0" may replace "L1W".
5	When controlling functions are not required by statutory requirements or guidelines "0" may replace "L1".
6	For pipe between machinery space and deck water seal, "0" may replace "L1".
7	For passenger ships, "X" is to replace "L1".
8	Scuppers serving open decks in positions 1 and 2, as defined in Regulation 13 of Protocol of 1988 relating to the International Convention on Load Lines, 1966, as amended, should be "X" throughout unless fitted at the upper end with the means of closing capable of being operated from a position above the freeboard deck in order to prevent downflooding.
9	For essential services, such as fuel oil tank heating and ships whistle, "X" is to replace "0".
10	For tankers where compliance with paragraph 6 of regulation 19 of MARPOL Annex I, as amended is required, "NA" is to replace "0".
11	L3 in service spaces, NA in accommodation and control spaces
12	Type Approved plastic piping without fire endurance test (0) is acceptable downstream of the tank valve, provided this valve is metal seated and arranged as fail-to-closed or with quick closing from a safe position outside the space in the event of fire.
13	For Passenger Ships subject to SOLAS II-2/21.4 (Safe return to Port), plastic pipes for services required to remain operative in the part of the ship not affected by the casualty thresholds, such as systems intended to support safe areas, are to be considered essential services. In accordance with MSC Circular MSC.1/Circ.1369, interpretation 12, for Safe Return to Port purposes, plastic piping can be considered to remain operational after a fire casualty if the plastic pipes and fittings have been tested to L1 standard.

### 1.7.5 Material Approval and Quality Control During Manufacture

**1.7.5.1** Except as required in 1.7.2.3, prototypes of pipes and fittings are to be tested to determine short-term and long-term design strength, fire endurance and low surface flame spread characteristics (if applicable), electrical resistance (for electrically conductive pipes), impact resistance in accordance with the applicable requirements in this Section.

**1.7.5.2** For prototype testing representative samples of pipes and fittings are to be selected to the satisfaction of the Register.

**1.7.5.3** The Manufacturer is to have quality system that meets ISO 9000:2015 or equivalent. The quality system is to consist of elements necessary to ensure that pipes and fittings are produced with consistent and uniform mechanical and physical properties.

**1.7.5.4** Each pipe and fitting is to be tested by the Manufacturer at a hydrostatic pressure not less than 1.5 times the nominal pressure. Alternatively, for pipes and fittings not employing hand layup techniques, the hydrostatic pressure test may be carried out in accordance with the hydrostatic testing requirements stipulated in the recognised national or

international standard to which the pipe or fittings are manufactured, provided that there is an effective quality system in place.

**1.7.5.5** Piping and fittings are to be permanently marked with identification. Identification is to include pressure ratings, the design standards that the pipe or fitting is manufactured in accordance with, and the material of which the pipe or fitting is made.

**1.7.5.6** In case the Manufacturer does not have an approved quality system complying with ISO 9000:2015 or equivalent, pipes and fittings are to be tested in accordance with this Section to the satisfaction of the surveyors of the *Register* for every batch of pipes.

**1.7.5.7** Depending upon the intended application a Society may require the pressure testing of each pipe and/or fitting.

## 1.7.6 Installation

### 1.7.6.1 Supports

- .1 Selection and spacing of pipe supports in shipboard systems are to be determined as a function of allowable stresses and maximum deflection criteria. Support spacing is not to be greater than the pipe Manufacturer's recommended spacing. The selection and spacing of pipe supports are to take into account pipe dimensions, length of the piping, mechanical and physical properties of the pipe material, mass of pipe and contained fluid, external pressure, operating temperature, thermal expansion effects, loads due to external forces, thrust forces, water hammer, vibrations, maximum accelerations to which the system may be subjected. Combination of loads is to be considered.
- .2 Each support is to evenly distribute the load of the pipe and its contents over the full width of the support. Measures are to be taken to minimise wear of the pipes where they contact the supports.
- .3 Heavy components in the piping system such as valves and expansion joints are to be independently supported.

### 1.7.6.2 Expansion

- .1 Suitable provision is to be made in each pipeline to allow for relative movement between pipes made of plastic and the steel structure, having due regard to:
  - a) the difference in the coefficients of thermal expansion;
  - b) deformations of the ship's hull and its structure.
- .2 When calculating the thermal expansions, account is to be taken of the system working temperature and the temperature at which assembly is performed.

### 1.7.6.3 External Loads

- .1 When installing the piping, allowance is to be made for temporary point loads, where

applicable. Such allowances are to include at least the force exerted by a load (person) of 100 kg at mid-span on any pipe of more than 100 mm nominal outside diameter.

- .2 Besides for providing adequate robustness for all piping including open-ended piping a minimum wall thickness, complying with 1.7.3.1, may be increased taking into the conditions encountered during service on board ships.
- .3 Pipes are to be protected from mechanical damage where necessary.

### 1.7.6.4 Strength of Connections

- .1 The strength of connections is to be not less than that of the piping system in which they are installed.
- .2 Pipes may be assembled using adhesive-bonded, welded, and flanged or other joints.
- .3 Adhesives, when used for joint assembly, are to be suitable for providing a permanent seal between the pipes and fittings throughout the temperature and pressure range of the intended application.
- .4 Tightening of joints is to be performed in accordance with Manufacturer's instructions.

### 1.7.6.5 Installation of Conductive Pipes

- .1 In piping systems for fluids with conductivity less than 1000 pico Siemens per metre (pS/m) such as refined products and distillates use is to be made of conductive pipes.
- .2 Regardless of the fluid being conveyed, plastic piping is to be electrically conductive if the piping passes through a hazardous area. The resistance to earth from any point in the piping system is not to exceed  $1 \times 10^6$  Ohm. It is preferred that pipes and fittings be homogeneously conductive. Pipes and fittings having conductive layers are to be protected against a possibility of spark damage to the pipe wall. Satisfactory earthing is to be provided.
- .3 After completion of the installation, the resistance to earth is to be verified. Earthing wires are to be accessible for inspection.

### 1.7.6.6 Application of Fire Protection Coatings

- .1 Fire protection coatings are to be applied on the joints, where necessary for meeting the required fire endurance as for 1.7.4.1.3, after performing hydrostatic pressure tests of the piping system.
- .2 The fire protection coatings are to be applied in accordance with Manufacturer's recommendations, using a procedure approved in each particular case.

### 1.7.6.7 Penetration of Divisions

- .1 Where plastic pipes pass through "A" or "B" class divisions, arrangements are to be made to ensure that the fire endurance is not

impaired. These arrangements are to be tested in accordance with Recommendations for fire test procedures for "A", "B" and "F" bulkheads specified in Part 3 of Annex 1 to the 2010 FTP Code.

- .2 When plastic pipes pass through watertight bulkheads or decks, the watertight integrity of the bulkhead or deck is to be maintained. For pipes not able to satisfy the requirements in 1.7.3.1.3 b), a metallic shut-off valve operable from above the freeboard deck should be fitted at the bulkhead or deck.
- .3 If the bulkhead or deck is also a fire division and destruction by fire of plastic pipes may cause the inflow of liquid from tanks, a metallic shut-off valve operable from above the freeboard deck should be fitted at the bulkhead or deck.

#### 1.7.6.8 Control During Installation

- .1 Installation is to be in accordance with the Manufacturer's guidelines.
- .2 Prior to commencing the work, joining techniques are to be approved by *Register*.
- .3 The tests and examinations specified in this UR are to be completed before shipboard piping installation commences.
- .4 The personnel performing this work is to be properly qualified and certified to the satisfaction of *Register*.
- .5 The procedure of making bonds is to include:
  - a) Materials used,
  - b) Tools and fixtures,
  - c) Joint preparation requirements,
  - d) Cure temperature,
  - e) Dimensional requirements and tolerances, and
  - f) Tests acceptance criteria upon completion of the assembly.
- .6 Any change in the bonding procedure, which will affect the physical and mechanical properties of the joint, is to require the procedure to be requalified.

#### 1.7.6.9 Bonding Procedure Quality Testing

- .1 A test assembly is to be fabricated in accordance with the procedure to be qualified and it is to consist of at least one pipe-to-pipe joint and one pipe-to-fitting joint.
- .2 When the test assembly has been cured, it is to be subjected to a hydrostatic test pressure at a safety factor 2,5 times the design pressure of the test assembly, for not less than one hour. No leakage or separation of joints is allowed. The test is to be conducted so that the joint is loaded in both longitudinal and circumferential directions.
- .3 Selecting of the pipes used for test assembly, is to be in accordance with the following:
  - a) When the largest size to be joined is 200 mm nominal outside diameter, or

smaller, the test assembly is to be the largest piping size to be joined.

- b) When the largest size to be joined is greater than 200 mm nominal outside diameter, the size of the test assembly is to be either 200 mm or 25% of the largest piping size to be joined, whichever is greater.
- .4 When conducting performance qualifications, each bonder and each bonding operator are to make up test assemblies, the size and number of which are to be as required above.

#### 1.7.6.10 Testing After Installation on Board

- .1 Piping systems for essential services are to be subjected to a test pressure not less than 1.5 times the design pressure or 4 bar whichever is greater. Notwithstanding the requirement above, the requirement in 1.7.6.10.2 may be applied to open ended pipes (drains, effluent, etc.).
- .2 Piping systems for non-essential services are to be checked for leakage under operational conditions.
- .3 For piping required to be electrically conductive, earthing is to be checked and random resistance testing is to be conducted.

### 1.7.7 Test specification for plastic pipes

#### 1.7.7.1 Scope

Section 1.7.7 contains requirements for the Type Approval of plastic pipes. It is applicable to rigid pipes, piping systems, including pipe joints and fittings, made predominately of other material than metal.

#### 1.7.7.2 Documentation

The following information for the plastic pipes, fittings and joints is to be submitted for consideration and approval:

1. General Information
  - a) Pipe and fitting dimensions
  - b) Maximum internal and external working pressure
  - c) Working temperature range
  - d) Intended services and installation locations
  - e) The level of fire endurance
  - f) Electrically conductive
  - g) Intended fluids
  - h) Limits on flow rates
  - i) Serviceable life
  - j) Installation instructions
  - k) Details of marking
- .2 Drawings and supporting documentation:
  - a) Certificates and reports for relevant tests previously carried out.
  - b) Details of relevant standards.
  - c) All relevant design drawings, catalogues, data sheets, calculations and functional descriptions.

- d) Fully detailed sectional assembly drawings showing pipe, fittings and pipe connections
- .3 Materials (as applicable)
  - a) The resin type.
  - b) Catalyst and accelerator types, and concentration employed in the case of reinforced polyester resin pipes or hardeners where epoxide resins are employed.
  - c) A statement of all reinforcements employed where the reference number does not identify the mass per unit area or the tex number of a roving used in a filament winding process, these are to be detailed.
  - d) Full information regarding the type of gel-coat or thermoplastic liner employed during construction, as appropriate.
  - e) Cure/post-cure conditions. The cure and post cure temperatures and times employ resin/reinforcement ratio.
  - f) Winding angle and orientation.
  - g) Joint bonding procedures and qualification tests results, see 1.6.8.5.

#### 1.7.7.3 Testing

Testing is to demonstrate compliance of the pipes, fittings and joints for which Type Approval is sought with the requirements in 1.7.

Pipes, joints and fittings are to be tested for compliance with the requirements of standards acceptable to the *Register*. The applicable standards are listed in *IACS Rec. 86* – as amended (latest revision - Rev. 2 of March 2019).

## 1.8 FLOW VELOCITY IN PIPING SYSTEMS

**1.8.1** This Article could be of assistance for piping design, since the flow velocity shall be carefully assessed at the design stage and the materials of pipes, valves etc., selected to suit the conditions.

**1.8.2** In order to follow the good shipbuilding practice, standard flow velocities ( $v$  m/s) are shown in diagrams within this Article, with respect to the nominal diameter of pipe (ND mm), pipe material and media

The diagrams are recommended as a reference for pipelines design in the marine piping systems generally.

**1.8.3** As a general rule, the water velocity in copper pipes should not exceed 1 m/s, but in the pipes of other materials specified in this Article the water (sea water and fresh water) velocity should normally be not less than about 1 m/s in order to avoid fouling and subsequent pitting.

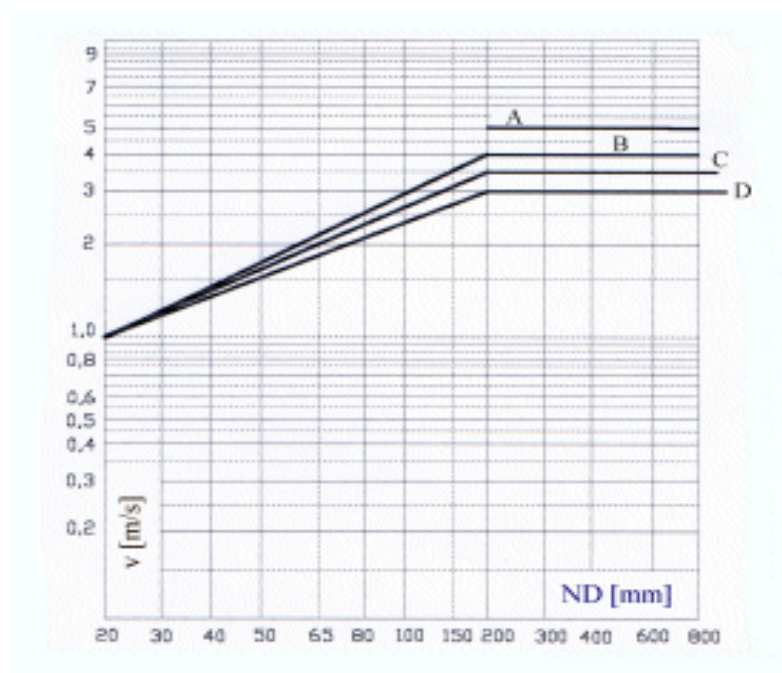
**1.8.4** Standard velocities for pipelines in sea water systems and recommended criterion for the continuous flow are shown on the diagram Figure 1.8.4, with respect to the material and nominal diameter of pipe (ND mm).

**1.8.5** Standard velocities of flow in steel pipe for water and oil generally are shown in Figure 1.8.5.

**1.8.6** Standard flow velocities in copper alloy pipe for sea water are shown in Figure 1.8.6.

**1.8.7** Standard flow velocities in steel pipe for exhaust gas are shown in Figure 1.8.7.

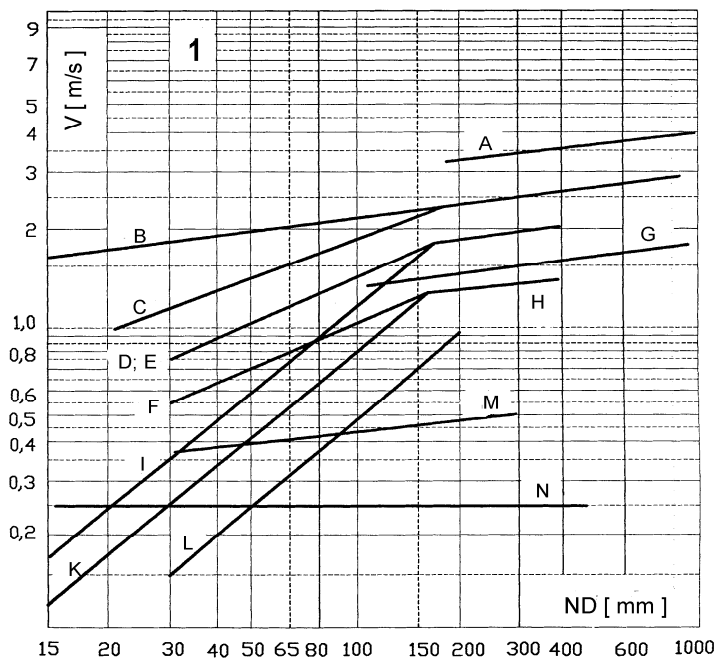
**1.8.8** Standard flow velocities in steam, exhaust and compressed air pipes are shown in Figure 1.8.8.



Where:

- A – Cast iron pipes
- B – 70/30 copper-nickel pipes (CuNi30Mn1Fe)
- C – 90/10 copper-nickel-iron pipes (CuNi10Fe1Mn)
- D – Galvanised steel pipes and Aluminium brass pipes (CuZn21Al2-Yorcalbro)

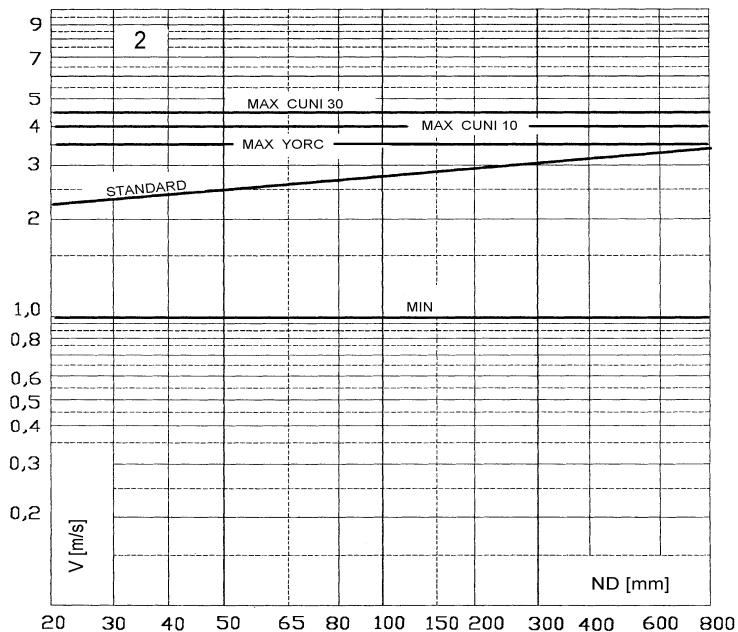
**Figure 1.8.4**  
Standard velocities in sea water pipelines of different material



Where:

- A - axial flow pump suction and discharge pipes (water)
- B - suction and discharge pipes (water) of centrifugal pump for general use
- C - low pressure direct acting reciprocating pump discharge pipes (water)
- D - low pressure direct acting reciprocating pump suction pipes (water)
- E - high-pressure direct acting reciprocating pump discharge pipes (water)
- F - high-pressure direct acting reciprocating pump suction pipes (water)
- G - centrifugal pump suction pipes (water)
- H - for special use (requiring high suction head)
- I - lubricating oil pump discharge pipes
- K - lubricating oil pump suction pipes and fuel oil pump discharge pipes
- L - fuel oil pump suction pipes
- M - condensate pump suction pipes
- N - drain discharge pipes, lubricating oil return pipes (non-pressure)

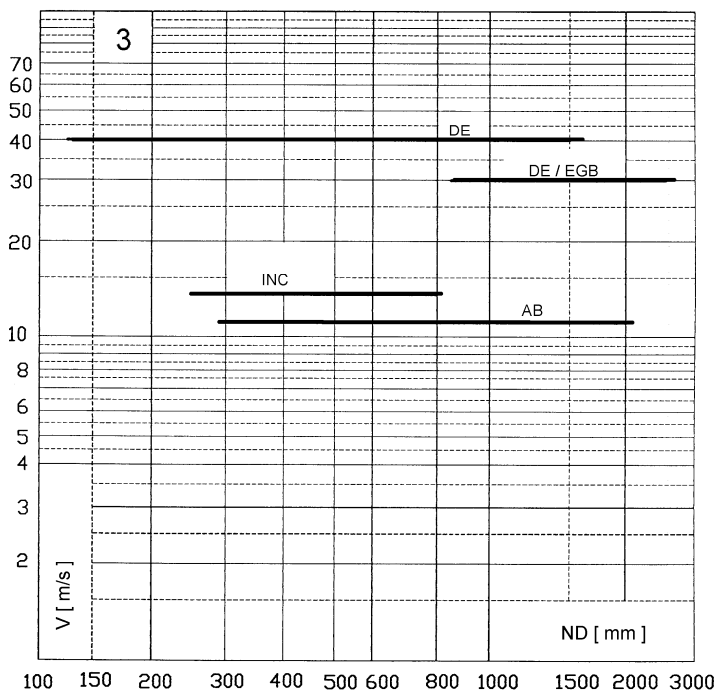
**Fig. 1.8.5**  
Standard velocities of flow in steel pipe for water and oil



Where, for protecting erosion:

- MAX-CUNI 30 - permissible maximum flow velocity for piping material 70/30 copper-nickel (CuNi30Mn1Fe)
- MAX-CUNI 10 - permissible maximum flow velocity for piping material 90/10 copper-nickel-iron (CuNi10Fe1Mn)
- MAX-YORC - permissible maximum flow velocity for piping material aluminium brass (Yorcalbro)
- STANDARD - standard flow velocity
- MIN - permissible minimum flow velocity for the piping material signifies lower limit flow velocity to be applicable for protecting pitting corrosion.

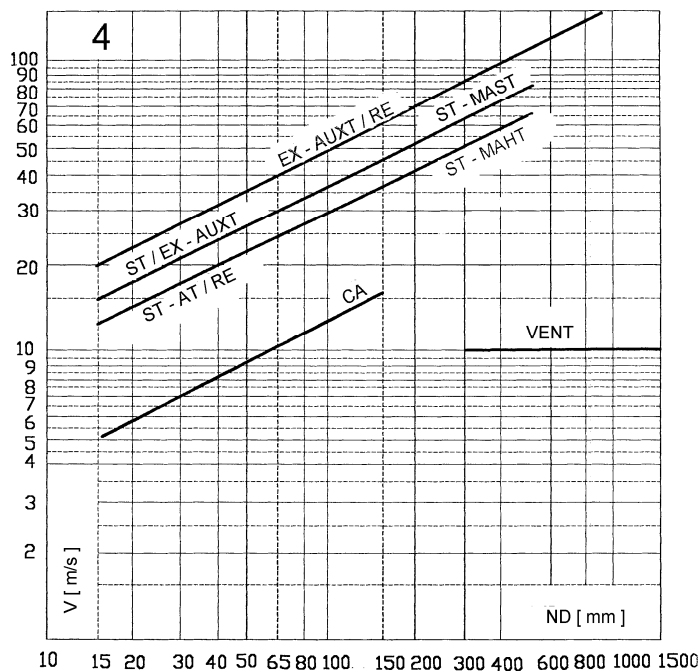
**Fig. 1.8.6**  
Standard flow velocities in copper alloy pipe for sea water



Where:

- DE/EGB - diesel engine with exhaust gas Economiser
- DE - diesel engine without exhaust gas economiser
- INC - waste oil incinerator
- AB - auxiliary boiler

**Fig. 1.8.7**  
Standard flow velocities in steel pipe for exhaust gas



**Figure 1.8.8**  
Standard flow velocities in steam, exhaust and compressed air pipes

Where:

- EX-AUXT/RE - exhaust pipes for auxiliary turbine (superheated) and for reciprocating engine
- ST/EX-AUXT - steam pipes (superheated) and exhaust pipes for auxiliary turbine
- ST/MAST - steam pipes (superheated) for main astern turbine
- ST-AT/RE - steam pipes (saturated) for auxiliary turbine and exhaust pipes for reciprocating engine
- ST-MAHT - steam pipes (superheated) for main ahead turbine
- CA - compressed air pipes
- VENT - ducted pipes for ventilation

## 1.9 MACHINERY, CONTROL AND MONITORING

**1.9.1** Pumps, fans, compressors and their electric drives used in systems which are described in this *Part of Rules* shall comply with the requirements of the *Rules for the classification of ships, Part 9 - Machines* and *Part 12 - Electrical Equipment*.

**1.9.2** Automation systems shall comply with the requirements of the *Rules for the classification of ships, Part 13 - Automation*.

**1.9.3** Heat exchangers and pressure vessels used in piping systems are to comply with the requirements of the *Rules for the classification of ships, Part 10 - Boilers, Heat Exchangers and Pressure Vessels*.

**1.9.4** In general, local gauges are to be provided at least at the following locations:

- .1 pressure gauges, in pressure vessels (see the *Rules for the classification of ships, Part 10 - Boilers, Heat Exchangers and Pressure Vessels*, 3.3 and 6.3), at pump or compressor discharge, on the low pressure side of pressure reducing valves as per 1.3.5.2;
- .2 temperature gauges, at heat exchanger inlet and outlet;
- .3 level gauges, in tanks and vessels containing liquids, subject to the provisions of 5.5.

## 1.10 TYPE APPROVAL OF MECHANICAL JOINTS (IACS UR P2.11)

### 1.10.1 General

**1.10.1.1** This specification describes the type testing condition for type approval of mechanical joints intended for use in marine piping systems. Conditions outlined in these requirements are to be fulfilled before Type Approval Certificates are issued.

**1.10.1.2** The *Register* may specify more severe testing conditions and additional tests if considered necessary to ensure the intended reliability and also accept alternative testing in accordance with national or international standards where applicable to the intended use and application.

### 1.10.2 Scope

**1.10.2.1** This specification is applicable to mechanical joints defined in 1.3.7.4 including compression couplings and slip-on joints of different types for marine use.

### 1.10.3 Documentation

**1.10.3.1** Following documents and information are to be submitted by Manufacturer for assessment and/or approval:

- .1 product quality assurance system implemented;
- .2 complete description of the product;

- .3 typical sectional drawings with all dimensions necessary for evaluation of joint design;
- .4 complete specification of materials used for all components of the assembly;
- .5 proposed test procedure as required in 1.10.5 and corresponding test reports or other previous relevant tests;
- .6 initial information:
  - maximum design pressures (pressure and vacuum);
  - maximum and minimum design temperatures;
  - conveyed media;
  - intended services;
  - maximum axial, lateral and angular deviation, allowed by manufacturer;
  - installation details.

**1.10.4 Materials**

The materials used for mechanical joints are to comply with the requirements of 1.3.7.4.4.

The manufacturer has to submit evidence to substantiate that all components are adequately resistant to working the media at design pressure and temperature specified.

**1.10.5 Testing, procedures and requirements**

The aim of tests is to demonstrate ability of the pipe joints to operate satisfactory under intended service conditions.

The scope and type of tests to be conducted e.g. applicable tests, sequence of testing, and the number of specimen, is subject to approval and will depend on joint design and its intended service in accordance with the requirements of this UR.

Unless otherwise specified, the water or oil as test fluid is to be used.

**1.10.5.1** Test program for mechanical joints shall include at least testing requirements as indicated in Table 1.10.5.2.

**1.10.5.2** Test specimens are to be selected from production line or at random from stock.

Where there are various sizes from type of joints requiring approval, minimum of three separate sizes representative of the range, from each type of joints are to be subject to the tests listed in Table 1.10.5.2.

**1.10.5.3 Mechanical Joint Assembly**

Assembly of mechanical joints should consist of components selected in accordance with 1.10.5.2 and the pipe sizes appropriate to the design of the joints.

Where pipe material would affect the performance of mechanical joints, the selection of joints for testing is to take the pipe material into consideration.

Where not specified, the length of pipes to be connected by means of the joint to be tested is to be at least five times the pipe diameter.

Before assembling the joint, conformity of components to the design requirements, is to be verified.

In all cases the assembly of the joint shall be carried out only according to the manufacturer’s instructions. No adjustment operations on the joint assembly, other than that specified by the manufacturer, are permitted during the test.

**1.10.5.4 Test Results Acceptance Criteria**

Where a mechanical joint assembly does not pass all or any part of the tests in Table 1.10.5.2, two assemblies of the same size and type that failed are to be tested and only those tests which mechanical joint assembly failed in the first instance, are to be repeated.

In the event where one of the assemblies fails the second test, that size and type of assembly is to be considered unacceptable.

The methods and results of each test are to be recorded and reproduced as and when required.

**Table 1.10.5.2**

Tests		Type of mechanical joint			Notes and references
		Compression couplings and pipe unions	Slip on joints		
			Grid type and machine grooved type	Slip type	
1	Tightness test	+	+	+	1.10.5.5.1
2	Vibration (fatigue) test	+	+	-	1.10.5.5.2
3	Pressure pulsation test <sup>1</sup>	+	+	-	1.10.5.5.3
4	Burst pressure test	+	+	+	1.10.5.5.4
5	Pull-out test	+	+	-	1.10.5.5.5
6	Fire endurance test	+ <sup>2</sup>	+	+	1.10.5.5.6 - If required by 1.3.7.4.5
7	Vacuum test	+ <sup>3</sup>	+	+	1.10.5.5.7 for suction lines only
8	8 Repeated assembly test	+ <sup>2</sup>	+	-	1.10.5.5.8

Table 1.10.5.2 - continued

<p>ABBREVIATIONS: + test is required - test is not required</p>	<p>NOTES: 1. for use in all Class I and II systems and those Class III systems where pressure pulsation other than water hammer is expected. 2. except permanent joint type (e.g., press type and swage type). 3. except joints with metal-to-metal tightening surfaces.</p>
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1.10.5.5 Methods of tests

1.10.5.5.1 Tightness test - in order to ensure correct assembly and tightness of the joints, all mechanical joints are to be subjected to a tightness test, as follows.

- a) Mechanical joint assembly test specimen is to be connected to the pipe or tubing in accordance with the requirements of 1.10.5.3 and the manufacturer's instructions, filled with test fluid and de-aerated. Mechanical joints assemblies intended for use in rigid connections of pipe lengths, are not to be longitudinally restrained. Pressure inside the joint assembly is to be slowly increased to 1.5 times of design pressure. This test pressure is to be retained for a minimum period of 5 minutes. In the event where there is a drop in pressure or there is visual indication of leakage, the test (including fire test) shall be repeated for two test pieces. If during the repeat test one test piece fails, the testing is regarded as having failed. Other alternative tightness test procedure, such as pneumatic test, may be accepted.
- b) For compression couplings a static gas pressure test is to be carried out to demonstrate the integrity of the mechanical joints assembly for tightness under the influence of gaseous media. The pressure is to be raised to maximum pressure or 70 bar whichever is less.
- c) Where the tightness test is carried out using gaseous media as permitted in (a) above, then the static pressure test mentioned in (b) above need not be carried out.

1.10.5.5.2 Vibration (fatigue) test - in order to establish the capability of the mechanical joint assembly to withstand fatigue, which is likely to occur due to vibrations under service conditions, mechanical joints assembly is to be subject to the following vibration test.

Conclusions of the vibration tests should show no leakage or damage, which could subsequently lead to a failure.

- a) Testing of compression couplings and pipe unions or other similar joints intended for use in rigid connections of pipe are to be tested in accordance with this method described as follows. Rigid connections are joints, connecting pipe length without free angular or axial movement. Two lengths of pipe are to be connected by means of the joint to be tested. One end of the pipe is to be rigidly fixed while the other

end is to be fitted to the vibration rig. The test rig and the joint assembly specimen being tested are to be arranged as shown in Fig.1.10.5.5.2 a.

The joint assembly is to be filled with test fluid, de-aerated and pressurised to the design pressure of the joint.

Pressure during the test is to be monitored. In the event of drop in the pressure and visual signs of leakage the test is to be repeated as described in 1.10.5.4.

Visual examination of the joint assembly is to be carried out for signs of damage which may probably lead to joint leakage.

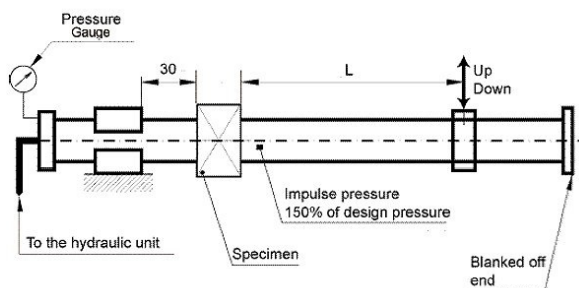


Fig.1.10.5.5.2 a

Re-tightening may be accepted once during the first 1000 cycles.

Vibration amplitude is to be within 5% of the value calculated from the following formula:

$$A = \frac{2 \cdot S \cdot L^2}{3 \cdot E \cdot D}$$

where:

- A - single amplitude, mm
- L - length of the pipe, mm
- S - allowable bending stress in N/mm<sup>2</sup> based on 0.25 of the yield stress
- E - modulus of elasticity of tube material (for mild steel, E = 210 kN/mm<sup>2</sup>)
- D - outside diameter of tube, mm.

Test specimen is to withstand not less than 107 cycles with frequency 20 - 50 Hz without leakage or damage.

- b) Grip type and Machine grooved type joints and other similar joints containing elastic elements are to be tested in accordance with the following method.

A test rig of cantilever type used for testing fatigue strength of components may be used. The test specimen being tested is to be

arranged in the test rig as shown in Fig. 1.10.5.5.2b.

Two lengths of pipes are to be connected by means of joint assembly specimen to be tested.

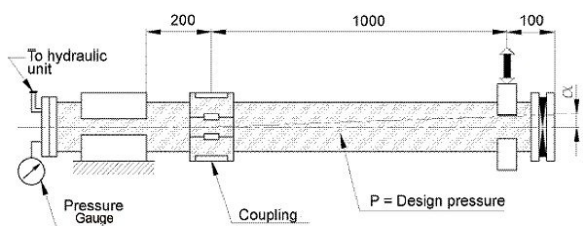
One end of the pipe is to be rigidly fixed while the other end is to be fitted to the vibrating element on the rig. The length of pipe connected to the fixed end should be kept as short as possible and in no case exceed 200 mm.

Mechanical joint assemblies are not to be longitudinally restrained.

The assembly is to be filled with test fluid, de-aerated and pressurized to the design pressure of the joint.

The amplitude is to be measured at 1m distance from the center line of the joint assembly at free pipe end connected to the rotating element of the rig. (See Fig. 1.10.5.5.2b).

Fig.1.10.5.5.2 b



Parameters of testing are to be as indicated in the table below and to be carried out on the same assembly:

Number of cycles	Amplitude, mm	Frequency, Hz
3·10	± 0,06	100
3·10	± 0,5	45
3·10	± 1,5	10

Pressure during the test is to be monitored. In the event of a drop in the pressure and visual signs of leakage the test is to be repeated as described in 1.10.5.5. 4. Visual examination of the joint assembly is to be carried out for signs of damage which may eventually cause leakage.

**1.10.5.5.3** Pressure pulsation test shall be performed in order to determine capability of mechanical joint assembly to withstand pressure pulsation likely to occur during working conditions. In that order the joint assemblies intended for use in rigid connections of pipe lengths, are to be tested in accordance with the following method.

The mechanical joint test specimen for carrying out this test may be the same as that used in the test in 1.10.5.5.1(a) provided it passed that test.

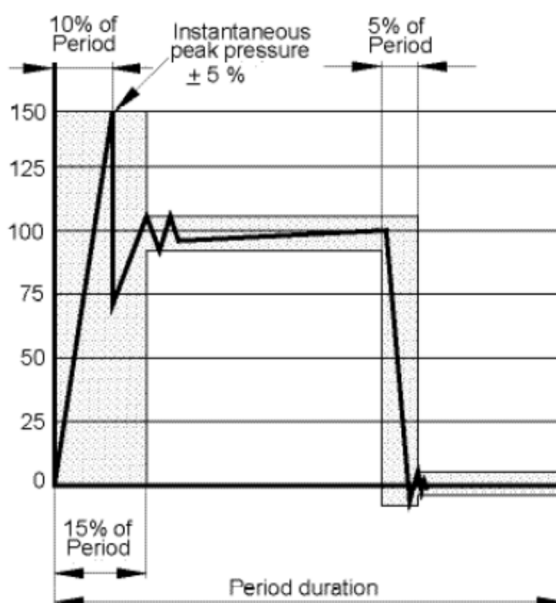
The vibration test in 1.10.5.5.2 and the pressure pulsation test are to be carried out simultaneously for compression couplings and pipe unions.

The mechanical joint test specimen is to be connected to a pressure source capable of generating pressure pulses of magnitude as shown in Fig 1.10.5.5.3.

Impulse pressure is to be raised from 0 to 1.5 times the design pressure of the joint with a frequency equal to 30-100 cycles per minute. The number of cycles is not to be less than 5 x 10<sup>5</sup>.

The mechanical joint is to be examined visually for sign of leakage or damage during the test.

Fig.1.10.5.5.3



**1.10.5.5.4** Burst pressure test is to be carried out in order to determine the capability of the mechanical joint assembly to withstand a pressure as stated by 1.3.7.4.4.

Mechanical joint test specimen is to be connected to the pipe or tubing in accordance with the requirements of 1.10.5.3, filled with test fluid, de-aerated and pressurized to test pressure with an increasing rate of 10% per minute of test pressure. The mechanical joint assembly intended for use in rigid connections of pipe lengths is not to be longitudinally restrained. Duration of this test is not to be less than 5 minutes at the maximum pressure. This pressure value will be annotated.

Where consider convenient, the mechanical joint test specimen used in tightness test in 1.10.5.5.1, same specimen may be used for the burst test provided it passed the tightness test. The specimen may have small deformation whilst under test pressure, but no leakage or visible cracks are permitted.

**1.10.5.5.5** Pull-out test is to be carried out in order to determine ability of a mechanical joint assembly to withstand axial load likely to be encountered in service without the connecting pipe from becoming detached.

Pipe length of suitable size is to be fitted to each end of the mechanical joints assembly test specimen. The test specimen is to be pressurized to design pressure. When pressure

is attained, an external axial load is to be imposed with a value calculated by the following formula:

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

where:

D - pipe outside diameter, mm

P - design pressure, N/mm<sup>2</sup>

L - applied axial load, N

The pressure and axial load are to be maintained for a period of 5 minutes. During the test, pressure is to be monitored and relative movement between the joint assembly and the pipe measured.

The mechanical joint assembly is to be visually examined for drop in pressure and signs of leakage or damage. There are to be no movement between mechanical joint assembly and the connecting pipes.

**1.10.5.5.6** Fire endurance test shall be carried out in order to establish capability of the mechanical joints to withstand effects of fire which may be encountered in service. The fire endurance test is to be conducted on the selected test specimens as per the following standards.

- a) ISO 19921: 2005(E): Ships and marine technology – Fire resistance of metallic pipe components with resilient and elastomeric seals – Test methods
- b) ISO 19922: 2005(E): Ships and marine technology – Fire resistance of metallic pipe components with resilient and elastomeric seals – Requirements imposed on the test bench.

Clarifications to the standard requirements in ISO 19921:2005, Paragraphs 7.2, 7.4, 7.6 and 7.7:

1. If the fire test is conducted with circulating water at a pressure different from the design pressure of the joint (however of at least 5 bar) the subsequent pressure test is to be carried out to 1.5 times the design pressure.
2. If the fire test is required in Table 1.3.7.4-10 to be “8 min dry + 22 min wet” or “30 min dry”, i.e. conducted for a period of time without circulating of water, the following test conditions apply:  
 Test condition “8 min dry + 22 min wet”  
 The test piece is not required to be rinsed with the test medium (water) in preparation for the test as required in Paragraph 7.2 of ISO 19921:2005. The exposure to fire is to be started and continued for 8 minutes with the sample dry; after 8 minutes of dry test condition the piping system is to be filled with water and test pressure is to be increased up to at least 5 bar within 2 minutes, then maintained to at least 5 bar. After further 22 minutes (i.e. 30 minutes from initial exposure to fire) the exposure to fire is to be stopped and a hydrostatic pressure test as specified in 1. is to be carried out.  
 Test condition “30 min dry”  
 The exposure to fire is to be started and continued for 30 minutes with the sample dry. After 30 minutes the exposure to fire is to

be stopped and a hydrostatic pressure test as specified in 1. is to be carried out.

Note

For fire tests in dry condition the pressure inside the test specimen is to be monitored for a rise due to heating of the enclosed air. Means of pressure relief should be provided where deemed necessary.

High pressures created during this test can result in failure of the test specimen. Precautions shall be taken to protect personnel and facilities.

Paragraph 7.5 of ISO 19921:2005 does not apply to the dry tests and no forced air circulation is to be arranged.

For fire endurance test requiring exposure time greater than 30 minutes test conditions are adjusted to meet the extended required total exposure time. In all cases for dry-wet test the minimum dry test exposure time is 8 minutes.

3. A selection of representative nominal bores may be tested in order to evaluate the fire resistance of a series or range of mechanical joints of the same design.  
 When a mechanical joint of a given nominal bore ( $D_n$ ) is so tested then other mechanical joints falling in the range  $D_n$  to  $2 \times D_n$  (both inclusive) are considered accepted.
4. Alternative test methods and/or test procedures considered to be at least equivalent may be accepted at the discretion of the *Register* in cases where the test pieces are too large for the test bench and cannot be completely enclosed by the flames.
5. Where thermal insulation is acceptable as a means of providing fire resistance, following requirements apply:
  - .1 Thermal insulation materials applied on couplings are to be non-combustible according to ISO 1182:2010 as required by the Fire Test Procedures Code defined in Regulation 3 of SOLAS Chapter II-2 as amended by IMO resolutions up to MSC.421(98).  
 Precautions are to be taken to protect the insulation from being impregnated with flammable oils.
  - .2 At least the fire endurance and the vibration testing in table 1.10.5.2 are to be carried out with thermal insulation in place.
  - .3 A service restriction is to be stated on the type approval certificate that the mechanical joints are to be fitted with thermal insulation during the installation in cases where the mechanical joints are used where fire resistance is required, unless mechanical joints are delivered already fitted with thermal insulation before installation.

**1.10.5.5.7** Vacuum test shall be carried out in order to establish capability of mechanical joint assembly to withstand

internal pressures below atmosphere, similar to the conditions likely to be encountered under service conditions.

Mechanical joint assembly is to be connected to a vacuum pump and subjected to a pressure 170 mbar absolute. Once this pressure is stabilized the mechanical joint assembly test specimen under test are to be isolated from the vacuum pump and this pressure is to be retained for a period of 5 minutes.

Pressure is to be monitored during the test. No internal pressure rise is permitted.

**1.10.5.5.8** Repeated assembly test shall be carried out. In that order the mechanical joint test specimen are to be dismantled and reassembled 10 times in accordance with manufacturer's instructions and then subjected to a tightness test as defined in 1.10.5.5.1.

## 1.11 TESTS OF FLEXIBLE HOSE ASSEMBLIES (IACS UR P2.12.5)

### 1.11.1 Tests

**1.11.1.1** Acceptance of flexible hose assemblies is subject to satisfactory prototype testing.

Prototype test programs for flexible hose assemblies are to be submitted by the manufacturer and are to be sufficiently detailed to demonstrate performance in accordance with the specified standards.

**1.11.1.2** The tests are, as applicable, to be carried out on different nominal diameters of hose type complete with end fittings for pressure, burst, impulse resistance and fire resistance in accordance with the requirements of the relevant standard. The following standards are to be used as applicable.

- ISO 6802:2018 - Rubber and plastics hoses and hose assemblies with wire reinforcements - Hydraulic impulse test with flexing.
- ISO 6803:2017 - Rubber or plastics hoses and hose assemblies – Hydraulic-pressure impulse test without flexing.
- ISO 15540:2016 - Ships and marine technology - Fire resistance of hose assemblies – Test methods.
- ISO 15541:2016 - Ships and marine technology - Fire resistance of hose assemblies - Requirements for test bench.
- ISO 10380:2012 - Pipework - Corrugated metal hoses and hose assemblies.

Other standards may be accepted where agreed by Register.

**NOTE:** Prototype tests are to be carried out for each size of hose assembly. However, for ranges with more than 3 different diameters, the prototype tests are to be carried out for at least:

- The smallest diameter,
- The largest diameter,
- Intermediate diameters selected based on the principle that prototype tests carried out for a hose assembly with a diameter D are considered valid only for the diameters ranging between 0.5 D and 2 D.

For fire resistance tests the specimens shall be selected in accordance with ISO 15540:2016.

**1.11.1.3** All flexible hose assemblies are to be satisfactorily prototype burst tested to an international standard\* to demonstrate they are able to withstand a pressure not less than four times its design pressure without indication of failure or leakage.

**Note:** \* The international standards, e.g. EN or SAE for burst testing of non-metallic hoses, require the pressure to be increased until burst without any holding period at 4 x MWP.

### 1.11.2 Marking

**1.11.2.1** Flexible hoses are to be permanently marked by the manufacturer with the following details:

- Hose manufacturer's name or trademark;
- Date of manufacture (month/year);
- Designation type reference;
- Nominal diameter;
- Pressure rating;
- Temperature rating.

Where a flexible hose assembly is made up of items from different manufacturers, the components are to be clearly identified and traceable to evidence of prototype testing.

## 2 BILGE SYSTEM

### 2.1 PUMPS

**2.1.1** Each self-propelled ship shall be provided with at least two power bilge pumps.

Independent ballast (except for segregated ballast), sanitary or general service pumps of sufficient capacity may be accepted as bilge pumps. One of the bilge pumps may be a main engine driven pump, or water or steam ejector, provided the steam boiler is always in operation. On passenger ships, the pump supplying the ejector shall not be used for other services.

If fire pumps are used as bilge pumps, the requirement of *Rules for the classification of ships, Part 17 - Fire Protection*, 10.2.2.1 shall be met.

In cargo ships of less than 500 GT navigating in restricted areas 5 to 8, alternative arrangements such as use of hand pump in lieu of a one power pump, may be accepted, subject to special consideration by the *Register*.

In special purpose ships, having a subdivision standard 2 or 3 compartments (see the *Rules for the classification of ships, Part 1 - General requirements*), number and arrangement of bilge pumps shall be in each particular case subject to special consideration of the *Register*.

**2.1.2** Passenger ships shall have at least three power driven pumps, one of these pumps may be driven from main engine.

Where the bilge pump numeral is 30 or more, one additional independent power pump shall be provided. This additional independent power pump is not mandatory for passenger ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8.

The bilge pump numeral shall be calculated as follows:

a) when  $P_1$  is greater than  $P$ :

$$\text{bilge pump numeral} = 72 \left[ \frac{M + 2P_1}{V + P_1 - P} \right]$$

b) in other cases:

$$\text{bilge pump numeral} = 72 \left[ \frac{M + 2P}{V} \right]$$

where:

$L$  = Length of the ship [mm], as defined in Part 2 - Hull, 1.2.3.1

$M$  = Volume of the machinery space [m<sup>3</sup>], as defined in Part 5 - Subdivision, 1.2.9, that is below the bulkhead deck; with the addition thereto of the volume of any permanent oil fuel bunkers which may be situated above the inner bottom and forward of, or abaft, the machinery space

$P$  = The whole volume of the passenger and crew spaces below the bulkhead deck (cubic meters), which are provided for the accommodation and use of passengers and crew, excluding baggage, store and provision rooms;

$V$  = Whole volume of the ship below the bulkhead deck [m<sup>3</sup>]

$P_1 = K N$

where:

$N$  = Number of passengers for which the ship is to be certified

$K = 0,056 L$

However, where the value of  $K N$  is greater than the sum of  $P$  and the whole volume of the actual passenger spaces above the bulkhead deck, the figure to be taken as  $P_1$  is that sum or two-thirds  $K N$ , whichever is the greater.

Anyhow, each of the above pumps is to have a capacity not less than that required in 2.1.8.

- c) If on ships intended for carriage of cars, fire-fighting water system is used, the *Register* may, if necessary, require increase of capacity or number of bilge pumps, in order to comply with the requirements in MSC.1/Circ.1320 – (Guidelines for the drainage of fire-fighting water from closed vehicle and ro-ro spaces and special category spaces of passenger and cargo ships).
- d) For passenger ships of less than 500 gross tonnage navigating in restricted areas 5 to 8, different number and capacity of bilge pumps may be also accepted if the criterion of related Flag State Administration Rules is complied with and was based on the Directive 2009/45/EC, as amended.

**2.1.3** For centrifugal bilge pumps, a self-priming ability is to be ensured. One of the bilge pumps is recommended to be of reciprocating type.

**2.1.4** On a passenger ship of 91,5 m in length  $L$  and upwards or having a bilge pump numeral, calculated in accordance with paragraph 2.1.2, of 30 or more, the arrangements shall be such that at least one power bilge pump shall be available for use in all flooding conditions which the ship is required to withstand, and, for passenger ships subject to the provisions of *Rules for the classification of ships, Part 5 – Subdivision, 2.1.5*, in all flooding conditions derived from consideration of minor damages as specified in *Rules for the classification of ships, Part 5 – Subdivision, 2.9*, as follows:

- .1 one of the required bilge pumps shall be an emergency pump of a reliable submersible type having a source of power situated above the bulkhead deck; or
- .2 the bilge pumps and their sources of power shall be so distributed throughout the length of the ship that at least one pump in an undamaged compartment will be available.

**2.1.5** In passenger ships not specified in 2.1.4 and in ships which are to comply with the requirements for subdivision in damaged condition, the bilge pumps, wherever practicable, shall be placed in different watertight compartments and so arranged or situated that these compartments will not be flooded by the same damage. If the main propulsion machinery, auxiliary machinery and boilers are in two or more watertight compartments, the pumps available for bilge service shall be distributed as far as is possible throughout these compartments.

**2.1.6** For draining the fore compartments of oil tankers provision shall be made for a separate pump or ejector which may also be used for filling and draining the tanks intended only for water ballast.

**2.1.7** Bilge of cargo pump rooms of oil tankers shall be drained by separate pumps or ejectors arranged in these rooms. Use of stripping pump is permitted, provided non-return shut-off valve is fitted at the open ends of the bilge suctions and a shut-off valve is arranged on the pipe connecting the valve box and the stripping pump.

Bilge of pump rooms in oil tankers of up to 500 tons gross tonnage may be drained by hand pumps.

Design of pumps shall be such as to exclude the possibility of spark formation.

**2.1.8** Capacity of each bilge pump, required in 2.1.1 and 2.1.2, shall be determined on the assumption that the rated speed of water in the bilge main is not less than 2 [m/s] under normal service conditions.

- a) Unless otherwise specified, the capacity of each required bilge pump is not to be less than:

$$Q = 0,00565 d^2$$

where:

Q: Minimum capacity of each pump in [m<sup>3</sup>/h]

d : Internal diameter of the bilge main determined as per 2.2, in [mm].

- b) One of the bilge pumps may be replaced by two pumps which in parallel operation have a total capacity not less than that specified above.
- c) Minimum capacity of a power-operated pump shall be 5,5 [m<sup>3</sup>/h] for ships of not more than 15 [m] in length and for ships exceeding 15 [m] but less than 24 [m] in length, it shall be 11,0 [m<sup>3</sup>/h].

**2.1.9** For technical floating units (see *the Rules Part 1 – General requirements, Chapter 1 – General information, 4.2.5.13*) the bilge system shall be as follow:

- a) Where auxiliary power is provided in floating units (defined in *Rules for the classification of ships, Part 1 – General requirements, Chapter 1 – General information, 4.2.5.19*), at least two power driven bilge pumps shall be installed, each of a capacity not less than 11,0 m<sup>3</sup>/h and the design flow velocity in the branch bilge suctions should not be less than 2 m/s under normal service conditions.

The pumps are to ensure drainage of any space below the bulkhead deck, and shall be so arranged that the essential rooms can be emptied even in flooded condition. For that purpose, a suitable portable pump could be accepted on the floating units of less than 500 GT, operating in restricted area 5-8.

- b) Where auxiliary power is not provided, hand pumps are to be fitted, in number and position, as may be required for the efficient drainage of the ship.

In general, two hand pumps connected to a bilge main, having at least one branch to each compartment, are to be provided. The total pump capacity is to be not less than those given in Table 2.1.9. The pumps shall be arranged above the bulkhead deck and shall have a sufficient suction head.

Alternatively, one hand pump may be provided for each compartment, having the suitable capacity determined in relation with the branch diameter required for this compartment, subject to special consideration in each particular case. However, the capacity shall not be less than 3 m<sup>3</sup>/h.

- c) Unmanned technical floating units, as well as units navigating in restricted area 8 in general, may have portable bilge pumping equipment only, arranged with their own power supply and suitable suction and discharge hoses as applicable. Each tank or compartment shall be provided with a suitable access hatches for the portable pumping equipment.

The portable equipment is to be either stored on the unit or carried on board an attending tug. The assumption that suitable bilge pumping equipment is carried on board the tug, shall be included in the appendix to the classification certificate for the technical floating unit.

**Table 2.1.9**

0,8 (L.B.D)*, [m <sup>3</sup> ]	Total pump capacity, [m <sup>3</sup> /h]
up to 100	4
101 - 600	8
601 - 1100	10
1101-1800	12

\* For definitions of L, B, D, (length, breadth and depth) in [m], see *Rules for the classification of ships, Part 4 - Stability, 1.2*. In any case shall be measured on bulkhead deck.

**2.1.10** For multi-hull ships, the power bilge pumping units required in 2.1.1 and 2.1.2 are to take suction from the bilge main in each hull. Where the bilge system in each hull is entirely separate, at least two power bilge pumping units are to be provided in each hull.

**2.1.11** Where a bilge main is not fitted and a compartment is served by a fixed reliable submersible pump, following shall be complied with:

- a) Capacity of the fixed submersible bilge pump is to be determined in accordance with 2.1.8, taking the diameter of the branch bilge suction (*d<sub>o</sub>*) for the compartment as defined in 2.2.2.
- b) In general, two fixed submersible pumps are to be provided for each watertight compartment.  
Pump situated outboard of a line drawn at one-fifth of the breadth of the hull shall not put the bilge system out of action.
- c) For ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8, only one pump could be accepted in each watertight compartment, provided that an additional emergency means of pumping out the compartment is available to the satisfaction of the *Register*.
- d) At least two non-return devices shall be fitted on discharge line, one positively controlled non return valve situated at the shell and the other may be an automatic non-

return valve fitted at or near the overboard valve. In general, the means for operating the positive action, normally closed valves shall be from readily accessible position above bulkhead deck and provided with an indicator showing whether the valve is open or closed.

Instead of the automatic non-return valve, may be accepted a pipework loop taken up to the highest practicable point below the watertight deck. The arrangements are to be effective in the maximum assumed damaged condition.

- e) The suction of the pump is to be fitted with a suitable strainer which can be easily removed for cleaning.
- f) Pump source of power and control shall be situated **outside the watertight compartment where pump is located.**

**2.1.12** Any unattended space for which bilge pumping arrangements are required is to be provided with a bilge level alarm.

## 2.2 PIPE DIAMETERS

**2.2.1** Unless otherwise specified, internal diameter  $d$  of the bilge main and of direct suction from the pump, shall be determined by the formula:

- a) For ships generally, unless otherwise specified:

$$d = 1,68 \sqrt{L (B + D)} + 25 [\text{mm}] \quad (2.2.1-1)$$

where:

$L$  - length of the ship, as defined in Part 4 - Stability, 1.2.2, in [m]

$B$  - breadth of the ship, as defined in Part 4 - Stability, 1.2.3, in [m]

For multi-hull ships, where the bilge system in each hull is completely separate, it can be the breadth of the corresponding single hull.

$D$  - **moulded depth of the ship to the bulkhead deck**, in [m]

In a ship having an enclosed cargo space on the bulkhead deck which is internally drained in accordance with the requirements of 2.6.12.2 and which extends for the full length of the ship,  $D$  shall be measured to the next deck above the bulkhead deck. Where the enclosed cargo spaces cover a lesser length,  $D$  shall be taken as the moulded depth to the bulkhead deck plus  $l \cdot h/L$  where  $l$  and  $h$  are the aggregate length and height respectively of the enclosed cargo spaces, in [m].

- b) In ships of dredging fleet having hopper spaces, the internal diameter of the bilge main and direct suction from the pump, shall be determined by the formula:

$$d = 1,68 \sqrt{L (B + D) - l_1 (b + D)} + 25 [\text{mm}]$$

(2.2.1-2)

where:

$l_1$  - length of hopper space, [m]

$b$  - mean width of hopper space, [m]

- c) In tankers and other ships where bilge pumps are draining only the machinery space outside cargo area (engine room), the internal diameter  $d$  of the bilge main can be less than that required in (2.2.1-1), provided that such bilge main has a cross-sectional area at least twice the cross-sectional area of the branch suction diameter determined by formula 2.2.2.

Practically, the internal diameter  $d$  shall be obtained from the following formula:

$$d = d_o \sqrt{2} [\text{mm}] \quad (2.2.1-3)$$

where:

$d_o$  - internal diameter in [mm], determined by formula 2.2.2, for length of engine room

- d) In yachts of less than 500 gross tonnage:

$$d = 0,84 L + 25 [\text{mm}] \quad (2.2.1-4)$$

- e) In no cases the actual internal diameter to be:
  - more than 5 mm smaller than that obtained from the formulas given in a), b), c) and d), or
  - less than that required in 2.2.3.

**2.2.2** Internal diameter  $d_o$  of branch bilge suction connected to the bilge main and the diameter of the suction pipe of the hand pump, shall not be less than the diameter determined by formula:

- a) For ships generally, unless otherwise specified:

$$d_o = 2,15 \sqrt{l (B + D)} + 25 [\text{mm}] \quad (2.2.2-1)$$

where:

$l$  - length of the compartment to be drained, measured at its bottom, [m].

- b) In yachts of less than 500 gross tonnage:

$$d_o = 0,84 l + 25 [\text{mm}] \quad (2.2.2-2)$$

**2.2.3** The inside diameter of main and branch bilge pipes is not to be less than 50 mm. For ships **exceeding 15 m but under 24 m** in length, the diameter is not to be less than 40 mm. For ships of not more than 15 m in length, refer to requirements of the *Rules for the classification of ships, Part 34 - Rules for the classification of vessels of less than 24 meters in length, 11.2.12*. For yachts of less than 500 gross tonnage, the diameter is not to be less than 35 mm.

Internal diameter of the bilge main and the branch suction which are directly connected to the bilge pump shall not be in any case less than diameter of suction of the bilge pump suction.

**2.2.4** Cross-sectional area of the pipe, connecting the distribution box with the bilge main shall not be less than the total cross-sectional area of two largest bilge suction

connected to the box, but it shall not be greater than the sectional area of the bilge main.

**2.2.5** In oil tankers, the bilge pumps serving spaces located within the cargo area are to be located in the cargo pump room or in another suitable space within the cargo area.

On tankers of less than 500 gross tonnage, which are intended for oil having the flash point > 60°C, the requirement is not mandatory provided that the criterion of related Flag State Administration Rules is complied with.

**2.2.6** Diameters of the suction for emergency drainage of the engine room shall be determined as per 2.3.8.

## 2.3 PIPING ARRANGEMENT

**2.3.1** Bilge lines and their branch suction shall be so arranged as to enable any watertight compartment to be drained by one of the pumps required in 2.1.1 and 2.1.2. This requirement does not apply neither to the spaces of ammonia refrigerating machinery, peaks, pump rooms and cofferdams of oil tankers, drained by individual pumps, nor to the tanks intended only for storage of liquids. Where the spaces are not fitted with bilge suction, other means for draining water shall be provided.

In cargo ships, where deemed acceptable by the *Register*, bilge pumping arrangements may be dispensed with in specific compartments provided the safety of the ship is not impaired.

In passenger ships the bilge pumping system shall be capable of operation under all practicable conditions after a casualty whether the ship is upright or listed. For this purpose wing suction shall generally be fitted except in narrow compartments at the end of the ship where one suction may be sufficient. In compartments of unusual form, additional suction may be required. Arrangements shall be made whereby water in the compartment may find its way to the suction pipes. Where, for particular compartments, the *Register* is satisfied that the provision of drainage may be undesirable, it may allow such provision to be dispensed with if ship stability calculations shows that the survival capability of the ship will not be impaired.

**2.3.2** Bilge pumping system shall be so arranged as to prevent the possibility of sea water passing inside the ship, or from one watertight compartment into another. For this purpose the suction valves of the distribution chests of the bilge pipes, as well as the valves of the branch suction connected directly to the main, are to be of screw-down non-return type.

Other equivalent arrangements are allowed.

**2.3.3** The arrangement of bilge pipes is to be such as to ensure the possibility of draining the engine rooms through the suction directly connected to the pump, the other compartments being simultaneously drained by other pumps.

**2.3.4** The arrangement of bilge pipes shall be such as to enable one of the pumps to be operated in case the rest of the pumps are inoperative or are used for other purposes. Suction branches of bilge pipelines shall be independent of other piping systems, up to the connections to the pumps.

In passenger ships, with the exception of additional pumps which may be provided for peak compartments only, each required bilge pump shall be so arranged as to draw water from any space required to be drained by 2.3.1.

**2.3.5** In passenger ships, provision shall be made to prevent the compartment served by any bilge suction pipe being flooded in the event of the pipe being severed or otherwise damaged by collision or grounding in any other compartment. For this purpose, where the pipe is at any part situated nearer the side of the ship than 1/5 of the breadth of the ship (measured at right angles to the centerline at the level of the deepest subdivision load line), or is in a duct keel, a non-return valve shall be fitted to the pipe in the compartment containing the open end.

For passenger ships subject to the provisions of *Rules for the classification of ships, Part 5 – Subdivision*, 2.1.5, the deepest subdivision load line shall be taken as the deepest subdivision draught.

**2.3.6** In passenger ships following shall be also complied with:

- a) All distribution chests, cocks and valves associated with the bilge pumping system shall be so arranged that in the event of flooding, one of the bilge pumps can be operative on any flooded compartment. Moreover, damage of pump or piping system connected to the bilge main outboard of a line drawn at one-fifth of the breadth of the ship shall not put the bilge system out of action.
- b) Where there is only one system of pipes common to all the pumps, the necessary cocks and valves for controlling the bilge suction shall be fitted with means enabling them to be controlled from above the bulkhead deck. They shall be fitted, at control places, with the equipment for indication of purpose and open-close position. This requirement is not mandatory for passenger ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8.
- c) Where, in addition to the main bilge pumping system, an emergency bilge system is provided, it shall be independent of the main system and shall be so arranged that a pump is capable of operating on any compartment under flooding conditions, specified in 2.3.1. In this case, only cocks and valves required for controlling the emergency system need be suited for being operated from above the bulkhead deck, while the pump and associated suction pipes shall be situated farther from the ship's side than 1/5 of the breadth of the ship.
- d) All cocks and valves referred to in 2.3.6 which can be operated from above the bulkhead deck shall have their controls at their place of operation clearly marked and shall be provided with means to indicate whether they are open or closed.

**2.3.7** As a rule, bilge pipes shall be led outside the double bottom. Where it is necessary to lead these pipes through the tanks for storage of fuel oil, lubricating oil, boiler feed water and drinking water, the pipes shall meet the requirements of 1.6.2.1.

Where the pipes are led through the double bottom, the suction pipes in each watertight compartment shall be fitted with non-return valves.

**2.3.8** In all self-propelled ships provision shall be made for emergency drainage of the engine rooms, in addition to the suction branches required by 2.4.1 and 2.4.4.

For this purpose one of the main circulating or cooling pumps shall be fitted with direct suction branch with non-return shut-off valve on the level which assures the engine room to be drained. The diameter of this direct suction branches shall be at least 2/3 of the diameter of the pump inlet in steam ships, and shall be at least equal to the diameter of the pump suction in motor ships.

Where the pumps specified above are not suitable for emergency drainage, a direct emergency bilge suction branch shall be connected to the largest available independent power pump not intended for drainage.

The capacity of this pump shall exceed that required in 2.1.8 by an amount satisfactory to the *Register*. The diameter of the suction emergency branches shall not be less than that of the pump suction.

Hand control wheel for non-return shut-off valves fitted to the suction branches shall be fitted above the engine room flooring to a sufficient height and shall have name plate "Emergency drainage only".

The emergency drainage system of machinery spaces is not mandatory for:

- Ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8;
- Any yacht of less than 500 gross tonnage.

**2.3.9** Before overboard discharge, oily water shall be separated. For this purpose the ship shall be provided with oily water separating equipment. Installation and operation of such equipment shall not interfere with normal working of the bilge and ballast systems indicated in 8.1.2.

The application of this criterion is not mandatory for ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8, provided that ship is equipped with tank(s) for oily bilge water and with the necessary equipment for its discharge in accordance with the *Rules for the classification of ships, Part 22 - Pollution prevention*, 2.6.4.

**2.3.10** All bilge pipes used in or under coal bunkers or fuel storage tanks or in boiler or machinery spaces, including spaces in which oil-settling tanks or oil fuel pumping units are situated, shall be of steel or other suitable material.

**2.3.11** All distribution boxes and manually operated valves in connection with the bilge pumping arrangements shall be in positions which are accessible under ordinary circumstances.

## 2.4 DRAINAGE OF MACHINERY SPACES

**2.4.1** Where engines and boilers are located in the same compartment and the double bottom either form bilges at the wings, or extends the full breadth of the compartment, it is necessary to provide two bilge suction at each side near the bulkheads, one of which shall be directly connected to an independent bilge pump.

**2.4.2** Where the engines and boilers are located in the same compartment with no double bottom, and the raise of floors is not less than 5°, two bilge suction shall be provided, one of which shall be directly connected to an independent bilge pump.

Where the raise of floor, towards the ship's side, is less than 5°, two additional bilge suction, one at each side, shall be fitted and connected to the bilge main.

**2.4.3** Where the engines and boilers as well as the auxiliaries or electric propulsion motors, are located in separate watertight compartments, number and position of bilge suction therein shall be adopted as set forth in 2.6. In ships which are to comply with the requirements for subdivision in damaged condition, each of these compartments shall be fitted with additional bilge suction direct-connected to an independent bilge pump.

In passenger ships each of independent pumps located in the machinery spaces shall have direct suction in these spaces. More than two such suction are not required for these spaces. Where two or more such suction are fitted, at least one of them shall be located on each side.

The independent power pump located in other spaces, may have direct suction in these spaces.

**2.4.4** Where the machinery space is situated at the after end of the ship, bilge suction shall be fitted in the forward wings of the space. Depending on the shape of the after end, the *Register* may require the instalment of one or two suction branches in the after end of the ship.

**2.4.5** In general, the bilge suction from machinery spaces and shaft tunnels shall be fitted with readily accessible mud boxes with covers that can be easily opened. The lower ends of these suction pipes shall not be fitted with strums.

Pipes between mud boxes and bilge wells shall be as straight as possible.

In ships less than 500 GT navigating in restricted areas 5 to 8, instead of mud boxes, strum boxes may be used, provided they are accessible for cleaning.

**2.4.6** The mud boxes, strum boxes or other type of strainers are not to be fitted on the emergency bilge suction. The lower end of these suction pipes can be roughly protected by simply crossed bars.

**2.4.7** Where there is a double bottom, machinery spaces shall be fitted with bilge wells of a capacity not less than 0,15 m<sup>3</sup>.

**2.4.8** Additional suction branches shall be installed in the log and echo sounder trunks, as well as in the double-bottom wells under the machinery and in other places which may accumulate water.

**2.4.9** Ships having an electric propulsion installation shall be provided with arrangement for proper drainage of the wells under the main generator and propulsion motor, as well as with automatic alarms to give warning at excess of permissible water level in the wells.

Automatic drainage of wells under main generators and propulsion motors is recommended to be used.

**2.4.10** Space of ammonia refrigerating machinery shall have an independent bilge system. Where a water spraying system is provided in this space, capacity of the bilge pump shall not be less than the capacity of the water spraying system pump. The discharge pipe of the bilge system shall be led directly overboard.

Bilge suction of the space for Freon refrigerating machinery may be connected to the bilge main of the ship.

## 2.5 DRAINAGE OF TUNNELS

**2.5.1** Each shaft tunnel and each pipe tunnel shall have the bilge suction branch, from the well in the after part of the tunnel, connected to the bilge main.

Where required, additional suctions may be provided in the fore part of the tunnel

Bilge suctions of the shaft tunnel shall be made in compliance with the requirements set forth in 2.4.5.

## 2.6 DRAINAGE OF CARGO HOLDS

**2.6.1** Each cargo hold, where the double bottom forms bilges at the wings, shall have at least one bilge suction in the after part of the hold at each side of the ship.

**2.6.2** Where the double bottom extends in the full breadth of the cargo hold, bilge wells shall be provided in the after part of the hold at each side.

The capacity of the wells shall comply with requirements of 2.4.7.

**2.6.3** In holds with double bottom where the inner bottom plating has inverse camber, provision shall be made also for suctions at the centerline, in addition to the suctions situated at the wings. Where a bilge well extends over the entire breadth of the hold, and the inverse camber exceeds 5°, only one branch suction may be led to this well.

**2.6.4** Where manholes for access to bilge wells are provided, they shall be arranged as near to the bilge suction as possible.

**2.6.5** In each cargo hold where there is no double bottom and the raise of floor in the hold exceeds 5°, one bilge suction near the centerline of the ship will be sufficient. If the rise of the floor is less than 5°, at least two suctions shall be fitted, one at each side of the hold.

**2.6.6** Where the length of a hold exceeds 35 m, bilge suctions shall be installed in the fore and the after parts of this hold, the requirements of 2.6.1 to 2.6.5 being complied with.

**2.6.7** At narrow ends of cargo holds single bilge suction may be allowed.

**2.6.8** Drain pipes from spaces located below the bulkhead deck and communicating with the cargo hold in the same compartment are permitted to be led into the wells of the hold.

Discharge of bilge water into the wells of a cargo hold from watertight spaces located below the bulkhead deck is not permitted.

For discharge of bilge water into bilges of refrigerated cargo spaces, see 2.7.

**2.6.9** Where a ceiling or removable covers are fitted over the bilges or wells in cargo holds, provision shall be made for free access of water into the bilges or wells.

**2.6.10** Branch bilge suctions shall be fitted with strum boxes, or strainers having perforations 8-10 [mm] in diameter.

Total area of these perforations shall not be less than twice the clear area of the given suction pipe.

Strum boxes and strainers shall be removable, or provision shall be made for cleaning them without disassembling any connection of suction branch.

**2.6.11** In bulk carrier holds the bilge system shall be so designed that its operability may not be affected when bulk cargo is carried.

**2.6.12** Cargo holds above bulkhead decks of passenger ships, or cargo ship that is assigned a subdivision distinguishing mark in its class notation, and on the freeboard deck of the cargo ship, are to be fitted with drainage arrangements specified under 2.6.12.1 and 2.6.12.2.

The *Register* may permit the means of drainage to be dispensed with in any particular compartment of any ship or class of ship if it is satisfied that by reason of size or internal subdivision of those spaces the safety of the ship is not thereby impaired.

For ships subject to the provisions of *Rules for the classification of ships, Part 5 – Subdivision*, 2.1.5, for the special hazards associated with loss of stability when fitted with fixed pressure water-spraying fire-extinguishing systems refer to requirements of *Rules for the classification of ships, Part 17 – Fire protection*, 20.6.1.4.

**2.6.12.1** Closed cargo holds may be drained directly to overboard, only when at a heel of the ship of 5°, the edge of the bulkhead deck of a passenger ship or freeboard deck of a cargo ship shall not be immersed below the water line. The scuppers and drain pipes shall be arranged and fitted according to 1.5.2.11 of the present Part of the Rules.

**2.6.12.2** Where the edge of the bulkhead deck of a passenger ship or freeboard deck of a cargo ship touches the water line or is already immersed when the ship heels 5°, the drainage shall be led to one or more drain tanks of adequate capacity. The drainage tanks are to be fitted with a high water level alarm and provided with suitable arrangements for discharge overboard. In such cases it shall be ensured that:

- .1 the number, size and disposition of the scuppers are such as to prevent unreasonable accumulation of free water;
- .2 the above mentioned pumping arrangements for the drainage of the cargo spaces provide water drainage with any fixed water fire-extinguishing systems, including spraying systems, that are required, respectively, for passenger and cargo ships;
- .3 water contaminated with petrol or other dangerous substances is not drained to machinery spaces or other spaces containing sources of ignition;
- .4 where the enclosed cargo spaces are protected by a fire smothering system the deck scuppers are fitted with means to prevent the escape of the gas.

**2.6.13** Bilge alarms should be provided in each hold fitted with non-weather-tight covers.

**2.6.14** Where it is intended to carry flammable or toxic liquids in enclosed cargo spaces, the bilge drainage system shall comply with requirements of *Rules for the classification of ships, Part 17 – Fire protection*, 19.3.5.

## 2.7 DRAINAGE OF REFRIGERATED CARGO SPACES

**2.7.1** Provision shall be made for draining all the spaces, trays, chutes and other places which may accumulate water.

**2.7.2** Drain pipes from non-refrigerated spaces are not permitted to be led into the bilges of refrigerated spaces.

**2.7.3** Each drain pipe of refrigerated cargo spaces shall be fitted with a liquid sealed trap or with another equivalent arrangement. The head of liquid shall be such that the arrangement will work effectively under any service conditions.

Liquid sealed traps shall be placed in accessible positions outside the insulation. Where drain pipes from the tween deck spaces and the hold are led into a common bilge well, non-return valves shall be fitted to the ends of the drains from the hold.

**2.7.4** As a rule, no shut-off valves shall be fitted on the drain pipes from refrigerated spaces.

## 2.8 DRAINAGE OF DEEP TANKS

**2.8.1** Deep tanks used also for carriage of dry cargo shall be fitted with bilge suction and with effective shut-off means isolating ballast and oil lines from the deep tanks and isolating bilge line when fuel oil or ballast are carried in the tanks.

The arrangement of the bilge suction is to comply with the requirements of 2.6.

## 2.9 DRAINAGE OF COFFERDAMS

**2.9.1** Cofferdams filled with water shall be provided with a drainage facility. The arrangement of branch suction in cofferdams shall be comply with requirements of 2.6.

**2.9.2** In tankers and multi-purpose ships the filled cofferdams, adjoining the cargo tanks or slop tanks, shall have independent drain arrangements.

## 2.10 DRAINAGE OF FORE AND AFTER PEAK

**2.10.1** Where the peaks are not used as water ballast tanks or as other tanks, independent drainage by hand pumps or water ejectors may be provided.

For ships of 500 tonnage and over, with service notation bulk carrier, ore carrier or combination carrier, see specific requirements 2.12.

## 2.11 DRAINAGE OF OTHER SPACES

**2.11.1** Drainage of chain lockers and boatswain's stores may be carried out by means of hand pumps, water ejectors or other means.

**2.11.2** Drainage of steering engine rooms and other compartments situated above the afterpeak may be carried out

by special hand pumps or water ejectors, as well as through drain pipes led into the bilges of engine room or shaft tunnel.

Drain pipes shall be fitted with readily accessible self-closing valves. The internal diameter of these valves shall be not less than 39 [mm].

In passenger ships, other than those of less than 500 gross tonnage, navigating in restricted areas 5 to 8, drain pipes shall not be used for drainage of the above-mentioned spaces.

**2.11.3** Drain pipes shall not be led into the bilges of engine rooms and shaft tunnels from the adjacent spaces situated in other watertight compartments below the bulkhead deck. This does not apply to the cases specified in 2.11.2.

Drain pipes from these spaces may be led into the engine rooms and shaft tunnels only if terminating into closed drain tanks.

Where several watertight compartments have a common drain tank, drain pipes from these compartments shall be fitted with non-return valves.

Drainage of such tank may be carried out through the bilge main, provided a non-return valve is fitted on the branch suction.

**2.11.4** Scuppers from drainage of the superstructures and deckhouses shall be led on ship's side. In general, the overboard arrangement shall comply with Section 16.

**2.11.5** Drain pipes from enclosed superstructures and deckhouses may be led into bilge wells of the engine room or the holds.

In ships which are to comply with the requirements for subdivision in damaged condition, these pipes shall be fitted with valves controllable from a place above the bulkhead deck.

**2.11.6** Drain pipes of storerooms for explosives shall be fitted with valves controllable from locations outside these rooms.

**2.11.7** Closed cargo spaces intended for carriage of flammable or poisonous liquids shall be provided with independent drainage system not communicating with the machinery space.

The *Register* may permit the use of the ship's main drainage system for the drainage of such spaces, if the design prevents accidental pumping of flammable or toxic liquids through the pipelines and pumps of the engine room

**2.11.8** In cargo pump rooms on oil tankers, the following requirements are included in the measures to prevent explosion:

- .1 High liquid level in the bilges shall activate an audible and visual alarm in the cargo control room and on the navigation bridge.
- .2 Cargo pumps, ballast pumps and stripping pumps, installed in cargo pump rooms and driven by shafts passing through pump room bulkheads shall be fitted with temperature sensing devices for bulkhead shaft glands, bearings and pump casings. Alarm shall be initiated in the cargo control room or the pump control station.

**2.11.9** For the special hazards associated with loss of stability which could arise due to large quantities of water

accumulating on the deck or decks during the operation of the fixed pressure water-spraying fire-extinguishing systems when fitted, the following arrangements shall be provided:

- .1 in passenger ships:
  - a) in the spaces above the bulkhead deck, scuppers shall be fitted so as to ensure that such water is rapidly discharged directly overboard, taking into account the guidelines developed by IMO and given in MSC.1/Circ.1320.
  - b) in ro-ro passenger ships, discharge valves for scuppers, fitted with positive means of closing operable from a position above the bulkhead deck in accordance with the requirements of the International Convention on Load Lines in force, shall be:
    - kept open while the ships are at sea;
    - any operation of these valves shall be recorded in the log-book;
  - c) in the spaces below the bulkhead deck, the Register may require pumping and drainage facilities to be provided additional to the requirements of regulation 2.1 and 2.2. In such case, the drainage system shall be sized to remove no less than 125% of the combined capacity of both the water-spraying system pumps and the required number of fire hose nozzles, taking into account the guidelines developed by IMO and given in MSC.1/Circ.1320. The drainage system valves shall be operable from outside the protected space at a position in the vicinity of the extinguishing system controls. Bilge wells shall be of sufficient holding capacity and shall be arranged at the side shell of the ship at a distance from each other of not more than 40 m in each watertight compartment;
- .2 In cargo ships:
 

The drainage and pumping arrangements shall be such as to prevent the build-up of free surfaces. In such case, the drainage system shall be sized to remove no less than 125% of the combined capacity of both the water-spraying system pumps and the required number of fire hose nozzles, taking into account the guidelines developed by IMO and given in the MSC.1/Circ.1320.

The drainage system valves shall be operable from outside the protected space at a position in the vicinity of the extinguishing system controls. Bilge wells shall be of sufficient holding capacity and shall be arranged at the side shell of the ship at a distance from each other of not more than 40 m in each watertight compartment. If this is not possible, the adverse effect upon stability of the added weight and free surface of water shall be taken into account to the extent deemed necessary by the *Register* in its approval of the stability information. Such

information shall be included in the stability information supplied to the master.

The Flag State Administration may also have additional requirements.

**2.11.10** On all ships, for closed vehicles and ro-ro spaces and special category spaces, where fixed pressure water-spraying systems are fitted, means shall be provided to prevent the blockage of drainage arrangements, taking into account the guidelines developed by IMO and given in the MSC.1/Circ.1320.

## 2.12 SPECIFIC REQUIREMENTS FOR DRAINAGE OF FORWARD SPACES IN BULK, ORE AND COMBINATION CARRIERS ("dewatering system")

**2.12.1** Unless otherwise specified, this requirement applies to ships of 500 tonnage and over, with service notation **bulk carrier, ore carrier or combination carrier**, as defined by *the Rules for the classification of ships, Part 1 - General requirements, Chapter 1 - General information, 4.2.*

**2.12.2** The bilge of dry spaces any part of which extends forward of the foremost cargo hold, as well as the means for draining and pumping ballast tanks forward of the collision bulkhead, is to be capable of being brought into operation from the navigation bridge, the propulsion machinery control position or readily accessible enclosed space, the location of which is accessible from the navigation bridge or propulsion machinery control position without traversing exposed freeboard or superstructure decks. The following criteria are to govern the application of the requirement:

- .1 A position which is accessible via an under deck passage, a pipe trunk or other similar means of access is not to be taken as being in the readily accessible enclosed space.
- .2 The requirement does not apply to the enclosed spaces the volume of which does not exceed 0,1% of the ship maximum displacement volume and to the chain locker.

**2.12.3** The water level detectors, giving an audible and visual alarm located on the navigation bridge, are to be fitted:

- .1 In any ballast tank forward of the collision bulkhead, indicating when the liquid in the tank reaches a level not exceeding 10% of the tank capacity. An alarm overriding device may be installed to be activated when the tank is in use.
- .2 In any dry or void space which is to comply with the requirements in 2.12.2, giving the alarm at a water level of 0,1 m above the deck.

**2.12.4** The capacity of the dewatering system is to be designed to remove water from the forward spaces at a rate of not less than  $320 A$  [m<sup>3</sup>/h], where  $A$  is the cross-sectional area in [m<sup>2</sup>] of the largest air pipe or ventilator pipe connected from the exposed deck to a closed forward space that is required to be dewatered by these arrangements.

**2.12.5** When dewatering systems are in operation, the following is to be fulfilled:

- .1 Other systems essential for the safety of the ship, including fire-fighting and bilge systems, are to remain available and ready for immediate use.
- .2 It is to be possible to start fire pumps immediately and to have a ready available supply of fire-fighting water.
- .3 The systems for normal operation of electric power supplies, propulsion and steering are not to be affected by this operation.

**2.12.6** The drainage arrangements are to be such that:

- .1 Any accumulated water can be drained directly by a pump or an eductor.
- .2 It should be possible to configure and use bilge system for any compartment when the drainage system is in operation.
- .3 Remotely operated valves within the system are to comply with the requirements 1.4.1.2.
- .4 Bilge wells are to be protected by gratings or strainers to prevent blockage of the drainage system with debris.

**2.12.7** Where pipes serving tanks in forward spaces or bilge pierce the collision bulkhead, the local hand powered valve operation from above the freeboard deck is still required. An acceptable alternative to such arrangement may be remotely operated actuators controlled as specified in 2.12.2 on the condition that the following is fulfilled:

- .1 The valve is to be capable of being controlled from the position as required in 2.12.2.
- .2 The valve is not to move from the demanded position in the case of failure of the control system power or actuator power.
- .3 Positive indication is to be provided at the remote control station to show that the valve is fully open or closed.

**2.12.8** The piping arrangements for drainage of closed dry spaces may be connected to the piping arrangements for drainage of water ballast tanks, provided that:

- .1 Two non-return valves are fitted to prevent the ingress of water into dry spaces from those intended for the carriage of water ballast.
- .2 The non-return valves are located in readily accessible positions.
- .3 One of these non-return valves is fitted with shut-off isolation arrangement.
- .4 The shut-off isolation arrangement is capable of being controlled from the position as required in 2.12.2.

**2.12.9** The enclosures of electrical equipment for the dewatering system installed in any of the forward dry spaces are to provide protection to IPX8 standard as defined in IEC Publication 60529:1989/AMD2:2013/COR1:2019 for a water head equal to the height of the space in which the electrical equipment is installed for a time duration of at least 24 hours.

### 3 BALLAST SYSTEM

#### 3.1 GENERAL

**3.1.1** As a general rule, ballast lines are to be entirely independent and distinct from other lines conveying liquid cargo, lubricating oil and fuel oil, with the exception of:

- pipes located between collecting boxes and pump suction
- pipes located between pumps and overboard discharges
- pipes supplying compartments likely to be used alternatively for ballast, fuel oil or liquid or dry cargoes, provided such pipes are fitted with blind flanges or other appropriate protection, in order to avoid any mishandling.

**3.1.2** Ballast systems and bilge systems are to be so designed as to avoid any risk of undesirable communication between spaces or with the sea.

**3.1.3** Holds and deep tanks designed for the alternative carriage of water ballast, fuel oil or dry cargo are to have their filling and suction lines provided with blind flanges or appropriate change-over devices to prevent any mishandling.

**3.1.4** For ships in restricted navigation areas 5 to 8, where permanent liquefied ballast was provided, the sanitary water or bilge pumps could be accepted for initial filling or emptying of the ballast tanks if the following is satisfied:

- ballast lines shall be fitted with a spool piece or equivalent protection accepted by the Register, to prevent any possible operation in normal condition;
- appropriate work instruction shall be fitted in vicinity of the spool piece or equivalent protection, including a label warning that the ballast lines are to be kept normally disabled.

**3.1.5** All tanks including aft and fore peak and double bottom tanks intended for ballast water are to be provided with suitable filling and suction pipes connected to special power driven pumps of adequate capacity.

**3.1.6** Small tanks used for the carriage of domestic fresh water may be served by hand pumps, subject to special consideration.

**3.1.7** In passenger ships, ballast tanks shall not be intended for carriage of fuel oil. Possible relaxations from this requirement, if provision is made for separators or other devices, shall be specially considered by the *Register* (see also 8.1.2).

#### 3.2 PUMPS

**3.2.1** At least two power driven ballast pumps are to be provided, one of which may be driven by the propulsion unit.

Alternative means of deballasting, such as an eductor, may be accepted in lieu of a second ballast pump, subject to special consideration in each particular case.

**3.2.2** Excluding the oil tankers, sanitary, general services, bilge, fire or stand-by cooling water pumps of sufficient capacity may be used as ballast pumps. For ballast pumps in oil tankers see 2.1.6 and 4.2.2.

**3.2.3** Bilge pumps may be used for ballast water transfer provided the provisions of 2.1 are fulfilled.

**3.2.4** Where the oil fuel tanks are generally used as ballast tanks, the standby cooling water pump or a fire pump shall not be used for ballasting, nor shall the ballast pump be used as fire pump or standby cooling pump.

**3.2.5** On bulk carriers, the means for draining and pumping ballast tanks forward of the collision bulkhead are to comply with 2.12.

**3.2.6** Pumps used for pumping out ballast water from the double-bottom tanks shall be of self-priming type.

#### 3.3 PIPING ARRANGEMENT

**3.3.1** Internal diameter of the ballast main and the ballast pipes from separate tanks shall be so determined as to ensure that the flow velocity does not exceed the standard acceptable values presented in 1.8.4.

**3.3.2** Arrangement of the suction shall be such as to ensure discharging of water from any of the ballast tanks, regardless of whether the ship is upright or listed not more than 5°. In that order, two suction may be required in long compartments.

**3.3.3** Suction and discharge pipes of clean ballast tanks shall not communicate with sea inlet boxes and pipelines servicing cargo tanks.

**3.3.4** The fore peak tank on oil tankers may be ballasted with the system serving ballast tanks located within cargo area, subject to the conditions specified with the Rules for the classification of ships, Part 17 - *Fire protection*, 4.5.9.3.

**3.3.5** For tankers with the integrated cargo and ballast systems installed for operation of ballast and/or cargo systems, see 4.5.

**3.3.6** The ballast steel pipes passing through tanks intended to contain fresh water, fuel oil or liquid cargo, if not contained in pipe tunnels they are:

- to have reinforced thickness, see Table 1.3.4.3
- to consist either of a single piece or of several pieces assembled by welding, by reinforced flanges or by devices deemed equivalent for the application considered
- to have a minimal number of joints in these lines
- to have expansion bends in these lines within the tank, where needed
- not to have slip joints.

For ballast lines passing through oil cargo tanks, where permitted, see 4.2.2.

**3.3.7** Valves controlling flow to ballast tanks are to be arranged so that they remain closed at all times except when ballasting. Where butterfly valves are used, they are to be of a type able to prevent movement of the valve position due to vibration or flow of fluids.

**3.3.8** Remote control valves, where fitted, are to be arranged so that they close and remain closed in the event of loss of control power. The valves may remain in the last ordered position upon loss of power, provided that there is a readily accessible manual means to close the valves upon loss of power.

Remote control valves are to be clearly identified as to the tanks they serve and are to be provided with position indicators at the ballast control station.

**3.3.8** Ballast piping arrangements For ships which are subject to damage stability, the piping arrangements are to comply with the requirements of 1.6.7 concerning the prevention of progressive flooding. The pipes, if damaged, which are located within the extent of assumed damage, are not to affect damage stability considerations.

**3.3.10** For ships navigating in Polar waters and Ice class ships, see also *Rules for the classification of ships, Part 29 - Polar class ships and Ice class ships*, 8.6.10 and 8.14.5.

It is recommended to provide heating facilities for double bottom ballast tanks situated in way of cargo holds.

### 3.4 REQUIREMENTS ON BALLAST WATER EXCHANGE AT SEA

#### 3.4.1 General

**3.4.1.1** Unless otherwise specified, this sub-article applies to the ships where ballast water exchange at sea is applied for the ballast water management (BWM).

Unless instructed otherwise, the requirements in this Section shall be applied in conjunction with the applicable requirements in the *Rules for technical supervision of sea-going ships, Part 22 - Pollution prevention*, Section 10.

#### 3.4.2 Definitions

**3.4.2.1** A Ballast Water Exchange (BWE) plan contains procedures and advice to safely and efficiently exchange of ballast water in accordance with applicable structural and stability requirements and taking into account the safety precautions contained in the IMO Resolution MEPC.124(53) and MEPC.127(53).

**3.4.2.2** *Sequential method* - a process by which a ballast tank or hold intended for the carriage of water ballast is emptied of at least 95% or more of its volume and then refilled with replacement ballast water.

**3.4.2.3** *Flow-through method* - a process by which replacement ballast water is pumped into a ballast tank or hold intended for the carriage of water ballast allowing water to flow through overflow or other arrangements. At least three times the tank or hold volume is to be pumped through the tank or hold.

**3.4.2.4** *Dilution method* - a process by which replacement ballast water is filled through the top of the ballast tank or hold intended for the carriage of water ballast with simultaneous discharge from the bottom at the same flow rate and maintaining a constant level in the tank or hold. At least three times the tank or hold volume is to be pumped through the tank or hold.

#### 3.4.3 Ballast water pumping and piping arrangement

**3.4.3.1** Ballast water pumping and piping arrangements are to be capable of filling and pumping out any ballast tank and hold intended for the carriage of water ballast under any environmental conditions permitted by the Ballast Water Exchange (BWE) plan.

**3.4.3.2** Where the flow-through method of water ballast exchange is used, the design of water ballast exit arrangements are to be such that when the tank or hold is overflowing at the maximum pumping capacity available to the tank or hold, it is not subject to a pressure greater than that for which it has been designed.

**3.4.3.3** Every ballast tank and hold intended for the carriage of water ballast is to be provided with isolating valves for filling and /or emptying purposes.

**3.4.3.4** On ships classed for navigation in ice, ship side ballast discharge valves placed above the assigned lightest load line are to be arranged with adequate heating arrangements. See also the *Rules for the classification of ships, Part 29 - Polar class ships and Ice class ships*, 8.14.5.3.

#### 3.4.4 Sea chests and shipside openings intended for ballast water exchange

**3.4.4.1** The relative positions of ballast water intake and discharge openings are to be such as to preclude as far as practicable the possibility of contamination of replacement ballast water by water which is being pumped out.

#### 3.4.5 Pumps

**3.4.5.1** The ballast system is to be served by at least two pumps.

**3.4.5.1** The complete ballast water exchange of cargo holds, where used for the carriage of water ballast, shall be possible by one pump within not more than twenty four hours.

#### 3.4.6 System arrangement

**3.4.6.1** The design of ballast water systems is to allow the ballast water exchange operations with the minimum number of operational procedures.

**3.4.6.2** The internal arrangements of ballast tanks, as well as ballast water piping inlet and outlet arrangements, are to allow, as far as practical, the complete ballast water exchange and the clearing of any sediments.

**3.4.6.3** The design of sea suction line strainers is to be such as to permit cleaning of strainers without interrupting ballast water exchange procedures.

#### 3.4.7 Control features

**3.4.7.1** Remote control, local control, emergency control  
- Remote control - ballast pumps, and all valves which may be operated during ballast water exchange are to be provided with

a means of remote control from a central ballast control station.

- Local control - a means of local control is to be provided at each ballast pump operated during ballast water exchange.
- Emergency control - a readily accessible manual means for control of any valve required for ballast water exchange is to be also provided to enable the emergency operation in the event of main control system failure.

**3.4.7.2** The central ballast control station is to include the following:

- a valve position indicating system,
- a tank level indicating system,
- a draft indicating system,
- a means of communication between the central ballast control station and those spaces containing the means of local control for the ballast pumps and the manually operated independent means of control for the valves.

**3.4.7.3** The ballast pump and ballast valve control systems are to be so arranged that the failure of any component within the control system is not to cause the loss of operation to the pumps or valves of other systems.

### 3.4.8 Tanks

**3.4.8.1** For ships with an ICE class notation and, generally, where a risk of water ballast freezing exists, water ballast tanks are to be provided with means to prevent the water from freezing. See also the *Rules for the classification of ships, Part 29 - Polar class ships and Ice class ships*, 6.10.

**3.4.8.2** The design of ballast tanks is to effort ready sampling of ballast water and sediments, as far as practical. Providing safe access to the tanks by the fitting of tank hatches as an alternative to manholes is recommended. The area immediately below any tank opening is to be free as in order to enable the use of sampling equipment or free access.

### 3.4.9 Special provisions depending on the method of ballast water exchange

**3.4.9.1** Flow-through method

- The capability of the ballast water system to provide ballast water exchange by the flow-through method without the risk of the tank being subject to a pressure greater than that

for which it has been designed is to be demonstrated by water flow calculations and by testing on board. Subject to consideration in each particular case, the calculation may be omitted where justified that total cross-sectional area of all vent pipes fitted to the tank is not less than twice the sectional area of the related filling pipes.

- The flow-through method with water flowing over the deck is not permitted. The use of collecting pipes, internal overflow pipes or interconnecting pipe/trunk arrangements between tanks may be accepted to avoid water flowing over the deck.

**3.4.9.2** Dilution method

- Where the dilution method is accepted, arrangements are to be made to automatically maintain the ballast water level in the tanks at a constant level. These arrangements are to include the provision of a manual emergency stop for any operating ballast pump, in case of valve malfunction or incorrect control actions.
- High and low water level alarms are to be provided where maintaining a constant level in a tank is essential to the safety of the ship during ballast water exchange.

## 3.5 INSTALLATION OF BALLAST WATER MANAGEMENT SYSTEMS

### 3.5.1 Application

**3.5.1** In addition to the requirements contained in BWM Convention (2004), the requirements set forth in *Rules for the classification of ships, Part 9 – Machines*, ANNEX D (see *IACS UR M74* also) are to be complied with.

Unless instructed otherwise, the requirements in this **Head** of the Rules shall be applied in conjunction with the applicable requirements in *the Rules for technical supervision of sea-going ships, Part 22 - Pollution prevention, Section 10*.

This **Head** of the Rules is not **applicable** to ship's ballast water systems including piping valves, pumps, etc. where the BWMS is not fitted.

This **Head** of the Rules is to be read in conjunction with requirements of the *Rules for the classification of ships, Part 17 – Fire protection*, ANNEX VI (see also *IACS UR F45*).

## 4 CARGO PIPING SYSTEM OF OIL TANKERS AND OIL COLLECTING SHIPS

### 4.1 PUMPS AND THEIR DRIVES

**4.1.1** Cargo oil pumps and cargo stripping pumps shall serve only the direct purpose, excluding even the cases specified in 2.1.7 and 4.2.3. These pumps shall not have any connections to the tanks other than cargo tanks.

Cargo oil and cargo stripping pumps shall be arranged in separate spaces.

**4.1.2** For the arrangement of cargo and stripping pumps driving machinery, see the *Rules for the classification of ships, Part 7 - Machinery Installation*, 1.12.6.

**4.1.3** Construction of pumps, fittings and fitting driving machinery, for oil with flashpoint < 60°C, shall preclude the possibility of spark formation to the maximum.

**4.1.4** Arrangements shall be provided for stopping each cargo oil and cargo stripping pump from the top flat of the pump room situated at the level of the main deck or from the central control station for loading or unloading of cargo. Electrical stopping arrangements of the pumps shall comply with the *Rules for the classification of ships, Part 12 - Electrical Equipment*, 5.7.

**4.1.5** The pressure gauges of the cargo oil discharge and cargo stripping mains shall be placed at the pumps and on the top flat of the pump room or at the central control station of cargo system.

### 4.2 PIPING ARRANGEMENT

**4.2.1** Ends of filling pipes inside cargo tanks shall be as near the bottom of these tanks as practicable.

Cargo oil pipes shall not be carried through the tanks or other spaces not intended for cargo oil and shall not be connected to other tanks or pipelines, including the fuel oil pipelines of the machinery installations.

Cofferdams shall not have any connections to the cargo oil tanks. Cargo transfer valves are not permitted to be fitted inside cofferdams.

Systems in which different cargoes may become mixed or may be contaminated by water, shall have duplicate isolating valves.

**4.2.2** Pipelines not intended to serve cargo tanks and slop tanks (see the *Rules for technical supervision of sea-going ships, Part 22 - Pollution prevention*, 2.1.2.20) shall not pass through these tanks and shall have no communication with them.

Segregated and clean ballast lines are permitted to be carried through cargo tanks as well as pipelines serving cargo tanks which are permitted to be carried through segregated and clean ballast tanks, provided the following requirements are fulfilled:

- .1 The pipes are to be of heavy gauge steel of minimum wall thickness according to the

table thereunder with welded or heavy flanged joints \* the number of which is to be kept to a minimum.

Minimum wall thickness of these pipes has to be determined in depend of nominal diameter (ND), and shall not be less than listed below:

- ND ≤ 50 [mm]	6,3 [mm]
- ND ≤ 100 [mm]	8,6 [mm]
- ND ≤ 125 [mm]	9,5 [mm]
- ND ≤ 150 [mm]	11,0 [mm]
- ND > 150 [mm]	12,5 [mm]

The thickness shown in the above table refers to carbon steel. For pipes of other material, minimum wall thickness is determined in agreement with the *Register*.

**\* NOTE:** Heavy flanges joints means welded flange joints rated at least PN10 or one pressure rating higher than required design pressure, whichever is greater.

- .2 Provision shall be made for expansion compensation of pipes within the tanks. Expansion bends\* only are permitted for this purpose.

**\* NOTE:** Expansion bends means expansion loops such as an omega bend ('Ω') in piping system to counteract excessive stresses or displacement caused by thermal expansion or hull deformation which could be fabricated from straight lengths of pipe.

- .3 Connection between cargo piping and ballast piping referred to above is not permitted. Nevertheless, provision may be made for emergency discharge of the segregated ballast by means of a connection to a cargo pump through a portable spool piece. In this case non-return valves should be fitted on the segregated ballast connections to prevent the passage of oil to the ballast tanks. Shut-off valves shall be provided to shut off the cargo and ballast lines before the spool piece is removed. The portable spool piece should be mounted in a conspicuous position in the pump room and a permanent notice restricting its use should be prominently displayed adjacent to it.
- .4 The ballast pump is to be located in the cargo pump room, or a similar space within the cargo area not containing any source of ignition.

The requirement is not mandatory for tankers for oil with flashpoint > 60°C.

Air and sounding pipes of fuel oil tanks may pass through the cargo tanks, provided they have no detachable connections, and efficiently secured and protected against mechanical damage. The wall thickness of these pipes shall be not less than indicated in Table 1.3.4.3, column D.

**4.2.3** Remote controlled valves shall comply with requirements specified in 1.4.1.2 and 1.4.1.3.

Spindles used to operate valves placed inside the tanks shall be carried to the open deck through sealing glands. These glands shall be gastight. Replacement of the sealing material shall be made from the open deck. Drives shall have arrangements showing whether the valve is open or closed.

Drives shall be of such construction as to prevent accumulation of the cargo oil residue in them.

**4.2.4** Pipe flanges and fastening pieces intended for hose connection from shore, as well as the earthing arrangements, for oil with flashpoint < 60°C, shall be made of materials precluding spark formation.

**4.2.5** Piping on the deck and in cargo tanks shall be efficiently secured and fitted with the thermal compensators.

**4.2.6** All the sections of cargo piping interconnected by flanges shall have reliable electrical connection. They shall have electric connection to the ship's hull in at least one place (see the *Rules for the classification of ships, Part 12 - Electrical Equipment, 2.6.6.2*).

**4.2.7** All remote controlled valves installed between the cargo mains and pumps, shall be capable of being operated also by hand.

Where rubbing parts of remote control linkage pass inside the cargo tanks and cofferdams, as well as on the cargo deck, precautions shall be such as to preclude spark formation.

**4.2.8** Slop tanks of oil tankers shall be, as a rule, provided with separate piping. Where such a system is not provided, spectacle flanges or other blanking means shall be fitted on the suction and filling pipes of slop tanks.

**4.2.9** On oil tankers, the heating media temperature within the cargo area is not to exceed 220°C, and pressure shall not exceed 2 Mpa.

On gas carriers and chemical tankers, the maximum temperature is to be adjusted to take into account the temperature class of the cargoes.

**4.2.10** Provisions shall be made for combination carriers by separate piping which connects the collecting tank with the cargo pump room. This may be effected by a valve provided with a spectacle flange or a removable pipe with a blank flange fitted at the tank.

If this proves to be impractical, such devices may be fitted in the cargo pump room directly at the bulkhead.

In ships intended to carry dry cargo, a separate pump and piping leading to open deck for discharge of a collecting tank shall be provided.

This system, as a rule, shall not be connected with other systems. The connection of the collecting tank discharge system with other systems shall be specially considered by the *Register*. Discharge pipe connection of the collecting tank on deck shall be provided with a valve and a spectacle flange.

### 4.3 OIL COLLECTING SYSTEM IN OIL COLLECTING SHIPS

**4.3.1** Oil collecting and oil transfer systems and arrangements shall be located out of engine rooms and accommodations.

**4.3.2** System shall be capable to ensure collecting and transfer of the recovered oil.

**4.3.3** Where the oil collecting system in a multi-purpose ship is not compatible with the required cargo system,

provision shall be made to separate appropriately these two systems.

**4.3.4** In case the ship is provided with a portable oil collecting arrangement, such an arrangement shall be connected to the open deck by means of not more than two removable pipes. Interconnection of pipelines of all oil collecting tanks, from both ship's sides is permitted.

Pipeline which interconnects such tanks shall not be led through accommodations. Leading of pipeline through enclosed non-hazardous zones (see the *Rules for the classification of ships, Part 12 - Electrical Equipment, 2.9*) shall be specially considered by the *Register*.

### 4.4 FORE AND AFT CARGO LOADING AND UNLOADING PIPING SYSTEM IN TANKERS

**4.4.1** Pipeline for loading and unloading cargo from fore or aft position in tanker shall be fixed. If necessary, connection elements to such pipelines can be removable.

**4.4.2** Pipelines shall be lead outside the accommodations and service spaces as well as outside engine rooms located in the area of accommodation spaces or control stations.

**4.4.3** Cargo pipeline branch connections shall be welded. If necessary, expansion joints may be used. Pipelines passing through cargo control station may be provided with removable branch connections.

Connecting of pipelines with valves may be carried out by means of flanges set forth in 1.3.7.2. These pipelines shall be specially marked and provision shall be made to enable their disconnecting by means of two valves fitted in the cargo area and provided with the devices for blocking them in closed position as well as the possibility to make sure that they are closed, or by means of one valve and other closing devices, such as a removable pipe.

**4.4.4** Pipeline section serving for earth connection shall be provided with a shut off valve, a blind flange and a tray below them.

Blind flange may not be provided if a special connection is available.

**4.4.5** Discharge arrangement for cargo residue shall be provided on the cargo pipeline. Cargo pipeline which is outside the cargo zone shall have possibility to drain the cargo and to fill this pipeline with inert gas. Arrangement on inert gas connection for separating inert gas system from cargo shall be provided.

**4.4.6** Tankers intended to supply other ships and which are provided with fore cargo loading and unloading piping, shall be provided with device for quick disconnection of flexible cargo hose in case of emergency. Structure and position of such device shall be specially considered by the *Register*.

**4.4.7** In ships specified in 4.4.6 air pipes of fore peak shall be at a maximum possible distance from the gas hazardous zones.

## 4.5 INTEGRATED CARGO AND BALLAST SYSTEMS ON TANKERS

**4.5.1** Unless otherwise specified, the requirements are applicable to integrated cargo and ballast systems installed on tankers (i.e. cargo ships constructed or adapted for the carriage of liquid cargoes in bulk), irrespective of the size or type of the tanker.

**4.5.2** The operation of cargo and/or ballast systems may be necessary, under certain emergency circumstances or during the course of navigation, to enhance the safety of tankers.

As such, measures are to be taken to prevent cargo and ballast pumps becoming inoperative simultaneously due to a single failure in the integrated cargo and ballast system, including its control and safety systems.

**4.5.3** Within the scope of these requirements, integrated cargo and ballast system means any integrated hydraulic and/or electric system used to drive both cargo and ballast pumps (including active control and safety systems and excluding passive components, e.g. piping).

**4.5.4** Integrated cargo and ballast systems are to incorporate, inter alia, the following design features:

- .1 The emergency stop circuits of the cargo and ballast systems are to be independent from the circuits for the control systems. A single failure in the control system circuits or the emergency stop circuits are not to render the integrated cargo and ballast system inoperative;
- .2 Manual emergency stops of the cargo pumps are to be arranged in a way that they are not to cause the stop of the power pack making ballast pumps inoperative;
- .3 The control systems are to be provided with backup power supply, which may be satisfied by a duplicate power supply from the main switch board. The failure of any power supply is to provide audible and visible alarm activation at each location where the control panel is fitted.
- .4 In the event of failure of the automatic or remote control systems, a secondary means of control is to be made available for the operation of the integrated cargo and ballast system.  
This is to be achieved by manual overriding and/or redundant arrangements within the control systems.

**4.5.5** Integrated electric system used to drive the cargo and ballast pumps (including active control and safety systems) are to comply with the *Rules for the classification of ships, Part 12 – Electrical equipment*, 19.2.7.

## 4.6 PARTICULAR REQUIREMENTS FOR COMBINATION CARRIERS

**4.6.1** The slop tanks shall be surrounded by cofferdams except where the boundaries of the slop tanks, where slop may be carried on dry cargo voyages, are part of the hull, main cargo deck, cargo pump-room bulkhead or oil fuel bunker tank.

These cofferdams shall not be open to a double bottom, pipe tunnel, pump-room or other enclosed space, nor

shall they be used for cargo or ballast and shall not be connected to piping systems serving oil cargo or ballast.

Means shall be provided for filling the cofferdams with water and for draining them.

Where the boundary of a slop tank is part of the cargo pump-room bulkhead, the pump-room shall not be open to the double bottom, pipe tunnel or other enclosed space; however, openings provided with gastight bolted covers may be permitted.

**4.6.2** Means shall be provided for isolating the piping connecting the pump-room with the slop tanks referred to in paragraph 4.6.1.

The means of isolation shall consist of a valve followed by a spectacle flange or a spool piece with appropriate blank flanges. This arrangement shall be located adjacent to the slop tanks, but where this is unreasonable or impracticable, it may be located within the pump-room directly after the piping penetrates the bulkhead.

A separate permanently installed pumping and piping arrangement incorporating a manifold, provided with a shut-off valve and a blank flange, shall be provided for discharging the contents of the slop tanks directly to the open deck for disposal to shore reception facilities when the ship is in the dry cargo mode.

When the transfer system is used for slop transfer in the dry cargo mode, it shall have no connection to other systems. Separation from other systems by means of removal of spool pieces may be accepted.

**4.6.3** Hatches and tank cleaning openings to slop tanks shall only be permitted on the open deck and shall be fitted with closing arrangements. Except where they consist of bolted plates with bolts at watertight spacing, these closing arrangements shall be provided with locking arrangements under the control of the responsible ship's officer.

**4.6.4** Where cargo wing tanks are provided, cargo oil lines below deck shall be installed inside these tanks.

However, the Flag State Administration may permit cargo oil lines to be placed in special ducts provided there are capable of being adequately cleaned and ventilated to the satisfaction of the Administration.

Where cargo wing tanks are not provided, cargo oil lines below deck shall be placed in special ducts.

## 5 AIR, GAS VENT, OVERFLOW AND SOUNDING SYSTEMS

### 5.1 AIR PIPES

#### 5.1.1 Principle

**5.1.1.1** Air pipes are to be fitted to all tanks, double bottoms, cofferdams, tunnels and other compartments which are not fitted with alternative ventilation arrangements, in order to allow the passage of air or liquid so as to prevent excessive pressure or vacuum in the tanks or compartments, in particular in those which are fitted with piping installations. Their open ends are to be so arranged as to prevent the free entry of sea water in the compartments.

#### 5.1.2 Number and position of air pipes

**5.1.2.1** Air pipes are to be so arranged and the upper part of compartments so designed that air or gas likely to accumulate at any point in the compartments can freely evacuate. The arrangement shall also preclude the formation of air pockets.

When the top of the compartment is of irregular form, the position of air pipes will be given special consideration by *Register*.

**5.1.2.2** Air pipes are to be fitted opposite the filling pipes and/or at the highest parts of the compartments, the ship being assumed to be on an even keel.

**5.1.2.3** In general, two air pipes are to be fitted for each compartment, except for small compartments where *Register* agrees that only one air pipe may be accepted.

In that order, two air vents are normally required for long tanks, like for example a ballast tank in a double hull ship.

**5.1.2.4** Tanks extending from side to side of the ship shall be generally fitted with air pipes at both sides. At the narrow ends of double bottom tanks in the forward and after parts of the ship, only one air pipe is sufficient.

**5.1.2.5** Where only one air pipe is provided, it is not to be used as a filling pipe.

**5.1.2.6** Except otherwise justified, the air pipes shall be provided also for structural sea inlet boxes. Such air pipes shall have suitable shut-off valves fitted directly on the boxes.

**5.1.2.7** For unmanned pontoons/technical floating units not fitted with auxiliary power and where portable pumps are provided in accordance with 2.1.9, void spaces need not be provided with air pipes or any other means of ventilation. In this case, a warning notice is to be placed in a prominent position specifying the precautions to be taken prior to opening a man-hole of a void space.

#### 5.1.3 Location of open ends of air pipes

**5.1.3.1** Air pipes of double-bottom tanks and of tanks adjoining the shell plating, of cofferdams and void spaces with

bilge connections, as well as the air pipes of sea inlet boxes, are to be extended above the open deck.

**5.1.3.2** Air pipes of tanks intended to be pumped up are to be led to the open deck above the bulkhead deck or the freeboard deck.

**5.1.3.3** Air pipes other than those of flammable oil tanks may be led to enclosed cargo spaces situated above the freeboard deck, provided that:

- overflow pipes are fitted in accordance with 5.3, where the tanks may be filled by pumping
- enclosed cargo spaces are fitted with scuppers discharging overboard and being capable of draining all the water which may enter through the air pipes without giving rise to any water accumulation
- suitable drainage arrangement is to be fitted below the air pipe outlet, leading to the nearest scupper
- such arrangement is not to impair integrity of fire divisions or watertight decks and bulkheads subject to the damage stability requirements.

**5.1.3.4** Unless otherwise specified, in passenger ships the air pipes terminating within a superstructure which are not fitted with watertight means of closure shall be considered as unprotected openings which shall be taken into consideration for relevant stability calculation (when applying the SOLAS, II-1/Reg. 7-2.6.1.1).

**5.1.3.5** In general, the air pipe from scupper tanks are to be led to the above freeboard deck.

**5.1.3.6** The location of air pipes for flammable oil tanks is also to comply with 5.1.7.

#### 5.1.4 Height of air pipes

**5.1.4.1** Height of the air pipes from the deck to the point where water may have access below shall be not less than 760 [mm] on the freeboard deck and 450 [mm] on the superstructure deck.

**5.1.4.2** If the height of the air pipes impedes the ship's service, the lower height may be permitted, provided that the closing devices and similar devices are still capable of their functions.

**5.1.4.3** The height of air pipes discharging through the side of the superstructure is to be at least 2,3 m above the summer load waterline.

**5.1.4.4** Different height of air pipes may be required on the ships where subdivision and damage stability requirements apply. Since the air pipe outlets should be generally above final water line at any assumed damaged condition, possible additional requirements are subject to the result from damage stability examination.

**5.1.4.4** In ships of restricted areas of navigation 5 to 8 the height of air pipes, with respect to the location, may be reduced up to the value specified in Table 5.1.4, unless the Flag State Administration expressly provided otherwise.

Table 5.1.4

Minimum height of air pipes [mm]	Area of navigation		
	1 to 4	5	6 to 8
On the freeboard deck	760	600	380
On the superstructure deck	450	380	300

### 5.1.5 Fitting of closing devices

**5.1.5.1** Suitable means permanently attached are to be provided for closing the air pipe outlets in order to prevent the free entry of water into the spaces concerned.

Except for air pipes of tanks fitted with cross-flooding connections and air pipes of sea suction boxes, this requirement shall generally apply to all air pipe outlets situated on the **exposed freeboard** deck and superstructure deck of the first tier (see the *Rules for the classification of ships, Part 3 - Hull Equipment, 1.2.5.5*) as well as the outlets on the decks of higher tiers within the region of the angle of flooding (see the *Rules for the classification of ships, Part 4 - Stability, 1.2*).

**5.1.5.2** Except otherwise specified, the automatic closing appliances are generally to be fitted in the following cases:

- where air pipes to ballast and other tanks or spaces extend above the freeboard or superstructure decks
- where, with the ship at its summer load waterline, the openings are immersed at an angle of heel of 40° or, at the angle of downflooding if the latter is less than 40°
- where, as per 5.1.3.3, air pipes terminate in enclosed spaces
- where, as per 5.1.4.2, the air pipes have a height lower than that required in 5.1.4.1
- and for ships assigned timber freeboard.

**5.1.5.3** For ships subject to specific buoyancy or stability requirements, the fitting of closing appliances to air pipes will be subject to special consideration.

**5.1.5.4** The air pipes closing devices are to comply with 5.1.6 and the automatic closing devices shall be of a type approved.

**5.1.5.5** Pressure/vacuum valves installed on cargo tanks, in accordance with 5.2, can also be accepted as closing appliances.

**5.1.5.6** The self-closing means preventing admission of sea water could be avoided on the air pipe outlet where following was justified (except for air pipes of fuel oil and lubricating oil tanks):

- the air vent outlet is so located that the admission of sea water will not be enabled even at 40° inclination of the ship **at its summer load line**, or
- the approved stability booklet is showing that possible flooding of the tank/space served by related air vent pipe can be accepted scenario.

### 5.1.6 Air pipe closing devices

**5.1.6.1** Air pipe closing devices where required by the Rules or the International Convention on Load Lines, 1966 or the Protocol of 1988 relating to the International Convention on Load Lines 1966, as amended by IMO resolutions up to MSC.375(93), shall be permanently fixed and fitted with automatic closing devices of an approved type.

Each type and size of air pipe automatic closing device is to be surveyed and type tested at the manufacturer's works or other acceptable location for the *Register*.

Type testing is to include at least the scope of minimum test requirements for an air pipe automatic closing device as given in 5.1.6.12 – 14 (*IACS UR P3*).

**5.1.6.2** Air pipe automatic closing devices are to be so designed that they will withstand both ambient and working conditions, and be suitable for use at inclinations up to and including ± 40°.

**5.1.6.3** Air pipe automatic closing devices are to be constructed to allow inspection of the closure and the inside of the casing as well as changing the seals.

**5.1.6.4** Efficient ball or float seating arrangements are to be provided for the closures. Bars cage or other devices are to be provided to prevent the ball or float from contacting the inner chamber in its normal state and made in such a way that the ball or float is not damaged when subjected to water impact due to a tank being overfilled.

**5.1.6.5** Air pipe automatic closing devices are to be self-draining.

**5.1.6.6** The clear area through an air pipe closing device in the open position is to be at least equal to the area of the inlet.

**5.1.6.7** An automatic closing devices is to:

- .1 Prevent the free entry of water into the tanks.
- .2 Allow the passage of air or liquid to prevent excessive pressure or vacuum coming on the tank.

**5.1.6.8** In the case of air pipe closing devices of the float type, suitable guides are to be provided to ensure unobstructed operation under all working conditions of heel and trim, as specified in 5.1.6.2.

**5.1.6.9** The maximum allowable tolerances for wall thickness of floats should not exceed ± 10% of thickness.

**5.1.6.10** The inner and the outer chambers of an automatic air pipe head is to be of a minimum thickness of 6 mm. Where side covers are provided and their function is integral to providing functions of the closing device as outlined in 5.1.6.7, they shall have a minimum wall thickness of 6 mm. If the air pipe head can meet the tightness test in 5.1.6.12.b without the side covers attached, then the side covers are not considered to be integral to the closing device, in which case a wall less than 6 mm can be acceptable for side covers.

**5.1.6.11** Materials are to comply with the following requirements:

- .1 Casings of air pipe closing devices are to be of approved metallic materials adequately protected against corrosion.

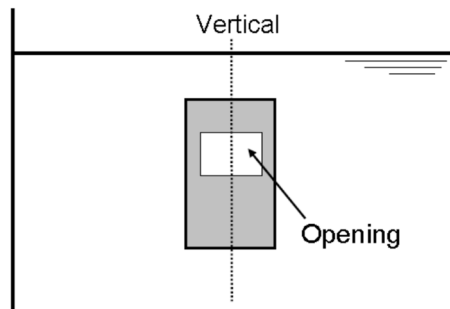
- 2 For galvanised steel air pipe heads, the zinc coating is to be applied by the hot method and the thickness is to be 70 to 100 microns.
- 3 For areas of the head susceptible to erosion (e.g. those parts directly subjected to ballast water impact when the tank is being pressed up, for example the inner chamber area above the air pipe, plus an overlap of 10° or more either side) an additional harder coating should be applied. This is to be an aluminium bearing epoxy, or other equivalent, coating, applied over the zinc.
- .4 Closures and seats made of non-metallic materials are to be compatible with the media intended to be carried in the tank and to seawater and suitable for operating at ambient temperatures between -25 ° C and 85 ° C.

**5.1.6.12** Further requirements of this item shall apply to Type Testing of Air Pipe Automatic Closing Devices (*see also IACS UR P3*).

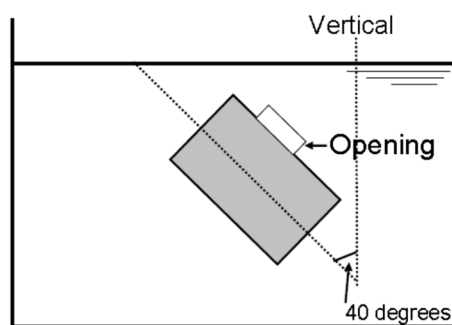
Each type and size of air pipe automatic closing device is to be surveyed and type tested at the manufacturer’s works or other acceptable location according to the *Register’s* practice. The minimum test requirements for an air pipe automatic closing device are to include the following:

- a) Determination of the Flow Characteristics.  
The flow characteristics of the air pipe closing device are to be determined. Measuring of the pressure drop versus rate of volume flow is to be carried out using water and with any intended flame or insect screens in place.
- b) Tightness test during immersion / emerging in water.  
An automatic closing device is to be subjected to a series of tightness tests involving not less than two (2) immersion cycles under each of the following conditions:
  - i) The automatic closing device is to be submerged slightly below the surface of the water at a velocity of approximately 4 m/min. and then returned to the original position immediately. The quantity of leakage is to be recorded.
  - ii) The automatic closing device is to be submerged to a point slightly below the surface of the water. The submerging velocity is to be approximately 8 m/min and the air pipe vent head is to remain submerged for not less than 5 minutes. The quantity of leakage shall be recorded.
  - iii) Each of the above tightness tests shall be carried out in the normal position as well as at an inclination of 40 degrees under the strictest conditions for the device. In cases where such strictest conditions are not clear, tests shall be carried out at an inclination of 40 degrees with the device opening facing in three different directions - upward, downward, sideways (left or right). See Fig. 5.1.6.12-1 to 5.1.6.12-4.

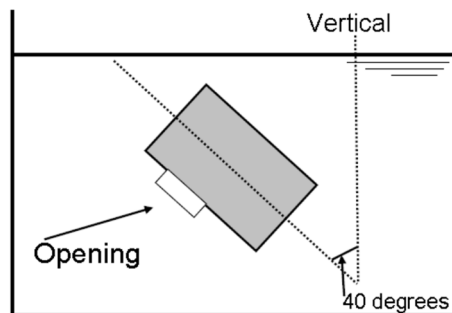
**Figure 5.1.6.12-1:** Example of normal position



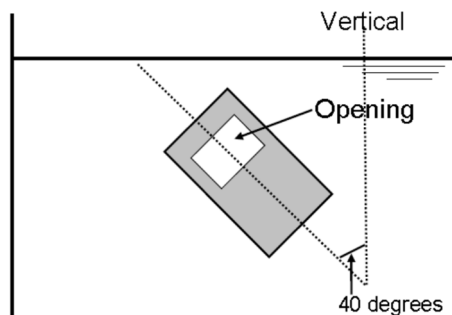
**Figure 5.1.6.12-2:** Example of inclination 40 degrees opening facing upward



**Figure 5.1.6.12-3:** Example of inclination 40 degrees opening facing downward



**Figure 5.1.6.12-4:** Example of inclination 40 degrees opening facing sideways



The maximum allowable leakage per cycle shall not exceed 2 ml/mm of nominal diameter of inlet pipe during any individual test.

- c) Discharge / Reverse flow test  
The air pipe head shall allow the passage of air to prevent excessive vacuum developing in the tank.
  - i) Reverse flow test
    - 1) A reverse flow test shall be performed. A vacuum pump or another suitable device shall be connected to the opening of the air pipe leading to the tank. The flow velocity shall be applied gradually at a constant rate until the float gets sucked and blocks the flow.; and
    - 2) The velocity at the point of blocking shall be recorded. 80% of the value recorded will be stated in the certificate.
  - ii) Alternative to the reverse flow test
    - 1) For pipe heads of 400 mm nominal diameter and above, as an alternative to the reverse flow test, a numerical simulation test based on computational fluid dynamics (CFD), to be carried out in conjunction with limited representative testing to establish the validity of the CFD modelling and results, may be accepted;
    - 2) CFD predictions for air pipe heads can be validated against the available actual reverse flow test results of same size and type of air pipe heads;
    - 3) The accuracy of the CFD modelling and the major assumptions used for the calculation are to be documented;
    - 4) Mesh convergence studies are to be carried out and documented; and
    - 5) The requirement as per the preceding i) 2) applies

**5.1.6.13** For testing of non-metallic Floats, impact and compression loading tests shall be carried out on the floats before and after preconditioning as follows:

Test condition	Test temperature °C		
	-25	20	85
Dry			
After immersing in water			
After immersing in fuel oil			
Immersing in water and fuel oil is to be for at least 48 hours			

- a) Impact Test may be conducted on a pendulum type testing machine. The floats shall be subjected to 5 impacts of 2.5 Nm each and shall not suffer permanent deformation, cracking or surface deterioration at this impact loading.

Subsequently the floats shall be subjected to 5 impacts of 25 Nm each. At this impact energy level some localised surface damage at the impact point may occur. No permanent deformation or cracking of the floats shall appear.

- b) Compression Loading Test  
Compression tests shall be conducted with the floats mounted on a supporting ring of a diameter and bearing area corresponding to those of the float seating with which it is intended that float shall be used. For ball type float, loads shall be applied through a concave cap of the same internal radius as the test float and bearing on an area of the same diameter as the seating. For a disc type float, loads are to be applied through a disc of equal diameter as the float.  
A load of 350 kg shall be applied over one minute and maintained for 60 minutes. The deflection shall be measured at intervals of 10 minutes after attachment of the full load. The record of deflection against time is to show no continuing increase in deflection and, after release of the load, there shall be no permanent deflection.

**5.1.6.14** For testing of Metallic Floats, tests shall be conducted in accordance with 5.1.6.13.a). The tests shall be carried out at room temperature and in the dry condition.

**5.1.7 Special arrangements for air pipes of flammable oil tanks**

**5.1.7.1** Open ends of air pipes from the fuel oil, thermal oil and lubricating oil tanks, as well as the air pipes from cofferdams on oil tankers, separating cargo oil or slop tanks, shall be led to a safe position on the open deck where no danger will be incurred from issuing oil or gases.

Where requirement for terminating of air pipes to a safe position is impracticable for application on ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8, the arrangement shall be subject to special consideration by the Register in each particular case. In any case the open ends of air pipes from the fuel oil, thermal oil and lubricating oil tanks shall be located at such positions where they cannot be damaged or they shall be provided with adequate guards. In addition, open end of air pipes from fuel oil tanks shall be fitted with suitable flame screen made of corrosion-resistant material and readily removable for cleaning and replacement. The clear area of the flame screen shall be not less than the cross-sectional area of the air pipe.

**5.1.7.2** Air pipes of lubricating or hydraulic oil storage tanks, which are neither heated nor subject to flooding in the event of hull damage, may be led to machinery spaces, provided that in the case of overflowing the oil cannot come into contact with electrical equipment, hot surfaces or other sources of ignition.

**5.1.7.3** Vents pipes for fuel oil service, settling and lubrication oil tanks directly serving the propulsion and generator engines are to be so located and arranged that in the event of a broken vent pipe, this will not directly lead to the risk of ingress of sea water splashes or rain water.

**5.1.7.4** Air pipes of fuel oil service, settling and lubrication oil tanks likely to be damaged by impact forces are to be adequately reinforced.

**5.1.7.5** Where seawater or rainwater may enter fuel oil service, settling and lubrication oil tanks through broken air pipes, suitable arrangements are to be provided such as water traps with:

- automatic draining, or
- alarm for water accumulation

**5.1.7.6** Air pipe outlets from the fuel oil tanks which are heated on temperature higher than limits specified in 8.3.4, including the air pipe outlets from circulating lub oil tanks, shall be protected by suitable flame screens. The clear area through these fittings shall be not less than the cross-sectional area of the air pipe.

In oil tankers carrying the oils with flash point of 60°C or below, identical requirements shall apply also for outlets of all air pipes from the cofferdams located at the fore and aft ends of the cargo spaces, including the tanks and cofferdams located within the cargo area and not intended for cargo.

Where fitted, flame screens are to be of corrosion resistant material and readily removable for cleaning and replacement.

**5.1.7.7** Air pipes of the fuel oil tanks and thermal oil tanks in way of the accommodation and refrigerated cargo spaces shall not have detachable connections.

Where the *Register* finds it acceptable, the application of this criterion is not mandatory for ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8, provided that number of detachable connections are kept to minimum.

**5.1.7.8** Routing of air pipes of fuel oil tanks through cargo tanks shall comply with the requirements of 4.2.3.

**5.1.7.9** Air pipes of the internal combustion engine crankcase shall comply with the requirements of 5.1.6, 5.1.8 and requirements of the *Rules for the classification of ships, Part 9 – Machines, 2.3.2.5*.

## 5.1.8 Construction of air pipes

**5.1.8.1** Minimum wall thickness (“s”) for outside diameter (“D”) of the air pipes coamings above open decks is to be not less than listed below:

- for  $D \leq 82,5$  [mm] – 6,3 [mm]
- for  $D \leq 114,3$  [mm] – 7,1 [mm]
- for  $D \leq 139,7$  [mm] – 8,0 [mm]
- for  $D > 139,7$  [mm] – 8,8 [mm]

For ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8, including the yachts in general, the *Register* may also permit the use of austenitic stainless steel pipes for the air pipes coamings above open decks, subject to the following condition:

- a) Minimum wall thickness (“s”) for outside diameter (“D”) of the pipes shall be as follows:
  - for  $D \leq 73,0$  [mm] – 3,2 [mm]
  - for  $D \leq 114,3$  [mm] – 4,0 [mm]
  - for  $D > 114,3$  [mm] – subject to specially considered by the *Register*

- b) Suitable reinforcement to the satisfaction of *Register* is to be provided against possible mechanical damage of the pipe, for example by additional clamps and supports fitted to the structure.

**5.1.8.2** In general, the air pipes shall be located in protected places where there is no possibility of their damage during cargo handling operations and closing appliances are to be readily accessible at all times. In case where it is possible that air pipe still could be damaged in normal operation on board, additional reinforcement is required.

The additional reinforcement is to be provided also for any air pipes with height exceeding 900 mm.

**5.1.8.3** The upper end of each air pipe shall be made as a bend, with its opening facing downwards or shall have another construction agreed upon with the *Register*.

In addition, suitable protecting corrosion-resistant screen shall be fitted to the air vent outlets serving potable water tanks, in order to prevent possible admission of foreign bodies or insects.

**5.1.8.4** For each compartment likely to be pumped up, and where no overflow pipe is provided, the total cross-sectional area of air pipes is not to be less than 1,25 times the cross-sectional area of the corresponding filling pipes.

Total cross-sectional area of the air pipes of tanks filled by gravity shall be not less than the total cross-sectional area of the filling pipes of these tanks.

The application of this criterion is not mandatory for air vent pipes within the sanitary discharge systems on ships in restricted navigation area 5 to 8, if justified that the cross-sectional area of the air pipes cannot create the conditions in which the collecting tanks or ship structure will be exposed to the unacceptable overpressure.

**5.1.8.5** Where tanks are fitted with cross flooding connections, the air pipes are to be determined for adequate cross flooding.

**5.1.8.6** Air pipes acting also as overflows may be accepted provided that both requirements are complied with, for air pipes and for overflows.

**5.1.8.7** The arrangement of the air pipes shall preclude the formation of hydraulic seals in the pipes under normal conditions of list and trim.

**5.1.8.8** Except otherwise specified, the internal diameter of air pipes from tanks or spaces of 2 [m<sup>3</sup>] and above is not to be less than 50 mm.

The internal diameter of air pipes from tanks or spaces of less than 2 [m<sup>3</sup>] are to be generally not less than 38 [mm], provided that the *Register* finds it acceptable in relation with the filling arrangement.

In case of gravity filled tanks of less than 2 [m<sup>3</sup>], smaller internal diameter of air pipes may be accepted but in no case less than 25 mm.

**5.1.8.9** Air pipes from several tanks or spaces may be connected to a common main line (air pipes collector), provided that following is satisfied:

- Tanks or spaces are not intended for medium which are not compatible and that the

arrangement could not effect unacceptable condition for the ship.

- Cross-sectional area of the air pipes collector is not to be less than the aggregate cross-sectional area of two largest pipes discharging into the main. However, a reduced value may be considered for acceptance in each particular case on the basis of back pressure calculation submitted for all normal working conditions.
- As far as practical, each separate air pipe is to be fitted to the air pipes collector from the top side.
- Where no overflow pipes are provided, the cross-sectional area of the air pipes collector for several tanks is not to be less than 1,25 times the area of the common filling pipeline for these tanks. See also requirements of 5.3.3.
- Effective drainage shall be provided at the lower part of the air pipes collector.
- Where the tanks or spaces are situated at the shell side, the connections to the air pipes collector are to be above the freeboard deck. If it is not practical, different position proposed as far as possible above the deepest load waterline may be considered for acceptance. For ships subject to damage stability requirements these connections should be above final water line at any damaged condition assumed by the damage stability examination.

**5.1.8.10** Name plates shall be affixed to the upper ends of all air pipes.

**5.1.9 Strength requirements to resist green sea forces for the air pipes, ventilator pipes and their closing devices located within the forward quarter length**

**5.1.9.1** In addition to all other requirements specified before, the air pipes, ventilator pipes and their closing devices located on the exposed deck over the forward 0,25 L, are to comply also with applicable requirements in the *Rules for the classification of ships, Part 3 – Hull equipment, Head 7.14 - Strength requirements for fore deck fittings and equipment (IACS UR S27)*

In general, the requirements shall apply to 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 0,1 L or 22 [m] above the summer load waterline, whichever is lesser, as defined in the above mentioned the *Rules for the classification of ships, Part 3 – Hull equipment*.

The requirements do not apply to the cargo tank venting systems and the inert gas systems of tankers.

**5.2 CARGO TANK VENTING, PURGING AND GAS-FREEING**

**5.2.0 Definitions**

**5.2.0.1** *Inert gas* means a gas or mixture of gases, such as flue gas, containing insufficient oxygen to support the combustion of hydrocarbons.

**5.2.0.2** *Inert condition* means a condition in which the oxygen content throughout the atmosphere of a tank has been reduced to 8 % or less by volume by addition of inert gas.

**5.2.0.3** *Inerting* means the introduction of inert gas into a tank with the object of attaining the condition as defined in “inert condition”.

**5.2.0.4** *Cargo tank venting* means a introduction of air or inert gas mixtures into a tank, as well as evacuation of vapour or inert gas mixtures from a tank, during cargo loading and blasting operations, or during thermal variations in a cargo tank.

**5.2.0.5** *Purging* means the introduction of inert gas into a tank already in the inert condition with the object of:

- .1 further reducing the existing oxygen content; and /or
- .2 reducing the existing hydrocarbon gas content to a level below which combustion cannot be supported if air is subsequently introduced into the tank.

**5.2.0.6** *Gas – freeing* means the introduction of fresh air into a tank with the object of removing toxic, flammable and inert gases and increasing the oxygen content to 21 % by volume.

**5.2.0.7** *Open tank venting system* means the cargo tank venting system, which offers no restriction except for friction losses to the free flow of vapours to and from cargo tanks during normal operations. An open venting system may consist of individual vents from each tank, or such individual vents may be combined into a common header or headers, with due regard to cargo segregation.

**5.2.0.8** *Controlled tank venting system* means the cargo tank venting system in which pressure and vacuum relief valves or pressure/vacuum valves are fitted to each tank to limit the pressure or vacuum in the tank. A controlled venting system may consist of individual vents from each tank, or such individual vents may be combined into a common header or headers, with due regard to cargo segregation.

**5.2.1 Cargo tank venting**

Except otherwise specified, the requirements within this 5.2.1 shall apply in addition to the general requirements in the *Rules for the classification of ships, Part 17 – Fire protection, 11.6.3.2*.

**5.2.1.1** All cargo tanks are to be provided with a venting system appropriate to the cargo being carried on the ship. Cargo tanks venting system shall fully comply with the applicable requirements set forth in the *Rules for the classification of ships, Part 17 – Fire protection, 4.5.3, 4.5.6 and 11.6*.

The requirements of this regulation are not applicable to the cargo tanks venting system on tankers engaged

exclusively in the carriage of cargoes with flash point above 60 °C.

**5.2.1.2** When calculating the capacity of the tank venting system, the pressure drop across flame arresting devices, if fitted, shall be increased relative to the pressure drop of the device(s) in clean conditions. Recommended guidance for this increase is 50% of value for the flame arresters in clean conditions.

**5.2.1.3** The venting system should be designed to take into consideration the maximum permissible loading/discharging rate for each cargo tank and in the case of a combined venting system, for each group of tanks.

**5.2.1.4** Slop tanks are to be equipped with the same venting arrangements as cargo tanks.

**5.2.1.5** For ships below 500 GT navigating in restricted areas 5 to 8, unless expressly provided otherwise, the application of this requirement is subject to special consideration by the *Register* in each particular case.

## 5.2.2 Cargo tank purging and/or gas-freeing

**5.2.2.1** Arrangements for purging and/or gas-freeing shall be such as to minimize the hazards due to dispersal of flammable vapours in the atmosphere and to flammable mixtures in a cargo tank. Cargo tanks purging and/or gas-freeing arrangement shall fully comply with the applicable requirements set forth in the *Rules for the classification of ships, Part 17 – Fire protection*, 4.5.6 and 16.3.2.

The requirements of this regulation are not applicable to tankers engaged exclusively in the carriage of cargoes with flash point above 60 °C.

**5.2.2.2** Cargo tanks venting and gas-freeing arrangement on chemical tankers shall comply with requirements in the *Rules for the classification of ships, Part 27 - Chemical Tankers*, Section 8.

**5.2.2.3** Inert gas system, if installed, shall comply with requirements in the *Rules for the classification of ships, Part 17 - Fire Protection*, 4.5.5, 4.5.6, 16.3.2 and 16.3.3.

## 5.3 OVERFLOW PIPES

**5.3.1** As a rule, each tank is to be fitted with overflow pipes. Fuel oil tanks shall be provided with overflow pipes leading to the overflow tank or settling tank having increased capacity, but in no case their capacity shall be less than that of the overflow tank specified in 5.4.1 and equipped in compliance with 5.4.2.

The use of a fuel storage tank as overflow tank is permissible but requires the installation of a high level alarm and an air pipe with 1,25 times the cross-sectional area of the main bunkering line. In addition, fuel oil storage tank shall have a space reserved for overflow purposes, not less than that of the overflow tank specified in 5.4.1.

The overflow pipes may be omitted if the arrangement of the fuel or lubricating oil system is such that the possibility of spilling overboard during loading and transferring of fuel or lubricating oil is precluded.

**5.3.2** Cross-sectional area of the overflow pipes shall be the same as for the air pipes (5.1.8.4 to 5.1.8.9). Cross-sectional area of slop tank overflow pipes shall be at least 2 times greater than sectional area of filling pipes.

**5.3.3** Where the overflow pipes from several tanks, situated in different watertight compartments, are led to a common header or pipe, this header or pipe shall be situated above the deepest damage waterline in ships which are to comply with the requirements for subdivision in damaged condition, and above the deepest load waterline in other ships.

The overflow collecting manifolds of fuel tanks are to be led at a sufficient gradient to an overflow tank. Overflow systems of heavy oil tanks shall be specially designed to avoid solidification of the liquid in the pipes, with insulated and heated overflow pipes where necessary.

**5.3.4** Where the air pipes are simultaneously used as overflow pipes, they shall not be connected to the air pipe of an overflow tank. In this case, the overflow pipes, or a common overflow pipe shall be connected directly to the overflow tank.

**5.3.5** Where the tank is used alternately for the carriage of fuel oil, water ballast, liquid cargoes or dry cargo, overflow pipes shall be so arranged as to preclude the possibility of liquid flowing from one tank into another and liquid cargo vapours entering a tank with dry cargo. In such cases, subject to agreement with the *Register*, the overflow pipes may be fitted with shut-off valves, provided these pipes are not used as air pipes.

**5.3.6** Overflow pipes of the daily tanks and fuel oil and lubricating oil settling tanks, shall be led into overflow tanks located lower than the above stated tanks.

**5.3.7** Overflow pipes shall be provided with a sight glass, fitted at a readily visible and accessible place, on vertical part of pipe or with an alarm device to give warning whether the fuel is over-flowing (see 5.4.2).

**5.3.8** Overflow pipes passing through cargo holds are to be protected against damage.

## 5.4 OVERFLOW TANKS

**5.4.1** The capacity of an overflow tank shall be not less than 10 minute capacity of the fuel transfer pump.

**5.4.2** An overflow tank shall be provided with audible and visual alarms operating whenever the tank filling exceeds 75 per cent.

## 5.5 SOUNDING ARRANGEMENTS

**5.5.1** Each tank, cofferdams and void spaces with bilge connections, as well as bilge and bilge wells in spaces which are not accessible at all times, shall be fitted with sounding pipes carried, as a rule, to the open deck. To comply with this requirement, following is to be satisfied:

- .1 In general, the sounding pipes are to be laid straight as far as possible and shall be extend as near as possible to the bottom;
- .2 For ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8, the application of this criterion is not mandatory for sanitary discharge holding tanks,

cofferdams and void spaces if following requirements are met:

- sanitary discharge holding tanks are fitted with high level alarm activating the audible and visible signalization at 80% tank height;
- cofferdams and void spaces are fitted with bilge level alarm.

.3 On application, the provision of sounding pipes for bilge wells in permanently accessible spaces may be dispensed with. For tanks and other spaces which normally may contain liquids, following could be accepted instead of sounding pipes:

- type-approved remote level indicator, effectively protected against possible mechanical damage; or
- two remote level indicators.

.4 As a rule, sounding pipe outlets shall not terminate in machinery spaces and tunnels. Where this requirement is impracticable, the *Register* may permit short sounding pipes led to readily accessible positions above the floor and fitted with efficient closing appliances. For tanks and cofferdams situated in double bottom such closing appliances are to be of self-closing type.

.5 Sounding pipes of flammable oil tanks shall terminate in open air, where no risk of ignition of spillage from sounding pipe might arise. In particular, they shall not terminate in passenger or crew spaces. Where this requirement is impracticable, the *Register* may permit sounding pipes to terminate in machinery spaces if following requirements are met:

- a) in addition, oil-level gauges are provided meeting the requirements of 5.5.2;
- b) the sounding pipes terminate in locations remote from ignition hazards unless precautions are taken, such as fitting of effective screens, to prevent the flammable oil in the case of spillage through the terminations of the sounding pipes from coming into contact with a source of ignition;
- c) the termination of sounding pipes are fitted with self-closing blanking devices complying with the requirements of 1.3.1.10, and with small-diameter self-closing control cock located below the blanking device for the purpose of ascertaining before the blanking device is opened that flammable oil is not present. Provision shall be made so as to ensure that any spillage of flammable oil through the control cock involves no ignition hazard. The pipe height shall not be less than 500 [mm] above the floor level.
- d) For lubricating oil tanks less than 2 m<sup>3</sup>, the oil-level gauge mentioned in a) and the control cock mentioned in **b)** need

not be provided on condition that the sounding pipes are fitted with appropriate means of closure.

- e) Short sounding pipes may be used for tanks other than double bottom tanks without the additional closed level gauge provided that an overflow system is fitted.

**5.5.2** The level gauges intended for installation in flammable oil systems defined in 1.1.4.4, are to be of a type approved. Depending on the type of ship, following requirements shall apply to its construction:

- .1 In passenger ships, such gauges shall not require penetration below the top of the tank and their failure or overfilling of the tanks shall not permit release of flammable oil. Level switches may be used below the tank top provided they are contained in a steel enclosure or other enclosures not capable of being destroyed by fire.
- .2 In cargo ships, the failure of such gauges or overfilling of the tank shall not permit release of flammable oil into the space. The *Register* may accept the use of suitably protected level gauges having heat resistant flat glass of substantial thickness and self-closing fittings at each tank connection. Self-closing fittings should not have locking devices fitted to keep them in the open position. Round gauge glasses are not permitted.
- .3 In the non-propelled ships and cargo ships of less than 500 GT, following could be accepted:
  - cylindrical gauges may be used provided they are fitted with self-closing valves at their lower end as well as at their upper end if the latter is below the maximum liquid level;
  - in the case of tanks not subject to filling by power pumps, with the exception of fuel oil service tanks, the valves need not be of the self-closing type. Such valves are, however, to be readily accessible and instruction plates are to be fitted adjacent to them specifying that they are to be kept closed.
- .4 Within the scope of classification, the *Register* may accept the use of level gauges as defined in 5.5.2.2 also for passenger ships of less than 500 gross tonnage navigating in restricted areas 5 to 8.

**5.5.3** Where the double bottom forms bilge wells, or the ship has a flat bottom, the sounding pipes shall be installed at each side. The pipes shall be as straight as possible or with small curves, as to enable easy passage of a sounding rod. Upper ends of sounding pipes shall be situated on readily accessible places over the bulkhead deck.

**5.5.4** A small-diameter self-closing control cock is generally recommended to be fitted below blanking device in all sounding systems other than those defined in 5.5.1.5.

Sounding pipes of fuel oil tanks led through cargo tanks shall comply with the requirements of 4.2.2.

**5.5.5** Sounding pipes of the double bottom water storage tanks are permitted to be led into spaces below the bulkhead deck that are located above them, provided they are accessible at all times.

Such pipes shall not be used as air pipes and shall be fitted with self-closing blanking devices.

**5.5.6** Provision shall be made under the open ends of the sounding pipes for welded straps or other strengthening to protect the bottom plating from damaging by a sounding rod.

In the case of slotted sounding pipes with blind lower end, the strengthening shall be provided at the lower end of the sounding pipe.

**5.5.7** Internal diameter of the sounding pipes shall be not less than 32 [mm]. Sounding pipes which pass through refrigerated cargo spaces in which the temperature may be reduced to 0 [°C] and below, as well as the pipes of tanks provided with heating system, and sounding pipes of oil storage tanks in oil collecting ships shall have an internal diameter of not less than 50 [mm].

**5.5.8** Name plates shall be affixed to the upper ends of the sounding pipes.

**5.5.9** In oil tankers facilities shall be provided so that the ullages of cargo and slop tanks may be noted without opening the tanks.

Open sounding devices are admitted only as a reserve means in ships having no inert gas system.

**5.5.10** The ends of the sounding pipes led to the exposed deck shall be fitted with tight plugs complying with the requirements of 1.3.1.9.

The use of closings of a different type will be specially considered by the *Register* in each particular case.

Where the sounding pipes project above the open deck, they shall be located at such positions where they cannot be damaged or they shall be provided with adequate guards.

**5.5.11** Sounding pipes of tanks are to be provided close to the top of the tank with holes for equalizing the pressure.

**5.5.12** In cargo holds, a sounding pipe is to be fitted to each bilge well.

**5.5.13** Where level alarms are arranged in each bilge well of cargo holds, the sounding pipes may be dispensed with. The level alarms are to be separate from each other and are to be type approved.

**5.5.14** Sounding pipes passing through cargo holds are to be laid in protected spaces or they are to be protected against damage.

**5.5.15** Sounding pipes are not to be used neither as filling nor vent pipes.

**5.5.16** Sounding pipes are to be located as close as possible to suction pipes.

## 6 EXHAUST GAS SYSTEM

### 6.1 EXHAUST GAS PIPES

**6.1.1** In general, the exhaust gas systems are to be so designed as to:

- a) limit the risk of fire;
- b) limit the exhaust line surface temperature where it may exceed 220 °C, or pass through spaces of the ship where a temperature rise may be dangerous;
- c) prevent gases from entering manned spaces, air conditioning systems and engine intakes;
- d) prevent water from entering engines;
- e) ensure that pressure losses in the exhaust lines do not exceed the maximum values permitted by the engine or boiler manufacturers;
- f) enable relevant thermal expansion and safe operation of the exhaust gas lines for design temperature limits at normal working condition.

**6.1.2** The exhaust gas pipes, as a rule, shall be led to the open decks.

Engine exhaust outlets which penetrate the hull below the freeboard deck should be provided with means to preclude the possibility of sea water getting into the engine, and generally to prevent any back flooding into the hull through a damaged exhaust system.

For ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8, including the yachts generally, where the fitting of a **non-return** positive closure is not practicable, the exhaust should be looped up above the waterline on the outboard side of the system, to a minimum height of 1000 mm, and be of equivalent construction to the hull.

Where the requested minimum height is not possible to achieve for technical reasons, the exhaust is to be looped up to a maximum possible height below **bulkhead** deck. Final acceptance of such arrangement shall be a subject to special consideration by the *Register* in each particular case.

**6.1.3** In oil tankers, timber carriers, supply ships and oil collecting ships, ships for carriage of dangerous cargoes and in ships taking the above mentioned ships in tow, the uptakes of boilers and galleys as well as the exhaust gas pipes of the propulsion and auxiliary engines shall be fitted with spark arresters of a construction approved by the *Register*.

In above mentioned ships, the exhaust gas pipes may be led through the shell plating at a distance not less than 0,3 [m] below the waterline of a ship in light condition.

**6.1.4** The exhaust gas pipes shall be led at a distance not less than 450 [mm] from the fuel oil tanks.

As a rule, the machinery exhaust systems shall not pass through accommodation. Where it is impractical and could not be avoided, the exhaust gas pipes shall be fitted in a gas tight trunk or each space should be fitted with a carbon monoxide detector, having an alarm provided locally and at a continuously manned station.

**6.1.5** Each propulsion engine shall have an individual exhaust gas pipe. Where required, exceptions may be allowed, subject to special consideration by the *Register*.

Exhaust gas pipes of auxiliary engines may be connected to a common exhaust gas pipeline only if provision is made for a reliable protective device that will preclude:

- the gases of the common line entering the pipes of the engines not actually at work;
- damage of any of the engines when starting.

In ships of restricted areas of navigation 5 to 8, the exhaust gas pipes of the propulsion and auxiliary engines may be permitted to connect to a common exhaust line, provided the foregoing precautions are fulfilled.

**6.1.6** Exhaust gas boilers and composite boilers, which by reason of structural features cannot be left without water while heated by exhaust gases, shall be provided with bypass lines and dampers.

**6.1.7** Uptakes of boilers and exhaust gas pipes of internal combustion engines shall be thermally insulated by means of suitable insulating material, with double walls or a screen.

Where the thermal insulation is provided, insulating materials shall comply with requirements of the *Rules for the classification of ships, Part 7 - Machinery Installation*, 1.11.9.

Double walls or a screen are permitted to be used only at places where, in case of overflow, pouring of fuel on them is precluded.

**6.1.8** When the uptakes of main and auxiliary boilers are arranged to discharge into a common uptake, dampers are permitted to be used in the uptake, provided they have arrangements to be locked open. When required, manholes and vertical ladders shall be provided for inspection and cleaning of the uptakes and air ducts of boilers.

**6.1.9** In tankers exhaust gas pipes of main and auxiliary engines, boilers, galleys and other installations with ignition sources as well as ventilation pipes of crankcase of internal combustion engines, shall be fitted at least 6 [m] above the highest water line and out of hazardous zones specified in the *Rules for the classification of ships, Part 12 - Electric Equipment*.

**6.1.10** Exhaust gas piping shall be provided with suitable drainage arrangement capable to prevent the entry of water into engine, particularly in exhaust ducting below exhaust gas boilers.

Drainage arrangement shall be fitted on easy accessible places and shall be provided with a possibility of cleaning.

Internal diameter of drain pipe of such devices shall not be less than 25 [mm].

Where exhaust pipes are water cooled, they are to be so arranged as to be self-draining overboard.

**6.1.11** Materials, manufacture and application of exhaust gas pipes shall be in lieu with 1.3.1.2, 1.3.7.1 and 1.3.7.2, and tables 1.2.2, 1.3.4.3 and 1.3.7.2-3.

## 6.2 SILENCERS AND SPARK ARRESTERS

**6.2.1** Silencers and spark arresters shall be so arranged as to permit cleaning. For this purpose they shall be fitted with appropriate handholes and drain cocks.

**6.2.2** Where waste-gas boilers and spark arresters of the wet type are installed, measures shall be taken to prevent the entry of water into the engines. For this purpose the drain pipes shall be led into the bilges of the engine room and shall be provided with hydraulic seals.

## 6.3 USE OF NON-METALLIC MATERIALS

**6.3.1** For ships of less than 500 gross tonnage navigating in restricted area 5 to 8, the use of non-metallic materials may be accepted in water cooled exhaust gas systems, subject to special consideration in each particular case.

The consideration is to be carried out including, but not limited to, the following conditions:

- .1 Diesel engines are to be for non-essential service, having a total power output of not more than 55 kW.
- .2 Suitable protection against unacceptable high temperature in exhaust gas piping shall be provided by means of engine shut-down in case of exhaust gas cooling water failure.
- .3 Use of plastic shall comply generally with the provisions of 1.7.
- .4 In general, all non-metallic parts of the exhaust gas piping are to be located outside the engine room category A and after water injection. However, the *Register* could accept application of plastic pipes inside engine room category A provided the plastic pipe material meets at least Level 3 fire endurance requirements in accordance with 1.7.4.1. and low flame spread characteristics in accordance with the 1.7.4.2.
5. High level bilge alarm shall be provided in spaces containing the non-metallic parts of the exhaust gas piping.
6. In general, the rigid pipes are to be used for the exhaust gas lines, having the flexible parts as short as practical only to compensate vibration and temperature dilatation where necessary.  
Such flexible parts shall be of an approved type for the service conditions and intended application.
7. The overboard outlets are to be fitted with suitable metallic shut-off valve fitted on the shell connection, controlled from outside the space.
- .8 The exhaust gas outlets on the shell side are to be located above the Summer Load line. Suitable means shall be provided to preclude the possibility of sea water getting into the engine, complying with 6.1.2.

## 6.4 ADDITIONAL REQUIREMENTS FOR EXHAUST GAS TREATMENT SYSTEMS

**6.4.1** In general, the exhaust gas treatment systems are to be designed, arranged and installed in accordance with relevant IMO Guidelines regarding environmental performance of equipment such as Exhaust gas cleaning systems (ECGS) and Selective catalytic reduction (SCR) systems.

Relevant requirements, being mandatory for classification also, are given in the following documents of the *Register*, being available upon request:

- .1 QW142 - EXHAUST GAS CLEANING SYSTEMS - SO<sub>x</sub> SCRUBBERS.
- .2 QW143 - SELECTIVE CATALYTIC REDUCTION SYSTEMS.
- .3 QW144 - EXHAUST GAS RECIRCULATION SYSTEMS- EGR.

Additionally, refer to the *Rules for the classification of ships, Part 9 – Machines*, ANNEX B - STORAGE AND USE OF SCR REDUCTANTS (see *IACS UR M77* also) and ANNEX C (see *IACS UR M81* also).

## 7 VENTILATION SYSTEM

### 7.1 VENTILATION GENERALLY

**7.1.1** In addition to general requirements in the *Rules for the classification of ships, Part 17 - Fire Protection, 9.7*, including applicable requirements in *Part 17 - Fire Protection, 4.5, 5.2, 8, 19.3.4 and 20.3.1*, the ventilation systems generally shall comply with the requirements of this Section.

**7.1.2** Unless instructed otherwise by the Administration, specific requirements concerning the ventilation capacity, number of air changes, ventilation ducts arrangement, duct penetrations, air inlets, coamings height, etc. are specified in the *Rules for the classification of ships, Part 5 - Subdivision, the Rules for the classification of ships, Part 17 - Fire protection and the Rules for technical supervision of sea-going ships, Part 20 - Protection at work and crew accommodation*.

**7.1.3** The construction and the arrangements of ventilation ducts shall comply with the applicable requirements specified in the *Rules for the classification of ships, Part 17 - Fire protection, 9.7.1, 9.7.2, 9.7.3 and 9.7.5*.

**7.1.4** In places of possible sweating the ventilation ducts are to be properly insulated. Drain plugs shall be provided for the portions of ducts where water is likely to accumulate.

**7.1.5** Control of air supply, closing appliances and stopping devices of ventilation shall be arranged in accordance with the *Rules for the classification of ships, Part 17 - Fire protection, 5.2*.

**7.1.6** Where it is necessary that a ventilation duct passes through "A" class divisions, the arrangement of penetration shall comply with applicable requirements in the *Rules for the classification of ships, Part 17 - Fire protection, 9.4.1.1*.

**7.1.7** Where it is necessary that a ventilation duct passes through "B" class divisions, the arrangement of penetration shall comply with applicable requirements in the *Rules for the classification of ships, Part 17 - Fire protection, 9.4.1.2*.

**7.1.8** Where it is necessary that a ventilation duct passes through a main vertical zone division, the arrangement shall comply with the *Rules for the classification of ships, Part 17 - Fire protection, 9.4.1.1.9*.

### 7.2 VENTILATION OF CARGO SHIPS OF 500 TONS GROSS TONNAGE AND UPWARDS, PASSENGER SHIPS CARRYING NOT MORE THAN 36 PASSENGERS AND SPECIAL PURPOSE SHIPS CARRYING NOT MORE THAN 200 PERSONS IN ADDITION TO CREW MEMBERS

**7.2.1** Ventilation systems of accommodation spaces, service spaces and control stations shall comply with requirements of 7.1.

**7.2.2** In addition to the requirements in 7.1.3 and 7.1.4, the ventilation ducts shall comply also with applicable requirements specified in the *Rules for the classification of ships, Part 17 - Fire protection, 9.9*.

**7.2.3** All necessary measures shall be taken for permanent ventilation of the control stations outside the machinery spaces, to ensure visibility and absence of smoke specified in the *Rules for the classification of ships, Part 17 - Fire protection, 8.2*.

### 7.3 VENTILATION OF PASSENGER SHIPS CARRYING MORE THAN 36 PASSENGERS AND SPECIAL PURPOSE SHIPS CARRYING MORE THAN 200 PERSONS IN ADDITION TO CREW MEMBERS

**7.3.1** Additionally to the requirements specified in the *Rules for the classification of ships, Part 17 - Fire Protection, 9.7.4*, the requirements in this head shall be also applied as applicable.

**7.3.2** Ventilation systems of accommodation spaces, service spaces and control stations shall comply with the requirements of 7.1 and 7.2.

**7.3.3** Ventilation systems for laundries shall be arranged in accordance with the *Rules for the classification of ships, Part 17 - Fire Protection, 9.7.7*.

**7.3.4** Where public spaces span two or more open decks (i.e. atriums) and contain combustibles (such as furniture) and enclosed spaces (such as shops, offices and restaurants), the space, shall be equipped with a smoke extraction system in accordance with the *Rules for the classification of ships, Part 17 - Fire Protection, 8.5*.

### 7.4 VENTILATION OF TANKERS AND COMBINATION CARRIERS

**7.4.1** In addition to requirements of 7.1, 7.2, 7.5 and 7.9, the ventilation systems of tankers and combination carriers shall comply with the requirements of this Section.

**7.4.2** Ventilation in cargo area of tankers shall be generally in compliance with applicable requirements of the *Rules for the classification of ships, Part 17 - Fire Protection, 4.5*.

Particular requirements for cargo tank venting arrangements are specified in the *Rules for the classification of ships, Part 17 - Fire Protection, 4.5.3*.

The arrangement of ventilation inlets and outlets, as well as other deckhouse and superstructure boundary space openings, shall be in accordance with the *Rules for the classification of ships, Part 17 - Fire Protection, 4.5.2.6*.

For the location and arrangement of vent outlets for cargo handling and ballasting, the *Rules for the classification of ships, Part 17 - Fire Protection, 4.5.3.4*.

Cargo pump rooms ventilation shall be arranged in accordance with the *Rules for the classification of ships, Part 17 - Fire Protection, 4.5.4*.

**7.4.3** Construction of the ventilation fans in cargo pump rooms shall comply with requirements of the *Rules for the classification of ships, Part 9 - Machines*, 5.3.3 and the location of their driving motors shall meet the requirements of the *Rules for the classification of ships, Part 7 - Machinery Installation*, 1.12.6.

**7.4.4** For cargo spaces in combination carriers, suitable mechanical ventilation shall be ensured in accordance with the *Rules for the classification of ships, Part 17 - Fire Protection*, 4.5.1.4 and 4.5.4.2.

## 7.5 VENTILATION OF MACHINERY SPACES AND TUNNELS

**7.5.1** In addition to the applicable requirements of 7.1, 7.2 and 7.9, the ventilation systems of machinery spaces and tunnels shall comply with the requirements of this Section.

**7.5.2** Ventilation of machinery spaces of category A shall be such as to ensure that when the machinery and boilers therein are operating at full load in all service conditions including heavy weather, a supply of air is maintained to the spaces sufficient for the safety and comfort of the personnel and the operation of machinery and boilers.

**7.5.3** The air supply shall be achieved through the suitably protected openings (ventilators) arranged in such a way that they can be used in all weather conditions, taking into account the requirements for their location and coamings height specified in the statutory requirements related to freeboard assignment.

Actually, the openings shall be so arranged that closing appliances are not required by the criterion of referent Rules.

**7.5.4** Ventilation rooms serving machinery spaces containing internal combustion machinery shall comply with the *Rules for the classification of ships, Part 17 - Fire Protection*, 9.7.6.

**7.5.5** Ventilation shall prevent formation of trapped zones also below the floor plates and near the oil fuel tanks and equipment. See also the *Rules for the classification of ships, Part 17 - Fire Protection*, 4.2.2.2.

**7.5.6** Shaft tunnels shall be properly ventilated. Pipe tunnels led in the double bottom shall have mechanical exhaust ventilation. See also the *Rules for the classification of ships, Part 17 - Fire Protection*, 4.5.2.8.

**7.5.7** Rooms containing main parts of the installations intended for preparation of flammable liquids (e.g. centrifugal separators) of working pressure above 1,5 MPa, shall have independent mechanical ventilation.

**7.5.8** In general, the ventilation inlets and outlets in machinery spaces shall have suitable means for opening and closure in accordance with the *Rules for the classification of ships, Part 17 - Fire Protection*, 5.2.2 and 9.5.2.

**7.5.9** In periodically unattended machinery spaces, the means of control the ventilation inlets and outlets shall comply also with additional requirements specified in the *Rules Part 17 - Fire Protection*, 5.2.3.

**7.5.10** Concerning the ventilation arrangements for spaces containing the independent source of power for the emergency equipment, see the *Rules for the classification of ships, Part 17 - Fire Protection*, 10.2.2.3.2.

**7.5.11** In machinery spaces where a fixed fire-smothering system is used (gas or equivalent aerosol systems) openings, such as skylights, ventilation inlets and outlets, openings in funnels etc., which may admit air to, or allow gas to escape from, shall be arranged in accordance with the *Rules for the classification of ships, Part 17 - Fire Protection*, 9.5.2.7.

**7.5.12** Concerning the arrangement required for release of smoke in the event of fire in machinery spaces, see the *Rules for the classification of ships, Part 17 - Fire Protection*, 8.3.

**7.5.13** Space containing emergency diesel-generator shall be provided with appropriate ventilation openings for the admission of combustion air to the emergency diesel-generator and the removal of heat to enable continuous running at full load in all service conditions when the space is closed.

In order to ensure satisfactory operation of the emergency diesel-generator in all weather conditions, the air inlet and discharge openings (ventilators) shall be generally so arranged that closing appliances are not required by the statutory requirements related to freeboard assignment.

These openings are usually provided with louvers which can be closed (when fire breaks out in emergency generator rooms). The louvers may be hand-operated or power-operated. Alternatively, the louvers may be of fixed type with a closing door which may be hand-operated or automatic.

**7.5.14** The following requirements apply to closable ventilation louvers and ventilator closing appliances serving emergency generator rooms, where fitted (IACS UR M75):

- .1 Ventilation louvers and closing appliances may either be hand-operated or power-operated (hydraulic / pneumatic / electric) and are to be operable under a fire condition.
- .2 Hand-operated ventilation louvers and closing appliances are to be kept open during normal operation of the ship. Corresponding instruction plates are to be provided at the location where hand-operation is provided.
- .3 Power-operated ventilation louvers and closing appliances shall be of a fail-to-open type. Closed power-operated ventilation louvers and closing appliances are acceptable during normal operation of the ship. Power-operated ventilation louvers and closing appliances shall open automatically whenever the emergency generator is starting / in operation.
- .4 It shall be possible to close ventilation openings by a manual operation from a clearly marked safe position outside the space where the closing operation can be easily confirmed. The louver status (open / closed) shall be indicated at this position. Such closing shall not be possible from any other remote position.

## 7.6 VENTILATION OF SPECIAL CATEGORY SPACES, CARGO SPACES INTENDED FOR CARRIAGE OF MOTOR VEHICLES WITH FUEL IN THEIR TANKS AND CLOSED RO-RO CARGO SPACES

**7.6.1** In addition to the general requirements of 7.1, the ventilation systems in closed vehicle spaces, closed ro-ro spaces and special category spaces shall comply with requirements of this Section and the applicable requirements in the *Rules for the classification of ships, Part 17 - Fire Protection*, 20.3.1, 20-1.3.2 and 20-1.4.2.

**7.6.2** Construction of the fans shall comply with the requirements of the *Rules for the classification of ships, Part 9 - Machines*, 5.3.3. See also the *Rules for the classification of ships, Part 17 - Fire protection*, 20-1.3.2.2.

Electric motors of the fans shall be of flameproof design. See also the *Rules for the classification of ships, Part 17 - Fire protection*, 20.3.3 and 20-1.4.2.1.

## 7.7 VENTILATION OF CARGO SPACES ADAPTED FOR CARRIAGE OF DANGEROUS GOODS

**7.7.1** The requirements of this Section shall apply additionally to general requirements of 7.1.

**7.7.2** Ventilation systems serving the enclosed cargo spaces intended for carriage of dangerous goods shall be generally in compliance with the *Rules for the classification of ships, Part 17 - Fire Protection*, 19.3.4 and 19.3.5.

**7.7.3** Construction of the fans shall comply with the requirements of the *Rules for the classification of ships, Part 9 - Machines*, 5.3.3. See also the *Rules for the classification of ships, Part 17 - Fire protection*, 20-1.3.2.2.

Electric motors of the fans shall be of flameproof design. See also the *Rules for the classification of ships, Part 17 - Fire protection*, 20.3.3 and 20-1.4.2.1.

**7.7.4** Ventilator heads of exhaust ducts from cargo spaces adapted for the carriage of dangerous goods emitting readily flammable and toxic vapours or gases shall be so located that the issuing vapours or gases will not enter other ship spaces.

## 7.8 VENTILATION OF REFRIGERATED SPACES

**7.8.1** In addition to applicable general requirements of 7.1, the ventilation systems for refrigerated cargo spaces shall comply with the *Rules for the classification of ships, Part 11 - Refrigerating Plant*, 3.3.5 to 3.3.8.

**7.8.2** Specific requirements to the ventilation of refrigerating machinery spaces are specified in the *Rules for the classification of ships, Part - 11 Refrigerating Plant*, 3.1.8 and 3.1.9.

## 7.9 FIRE-EXTINGUISHING AND SMOTHERING STATIONS

**7.9.1** The requirements of this Section shall apply additionally to general requirements of 7.1.

**7.9.2** Ventilation systems serving the foam fire-extinguishing and smothering stations shall be generally in compliance with applicable requirements in the *Rules for the classification of ships, Part 17- Fire Protection*, 10.4.3.

**7.9.3** Foam fire-extinguishing and smothering stations shall be equipped with efficient ventilation systems.

Carbon dioxide fire-extinguishing stations shall be provided with an exhaust and supply ventilation independent from other ventilation systems.

The inlets of exhaust ducts shall be located in the lower part of the station.

**7.9.4** The high-expansion foam fire-extinguishing stations shall be equipped with devices ensuring air supply in an amount sufficient for the operation of foam generators.

## 7.10 VENTILATION OF ACCUMULATOR BATTERY ROOMS AND BOXES

**7.10.1** Accumulator battery rooms and boxes shall be provided with independent ventilation system capable of removing air from upper part of the ventilated spaces. The exhaust ducts shall be gastight.

**7.10.2** Inlet air shall be supplied into the lower part of the ventilated space.

Battery room ventilators are to be fitted with a means of closing whenever:

- .1 The battery room does not open directly onto an exposed deck.
- .2 The ventilation opening for the battery room is required to be fitted with a closing device according to the Load Line Convention (i.e. the height of the opening does not extend to more than 4.5 m (14.8 feet) above the deck for position 1 or to more than 2.3 m (7.5 feet) above the deck in position 2; or
- .3 The battery room is fitted with a fixed gas fire extinguishing system.

Where a battery room ventilator is fitted with a closing device, then a warning notice stating, for example "This closing device is to be kept open and only closed in the event of fire or other emergency – Explosive gas", is to be provided at the closing device to mitigate the possibility of inadvertent closing.

**7.10.3** Outlets of ventilation ducts shall be so constructed as to preclude the admission of sea water, atmospheric precipitation and solids.

Discharges of exhaust ducts shall be led to places where the issuing gases do not present a fire hazard.

**7.10.4** Boxes of accumulator batteries having a charging capacity not over 0,2 kW may be ventilated through the openings in the lower and upper parts of the box to ensure removal of the gases.

**7.10.5** The rate of air flow  $Q$ , for the ventilation of an accumulator battery room or box shall be not less than that determined by the formula:

$$Q = 0,11 I \cdot n \quad [\text{m}^3/\text{h}] \quad (7.10.5)$$

where:

- $I$  – maximum charging current during gas emission, but not less than 0,25 of maximum current of the charging device, in A;
- $n$  – number of battery cells.

**7.10.6** The cross-sectional area,  $F$ , of a duct, in case of natural ventilation of accumulator battery rooms and boxes, shall be not less than determined by the formula.

$$F = 0,29 Q \quad [\text{cm}^2] \quad (7.10.6)$$

but in any case not less than 40 [cm<sup>2</sup>].

where:

- $Q$  – rate of air flow determined by Formula (7.10.5).

**7.10.7** Natural ventilation of the spaces may be used in the following cases:

- .1 the required amount of air, calculated by Formula (7.10.5), is less than 85 [m<sup>3</sup>/h];
- .2 the angle of the duct deflection from the vertical is less than 45°;
- .3 the number of bends of the duct does not exceed 2;
- .4 the length of the duct does not exceed 5 [m];
- .5 the operation of ventilation system does not depend on the direction of the wind;
- .6 the cross-sectional area of the duct shall be taken not less than that determined by Formula (7.10.6).

**7.10.8** Where the rate of air flow determined by formula (7.10.5) is 85 [m<sup>3</sup>/h] and over, the accumulator battery room shall be provided with mechanical exhaust ventilation.

**7.10.9** The internal surfaces of the exhaust ducts, as well as the ventilating fans shall be protected against the action of the electrolyte.

**7.10.10** The motors of the ventilating fans shall not be arranged in way of gas exhaust.

The construction of the ventilating fans is to comply with the requirements of the *Rules for the classification of ships, Part 9 - Machines*, 5.3.

## 7.11 VENTILATION OF HANGARS FOR HELICOPTERS

**7.11.1** Hangars for helicopters shall be provided with mechanical exhaust ventilation sufficient to give at least 10 air changes per hour.

See also applicable requirements in the *Rules for the classification of ships, Part 17 - Fire protection*, 18.7.

## 7.12 VENTILATION OF RADIO ROOM

**7.12.1** Ventilation of radio room is to ensure at least 20 changes of air per hour.

## 7.13 VENTILATION OF OIL COLLECTING SHIPS

**7.13.1** In addition to general requirements of 7.1, the ventilation systems serving the oil collecting ships are to comply with the requirements of this Section. See also the *Rules for the classification of ships, Part 17 - Fire protection*, 9.10.10.

**7.13.2** Ventilation of spaces with explosion hazard shall be independent of ventilation of non-hazardous spaces. Spaces in zones with different hazardous classes specified in the *Rules for the classification of ships, Part 12 - Electrical Equipment*, 2.9.4, shall be provided with separate ventilation systems.

**7.13.3** Non-hazardous spaces and air screen shall be provided with pressure ventilation being capable to ensure over pressure in them in relation to the adjacent spaces with explosion hazard.

**7.13.4** Provision shall be made for the automatic start of ventilators and signalization in the case of pressure drop in the air screen.

Alternatively, the following may be provided:

- .1 visual signalization during operation of each ventilator.
- .2 to enable starting of ventilator only when the cover of ventilation duct is open
- .3 audible alarm in case of accidental stopping of ventilator electromotor.

**7.13.5** In general, the location and arrangement of ventilation openings on the oil recovery ships shall comply with applicable requirements in the *Rules for the classification of ships, Part 17 - Fire protection*, 9.10.10.

Suction openings of the supply ventilation ducts shall be fitted out of hazardous zones on open decks.

Outlets opening of exhaust duct shall be fitted out of hazardous zones on open decks.

**7.13.6** Spaces with explosion hazard located in zone 1 shall be provided with mechanical ventilation capable to ensure at least 20 changes of air per hour.

Ventilation systems may be used with automatic change-over of ventilators from 10 changes of air per hour to 20 changes of air per hour when gas concentration in the space is  $\pm 10\%$  of the lower explosion limit.

Spaces with explosion hazard of zone 2 shall be provided with ventilation capable to ensure 10 changes of air per hour.

**7.13.7** Suction ventilation ducts of spaces with explosion hazard shall be gas-tight, of rigid structure and shall not be led through nonhazardous spaces.

**7.13.8** Ventilation systems of spaces and air screen shall be provided with instruments to control the operation of ventilators and the equipment stated under 7.13.3 and 7.13.6.

## 7.14 VENTILATION OF SPACES WITH INERT GAS OR NITROGEN SYSTEM DEVICES

**7.14.1** In addition to general requirements of 7.1, which shall apply as applicable, the ventilation systems of spaces with

inert gas or nitrogen system devices are to comply with the requirements of this Section.

For the flue gas and inert gas generator systems, see applicable ventilation requirements in the *Rules for the classification of ships, Part 17 - Fire protection, 24.15.2.3*.

For the nitrogen generator systems, see applicable ventilation requirements in the *Rules for the classification of ships, Part 17 - Fire protection, 24.15.2.4*.

**7.14.2** For spaces with installed inert system devices for cargo tanks, including generators, gas purifiers, ventilators and their fittings, artificial suction ventilation shall be provided, assuring at least 6 changes of air per hour, based on empty space volume. Air supply ventilation may be natural.

If said devices are installed in machinery spaces, requirements specified in 7.5 shall be satisfied.

**7.14.2** For ventilation of double hull and double bottom spaces see in the *Rules for the classification of ships, Part 17 - Fire Protection, 4.5.5*. Artificial suction ventilation shall be provided with capability of air changes not less than for ventilation from 7.14.1.

## 8 FUEL OIL SYSTEM

### 8.1 GENERAL

**8.1.1** Design pressure for the fuel oil systems shall be determined in accordance with Table 1.3.4.1-4.

Oil fuel used in ships shall be in compliance with the requirements of the *Rules for the classification of ships, Part 7 - Machinery Installations*, 1.1.2.

**8.1.2** Suitable means shall be provided for the fuel oil transferring operation, taking into consideration as follows:

- a) At least two power pumps shall be provided for fuel oil transfer, one of which being a stand-by pump.
- b) Any suitable pump, including the fuel oil separator pump, may be used as a stand-by pump.
- c) In ships of restricted navigation areas 5 to 8 a stand-by pump is not required.
- d) In ships with daily consumption of fuel less than 2 t, a single hand pump is admissible.

**8.1.3** Fuel transfer pumps and separator pumps, besides local hand control, shall be provided with stopping means operable from always accessible position outside the space where the pumps are installed.

**8.1.4** The pressure and suction side of fuel pumps shall be provided with the shut - off valves.

**8.1.5** Where the fuel oil tanks, including the deep tanks, are used also for water ballast, provision shall be made for reliable arrangements disconnecting the ballast system from these tanks when carrying fuel oil and the fuel oil system when containing ballast. In addition, the requirements of 2.3.9 shall be complied with.

### 8.2 PIPING ARRANGEMENT

**8.2.1** In general, the fuel oil pipeline shall have no communication with other piping systems and shall not pass either through cargo tanks or slop tanks. Where the fuel tanks are used as water ballast tanks, the requirements of 8.1.2 shall be complied with.

**8.2.2** Pressure pipes for conveying pressurized fuel oil with pressure greater than 0,18 MPa shall be arranged in clearly visible and accessible positions.

**8.2.3** Fuel oil pipes, as a rule, shall not be led above the internal combustion engines, turbines, exhaust gas pipes, steam pipes (except heating steam coils), steam boilers, boiler uptake, silencers, electrical installations and other sources of ignition.

In exceptional cases, it is allowed to lead the fuel oil pipes above the said equipment provided that in these positions the pipes have no detachable joints or that in necessary places provision is made for suitable screening and drainage preventing the spillage of fuel oil on the sources of ignition.

Alternatively to screening and drainage arrangements, anti-splashing tape or anti-spray cover made of approved materials may be fitted around flanged joints, flanged bonnets and any other flanged or threaded connections which have

possibility of being in contact with potential ignition sources by direct spray or by reflection.

The number of joints in such piping systems shall be kept to a minimum.

**8.2.4** Oil fuel pipes, which, if damaged, would allow oil to escape from a storage, settling or daily service tank having a capacity of 500 liters and above situated above the double bottom, shall be provided with shut-off valves fitted directly on the tanks. These valves shall be capable of being remotely closed from accessible places located outside the space containing the tanks. Quick-closing valves are recommended for that purpose.

**8.2.5** If the fuel oil tanks are located above the double bottom and are adjoining with shaft or pipeline tunnels or other similar spaces, the valves fitted on these tanks may have local control, but the pipeline shall be provided with additional valve installed in readily accessible place outside the above mentioned spaces. If this additional valve is fitted in the machinery space, the possibility of remote-control closing of the valve outside the machinery space shall be provided.

**8.2.6** The controls for remote operation of the valve for the emergency generator fuel tank shall be in a separate location from the controls for remote operation of other valves for tanks located in machinery spaces.

**8.2.7** Oil fuel pipes, which, if damaged, would allow oil to escape from a fuel oil tanks having a capacity less than 500 lit., shall be provided with shut-off valves fitted directly on the tanks. These valves may have local control only.

**8.2.8** Remote operation for the fuel (quick closing) valves required in 8.2.4 are to be grouped per engine room and marked in large letters with the words that are in common use on board.

Small neat labels shall be provided on the remote operation and on multi-engine ships the order and logic of their relative positioning. There must be no risk of the wrong engine room being shut down.

**8.2.9** In general, the fuel oil pipes and valves shall be so arranged as to prevent the possible oil pollution in the event of collision or grounding.

Unless otherwise specified, this Article applies to all ships with an aggregate oil fuel capacity of 600 [m3] and above, taking into consideration as follows:

- a) The requirement shall apply to all fuel oil tanks except those where a maximum individual capacity not exceeding 30 [m3], provided that the aggregate capacity of such excluded tanks is not greater than 600 [m3]. For the purpose of this Article, oil fuel means any oil used as fuel for the propulsion and auxiliary machinery of the ship in which such oil is carried. The oil fuel overflow tanks shall be also included, except if they are provided with an alarm for detection of oil and kept empty according to the operational procedures.
- b) Oil fuel tanks are to be located at a sufficient distance from the bottom shell plating and from the side shell plating, in accordance with the *Rules for the classification of ships, Part 2 – Hull*, 18.1.6.
- c) Suction wells in oil fuel tanks may protrude into the double bottom below the boundary

line defined by the distance  $h$  (see the *Rules for the classification of ships, Part 2 – Hull, 18.1.2*), provided that such wells are as small as practicable and the distance between the well bottom and the bottom shell plating is not less than  $0.5h$ . See Fig.8.2.9.

- d) Fuel oil pipelines located at a distance from the ship's bottom or from the ship's side less than those referred to in c) are to be fitted with valves or similar closing devices within, or immediately adjacent to, the oil fuel tank. See examples in the Fig.8.2.9.
- e) These valves are to be capable of being brought into operation from a readily accessible enclosed space the location of which is accessible from the navigation bridge or propulsion machinery control position without traversing exposed freeboard or superstructure decks. The valves are to close in case of remote control system failure and are to be kept closed at sea at any time when the tank contains oil fuel except that they may be opened during oil fuel transfer operations.

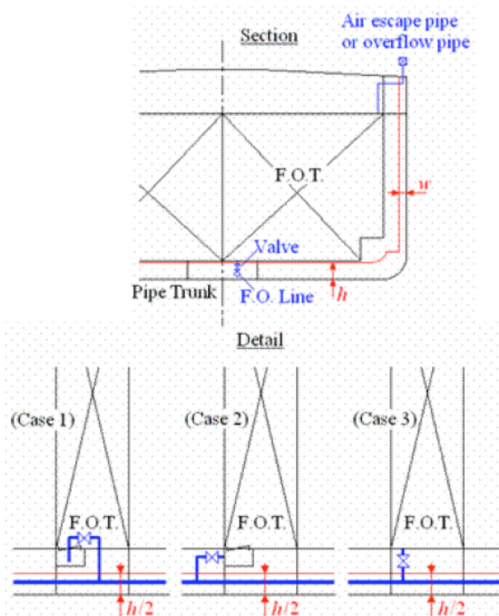


Fig. 8.2.9

Examples of the fuel oil pips and valves arrangement

**8.2.10** Except otherwise specified, the propulsion machinery and auxiliary engines which are able to use the same type of fuel may be supplied from the same fuel source, provided that the following is satisfied:

- a) The viscosity, inlet pressure and outlet pressure required by the engine's manufacturer are to be identical. An exemption from this requirement could be accepted, depending on particular arrangement of the fuel oil supply system, subject to special consideration by the Register.
- b) The fuel oil preparation unit is to comply with the provisions of 8.8.

- c) The capacity of fuel oil preparation unit is to be sufficient for maximum continuous rating of all supplied propulsion and auxiliary engines in normal working conditions. An exemption from this requirement could be accepted, subject to special consideration by the Register in each particular case.
- d) The fuel oil lines supplying propulsion machinery and those supplying auxiliary engines are to be so arranged that a failure within one of those lines is not to render the other lines inoperable.
- e) The arrangement to stop propulsion from outside the machinery spaces is not to affect the main electrical power supply.

**8.2.11** In addition, the requirements specified in the *Rules for the classification of ships, Part 17 – Fire protection, 4.2.2.5* shall be complied with.

### 8.3 ARRANGEMENTS FOR HEATING OF FUEL OIL IN TANKS

**8.3.1** Fuel oil may be heated by means of steam or water coils and by means of electric heating appliances as well, when the requirements of the *Rules for the classification of ships, Part 12 - Electrical Equipment, 15.3* shall be complied with.

**8.3.2** Heating coils and electrical heating elements shall be located in the lowermost parts of the tanks.

**8.3.3** Suction ends of the fuel oil pipes in the daily service and settling tanks shall be arranged above the heating coils and electrical heating elements, so that the latter remain, whenever practicable, submerged all time.

**8.3.4** Oil fuel in storage tanks is not to be heated to temperatures within  $10\text{ }^{\circ}\text{C}$  below the flash point of the fuel oil, except that where oil fuel in service tanks, settling tanks and any other tanks in supply system is heated the following arrangements are to be provided.

- .1 the length of the vent pipes from such tanks and/or a cooling device is sufficient for cooling the vapours to below  $60\text{ }^{\circ}\text{C}$ , or the outlet of the vent pipes is located at least 3 m away from a source of ignition;
- .2 the vent pipes are fitted with flame screens;
- .3 there are no openings from the vapour space of the fuel tanks into machinery spaces (bolted manholes are acceptable);
- .4 enclosed spaces are not to be located directly over such fuel tanks, except for vented cofferdams;
- .5 electrical equipment is not to be fitted in the vapour space of the tanks, unless it is certified to be intrinsically safe.

**8.3.5** The heating steam condensate shall pass through an observation tank fitted with a sight glass.

**8.3.6** The pressure of steam used for heating fuel oil shall not exceed 0,7 MPa.

**8.3.7** Thermometers shall be fitted in appropriate positions to check the temperature of fuel oil heating.

In periodically unattended machinery spaces, where daily service oil fuel tanks or settling tanks are fitted with heating arrangements, a high temperature alarm shall be provided if the flashpoint of the oil fuel can be exceeded.

## 8.4 DRAINAGE ARRANGEMENTS OF FUEL OIL TANKS

**8.4.1** For draining water from the bottom of the daily service and settling tanks, these tanks shall be fitted with self-closing valves and pipes connected to drain tanks.

The drain pipes shall be fitted with sight glasses. Where trays are available, open funnels may be used instead of sight glasses.

## 8.5 ARRANGEMENTS FOR COLLECTION OF LEAKAGE FUEL

**8.5.1** Tanks not forming part of ship's hull, as well as pumps, filters and other equipment shall be fitted with drip trays where there is a possibility of fuel oil leakage.

**8.5.2** Drain pipes from the drip trays shall be led into fuel oil drain tanks. Drainage of fuel oil into bilges and overflow tanks is not permitted.

Arrangement of fuel oil drain tanks and drain pipes are not mandatory for ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8, provided that drip trays are fitted as per 8.5.1.

**8.5.3** The internal diameter of the drain pipes shall not be less than 25 [mm].

**8.5.4** The ends of the drain pipes shall be led to the tank bottom with a minimum gap. Where the drain tank is situated in the double-bottom space, structural measures shall be taken to prevent penetration of water into machinery spaces through the open ends of the drain pipes in the event of damage to the shell plating.

Provision shall be made for an alarm device to give warning if the fuel oil reaches the upper predetermined level in the drain tank.

**8.5.5** Where drain pipes from the drip trays in various watertight spaces are led into the common drain tank, structural measures shall be taken to prevent penetration of water from one flooded space to the other through the open ends of the drain pipes.

## 8.6 FILLING OF FUEL OIL TANKS

**8.6.1** Filling of fuel oil storage tanks shall be carried out through a permanent pipeline. This pipeline shall be provided with the required fittings ensuring fuel oil delivery to all storage tanks.

The end of the fuel oil filling pipe shall be led to the tank bottom with a minimum gap.

**8.6.2** Filling pipes of fuel oil tanks are to terminate on open deck or in filling stations isolated from other spaces and efficiently ventilated.

Suitable coamings and drains are to be provided to collect any leakage resulting from filling operations.

Location and construction of the filling stations in general shall comply with the provision of the *Rules for the classification of ships, Part 17 - Fire protection, Section 9*, or other relevant statutory rules of the Flag State Administration, as applicable.

**8.6.3** The means shall be provided for the filling lines to prevent of possible overpressure during the bunkering operation, which could be caused by pumps from outboard filling station.

For that purpose a warning label may be accepted with clearly declared design pressure of the filling lines and the local pressure gauge fitted in vicinity of the filling connection.

**8.6.4** The arrangements are to be made to avoid overpressure in the filling lines which are served by pumps on board.

Where safety valves are provided for this purpose, they are to discharge to the suitable overflow tank or fuel oil drain tank referred to in 8.5.2 or other safe positions deemed satisfactory.

**8.6.5** Filling lines shall be led through the tank top. Where this is impracticable, the filling lines shall be fitted with non-return valves installed directly on the tanks. When filling line is led through tank top, which, if damaged, would allow fuel oil to escape from the tank situated above the double bottom, the filling pipe shall be fitted with non-return valve installed directly on the tank.

Where filling pipes are used as suction pipes, non-return valves shall be replaced with a remote-controlled shut-off valves operable from accessible position outside the space in which the tank is located.

**8.6.6** In periodically unattended machinery spaces, where daily service oil fuel tanks are filled automatically, or by remote control, means shall be provided to prevent overflow spillages. Other equipment which treats flammable liquids automatically (e.g. oil fuel purifiers) which, whenever practicable, shall be installed in a special space reserved for purifiers and their heaters, shall have arrangements to prevent overflow spillages.

## 8.7 FUEL OIL TANKS

**8.7.1** Construction of the fuel oil tanks, where they are not integral parts of ship's hull, shall comply with the requirements of the *Rules for the classification of ships, Part 2 - Hull*, 11.4.

**8.7.2** Two fuel oil service tanks for each type of fuel used on board necessary for propulsion and vital systems shall be provided on each new ship (see the *Rules for the classification of ships, Part 1 - General requirements, Chapter 1 - General information*, 4.22), with a capacity of at least 8 h at maximum continuous rating (MCR) of the propulsion plant and normal operating load at sea of the generator plant.

Instead of a.m. solution, some equivalent arrangements can be accepted also, but it is subject to special consideration by the *Register* in each particular case. For the most common systems, example of acceptable equivalent arrangement can be as follow:

- .1 For “one fuel ship”, where main engines, auxiliary engines and boilers operating with heavy fuel oil (HFO):
  - .1.1 one HFO service tank with a capacity enough for at least 8 h at MCR of the main engines, normal operating load at sea of the auxiliary engines and auxiliary boilers;
  - .1.2 one marine diesel oil (MDO) service tank with a capacity enough for at least 8 h at MCR of the main engines, normal operating load at sea of the auxiliary engines and auxiliary boilers.

For pilot burners of auxiliary boilers if provided, an additional MDO tank for 8 hours may be necessary.

This arrangement only applies where main and auxiliary engines can operate with fuel oil under all load conditions and, in the case of main engines, during manoeuvring.

- .2 Where main engines and auxiliary boilers operating with HFO, auxiliary engines operating with MDO:
  - .2.1 one HFO service tank with a capacity enough for at least 8 h at MCR of the main engines and auxiliary boilers;
  - .2.2 one MDO service tank with a capacity enough for at least 4 h at MCR of the main engines, normal operating load at sea of the auxiliary engines and auxiliary boilers, or capacity enough for at least 8 h of the normal operating load at sea of the auxiliary engines and auxiliary boilers;
  - .2.3 one MDO service tank with a capacity enough for at least 4 h at MCR of the main engines, normal operating load at sea of the auxiliary engines and auxiliary boilers, or capacity enough for at least 8 h of the normal operating load at sea of the auxiliary engines and auxiliary boilers.
- .3 The arrangements in .1 and .2 apply, provided the propulsion and vital systems which use two types of fuel support rapid fuel change over and are capable of operating in all normal operating conditions at sea with both types of fuel (MDO and HFO).

Any fuel oil which requires post service tank heating to achieve the required injection viscosity is not regarded in this context as MDO. Use of a settling tank with or without purifiers, or purifiers alone, and one service tank is not acceptable as an equivalent arrangement to two service tanks.

The arrangement of the fuel oil tanks in machinery spaces shall comply with the *Rules for the classification of ships, Part 7 - Machinery Installation*, 1.12.5.

**8.7.3** Fuel tanks situated on weather decks and superstructure decks, as well as in other exposed positions shall be provided against the effect of sun rays.

**8.7.4** In glass-reinforced plastic ships the fuel oil tanks shall not directly adjoin the accommodation spaces. The air space between the fuel oil tank and the accommodation space shall be effectively ventilated.

As a rule, the fuel oil tanks shall not be arranged in the machinery spaces. If the fuel tanks are arranged in machinery spaces, they shall be made of steel or other equivalent material.

**8.7.5** Fuel oil tanks shall be separated from the drinking water, feed water and vegetable oil tanks, as well as from lubricating oil tanks, by cofferdams meeting requirements of the *Rules for the classification of ships, Part 2 - Hull*, 11.1.4 and 17.3.2.

**8.7.6** Fuel oil, lubrication oil and other flammable oils shall not be carried in fore peak tanks.

## 8.8 FUEL OIL SUPPLY SYSTEM OF INTERNAL COMBUSTION ENGINES

**8.8.1** The equipment of fuel oil system shall be capable of supplying fuel oil suitably prepared and cleaned to the extent required for the given engine.

**8.8.2** The filter fitted in the fuel oil supply line to the propulsion engine shall be such that it can be cleaned without interrupting the operation of the engine.

Where machinery installations comprises two or more propulsion engines, each one with its own filter, application of this criterion is not mandatory provided that one readily accessible and easily replaceable spare filter is available on board.

The application of this criterion is not mandatory for ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8, provided that:

- a) where one propulsion engine is fitted, one readily accessible and easily replaceable spare filter is available on board, or
- b) where two or more propulsion engines are fitted each one with its own filter, it can be demonstrated during sea trials that the ship is capable of safe navigation and manoeuvring with one propulsion engine out of use.

**8.8.3** Means shall be provided in fuel oil supply system whereby normal operation of propulsion machinery can be sustained or restored even though one of the essential components becomes inoperative.

Where one fuel oil supply pump is fitted to serve the propulsion engines the arrangements shall be such that the engines are supplied with fuel oil in the event of damage to the fuel oil supply pumps.

Where machinery installations comprises two or more propulsion engines each having its own fuel oil supply pump, the application of this criterion is not mandatory provided that one complete spare fuel oil supply pump of appropriate capacity ready to be connected is carried on board.

The application of this criterion is not mandatory for ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8, provided that:

- a) where one propulsion engine is fitted, one complete spare fuel oil supply pump of appropriate capacity ready to be connected is carried on board, or
- b) where two or more propulsion engines are fitted each having its own fuel oil supply

pump, it can be demonstrated during sea trials that the ship is capable of safe navigation and manoeuvring with one propulsion engine out of use.

For ships operating in the emission control areas see 8.12.

**8.8.4** Where propulsion engines operate on different grades of fuel oil, provision shall be made to prevent auxiliary engines and other consumers from being supplied with fuel oil that is unfit for their operation.

**8.8.5** Emergency diesel-generator shall be provided with a separate fuel oil tank located in the same room. The fuel oil from such tank shall not be used for other purposes.

The contents of that tank shall be such as to provide running of the engine at full load in duration determined in the *Rules for the classification of ships, Part 12 - Electrical Equipment*, 9.3.

## 8.9 FUEL OIL SYSTEM OF BOILERS

**8.9.1** Where boilers are important auxiliary for normal operation of propulsion machinery, means shall be provided in fuel oil supply system whereby normal operation of the boiler can be sustained or restored even though one of the essential components becomes inoperative.

When the fuel oil injection of main and essential auxiliary boilers is performed under hydraulic pressure, two sets of fuel oil pumps, filters of delivery and suction pipelines and heaters shall be provided. Each set shall be of such a capacity as to achieve full capacity of the boiler.

Apart from local controls, the fuel oil pumps shall have means enabling them to be stopped remotely from easily accessible positions outside of the spaces in which they are situated.

Except for passenger ships, this requirement is not mandatory for ships with restricted areas of navigation 5 to 8.

For ships operating in the emission control areas see applicable criterion in 8.12.

**8.9.2** Pumps supplying fuel oil to the boilers shall not be used for other purposes.

**8.9.3** Pipes supplying fuel to the burners of each boiler shall be fitted with a quick-action shut-off valve operated by hand.

This requirement applies to the boilers put into action by hand igniters, as well as to the boilers with fuel oil supplied by gravity.

**8.9.4** Where fuel oil is supplied by gravity, filters shall be fitted on the pipe supplying fuel oil to the burners.

**8.9.5** It shall be possible to bring the main boilers into operation without having recourse to a source of power located outside of the ship.

**8.9.6** If the fuel oil tanks of main and essential auxiliary boilers are used also as water ballast tanks, provision shall be made for settling tanks.

Where two daily service tanks are available, settling tanks may be omitted.

**8.9.7** The fuel oil installation of the boilers shall comply with requirements of the *Rules for the classification of ships, Part 10 - Boilers, Heat Exchangers and Pressure Vessels*, Section 5.

**8.9.8** Thermometers and pressure gauges shall be installed in suitable positions on the pipes supplying oil fuel to the burners.

## 8.10 FUEL OIL SUPPLY TO GAS TURBINES

**8.10.1** The main gas turbine installation shall have at least two fuel pumps; main and stand by, of which one may be driven from the main turbine.

The capacity of the stand by pump shall be not less than that of the main pump.

Where the installation includes two or more gas turbines, one independent stand by pump will suffice.

**8.10.2** An appropriate system for removing the remainder of fuel from turbine casing, combustion chambers and gas lines shall be provided.

**8.10.3** An interlock device shall be provided to preclude admission of fuel into combustion chambers with the turbine stopped.

**8.10.4** Fuel oil system of a gas turbine installation shall comply also with requirements stated in 8.8.

**8.10.5** Provision shall be made for discharge of oil fuel from pressure piping, the starting and main burners after a stop of the turbine or burner operation.

## 8.11 USAGE OF CRUDE OIL AND CARGO RESIDUES AS FUEL FOR BOILERS

**8.11.1** This Head of the Rules applies to tankers where crude oil or cargo residues are used as fuel for boilers, except for the requirement(s) in this Head which create conflict with the statutory requirements related to alternative design and arrangements required by SOLAS II-1/55 that do not need to be complied with (i.e., statutory requirements take precedence over requirements in this Head).

**8.11.2** In accordance with requirements stated in this paragraph, crude oil or cargo residues may be used as fuel for main and auxiliary boilers in oil tankers.

For this purpose, general plan design of the plant with schemes of the pipelines and safety devices shall be submitted to the *Register* for consideration and approval.

**8.11.3** Crude oil or cargo residues shall be supplied from cargo tanks, drain tanks or special tanks situated in the cargo tanks space. By means of gastight cofferdams they shall be separated from gas nondangerous spaces.

**8.11.4** Construction of the boilers and atomizer, intended for work with crude oil shall be approved as usable.

Regarding the machinery space the outside insulation of boiler shall be of a gastight type.

Before putting in operation, the boilers shall be subjected to the gastight tests.

The entire system of the pumps, filters, separators and heaters, where fitted, shall be situated in the cargo pump station, or in any other space considered to be dangerous and separated from the machinery spaces and boilers, by means of gastight cofferdams.

Where crude oil heating by steam or hot water is anticipated, discharge pipes shall be led into a special control tank situated within one of the above mentioned places.

This closed control tank shall be provided with an exhaust pipe leading to a safe place on the open deck, in compliance with requirements of the *Rules for the classification of ships, Part 17 - Fire Protection, 4.5.3.4.1.3* applying to oil tanker. The outer ends of exhaust pipes shall be provided with easy detachable flame arresting fittings.

**8.11.5** Arrangement of the drives for pumps, separators, etc., shall meet the requirements of the *Rules for the classification of ships, Part 7 - Machinery Installation, 1.12.6*.

**8.11.6** Pumps shall be provided with safety valves enabling the leaked oil to be led to the suction side of the pump or to the suction part of the pipeline.

Pump shall have means enabling them to be stopped remotely from the place before the boilers, or from the central control station or from the position outside the machinery space.

**8.11.7** Where crude oil or cargo residues shall be heated, the heating temperature shall be regulated automatically, and the signal instrument indicating the exceeding temperature shall be provided.

**8.11.8** The wall thickness of the crude oil or cargo residues piping, as well as of the drain pipes specified in **8.11.10**, shall meet the values indicated in the Table 1.3.4.3-1, column D.

The number of joints in fuel oil pipelines is to be kept to a minimum. They shall comply with Table 1.3.7.2-3, for Class I.

The previously mentioned pipelines, along the whole length in the machinery and boiler rooms, shall be located in the gastight metal duct, firmly connected to the pump station cofferdam and to the tray.

The duct with the pipeline shall be fitted at a distance from the ship's side of at least 20% of the vessel's beam amidships and have an inclination from the boiler's side towards the pump station. The duct shall be provided with gastight control openings fitted with gastight covers at the pipe joint areas, as well as with the drain arrangement automatically closed, and located in the pump station, installed in such a way as to enable pouring of the leaked crude oil into the pump station.

The drain tanks specified in **8.11.10** shall be provided with a level indicator having an appropriate signalling device indicating the overflow appearance.

Besides that, the highest part of the duct shall be provided with air pipe ending at the safe place on the open deck. The air pipes outlets shall be fitted with an easy detachable flame arresting fittings.

The duct shall be continuously connected to the inert gas system or steam system to enable:

- inert gas or steam supply in the case of fire or leakage,
- duct scavenging before the operation starts again, in case of fuel leakage.

**8.11.9** Supply and discharge oil piping, in vicinity of the bulkhead to which the duct is attached, shall be provided with shut-off valves installed at the pump station side and fitted with remote control device, which can be operated from the place near the front line of the boilers or from the central control station.

Valves shall be opened in connection with suction ventilation of the duct stated in **8.11.11**, to ensure the operation of ventilators during crude oil supply.

**8.11.10** Boilers shall be provided with drip trays or drain grooves of a height exceeding 200 [mm], arranged in such a way as to accumulate all leaked oil from the atomizers, valves and joints.

Drip trays and drain grooves shall be provided with an easy detachable flame arresting fittings located in the upper part.

Where passing through the drip trays or drain groove, supply and discharge oil pipes shall be fitted with tight gasket and connected to the oil drain tank.

The pipeline besides each tank shall be fitted with quick-closing control valve.

Drip trays and the drain groove shall be provided with drain pipe for oil discharge into the drain tank located in the pump station. This tank shall be provided with an air pipe having an outlet at the safe place on the open deck. Air pipe outlets shall be fitted with an easy detachable flame arresting fittings.

The drain pipe shall be fitted with a device preventing the gas from flowing-back into boilers and machinery rooms.

**8.11.11** Boilers shall be provided with an adequate protective plating maximally protecting nozzles, valves and oil pipes, without preventing air supply to the nozzles.

If needed, the plating shall be provided with arrangements enabling examination and access to the pipes and valves placed from the inside of the plating.

The plating shall be provided with the duct, the outlet of which is leading to the safe place on the open deck, and shall be fitted with an easy detachable flame arresting fittings.

At least two suction ventilators of safe type (the possibility of sparking excluded) shall be provided, which are intended for pressure maintenance in the protective plating, being lower than the air pressure in the boiler room.

These suction ventilators shall be provided with an automatic device enabling the other ventilator of being operated in the case the ventilator in operation is being stopped.

Motors of the suction ventilator shall be located outside the duct, and their shafts shall be fitted with gastight gaskets.

Electrical equipment located in the gas dangerous spaces or in places which could become dangerous (e.g. inside the crude oil piping duct or the protective plating) shall be of the safe type approved by the authorized institution.

**8.11.12** Provision shall be made for supply and discharge of fuel oil for the boilers. For this purpose the boiler room shall be fitted with an arrangement complying with requirements of **8.9** and of the *Rules for the classification of ships, Part 10 - Boilers, Heat Exchangers and Pressure Vessels*, Section 5.

Fuel supply and discharge to the nozzles shall be done by means of mechanical stopping device, which automatically puts the propulsive fuel supply for boilers out of operation, in the case crude oil is being used, and vice versa.

**8.11.13** The boiler room shall be equipped with mechanical ventilation of such a construction as to exclude the possibility of the trapped zones formation. The ventilation shall be specially effective in the spaces of electrical installations, machinery and other installations which may cause sparking. This ventilation shall not be connected to the ventilation of other spaces and shall comply with requirements of Section 7.

**8.11.14** An arrangement indicating gas leakage in the duct specified in **8.11.8** and in protective plating of the boilers front side shall be placed in the suction ventilation stream and in all other places where the ventilation effect may be reduced.

Warning signal lights shall be placed in the vicinity of the boilers front side and at the central control station. Audible alarms shall be provided in the engine room and in the central control station.

**8.11.15** The arrangements shall be provided for automatic blowing-off of the boiler's combustion space before the ignition is started.

**8.11.16** Apart from the stationary fire protection system, which is required according to the rules that apply to the machinery and boilers rooms, an additional firefighting arrangement shall be provided enabling the front side of the boilers and trays stated in **8.11.10** to be directly supplied with firefighting means.

When the firefighting means are supplied, ventilation of the protective plating shall be stopped automatically (see **8.11.9**).

**8.11.17** On the visible place in the vicinity of the front side of the boilers the name plate shall be fitted with the warning applying to the explosive mixture occurrence when the light signal shall be activated (see **8.11.14**) and the personnel is obliged to **shut off** the remotely controlled valves located in the pump station on the piping from the crude oil supply and discharge, to stop the corresponding pumps, to let inert gas into the duct specified in **8.11.8** and to connect the boiler to the drive using the usual fuel oil.

**8.11.18** An additional way of boilers ignition **is required**, in addition to the ordinary ignition device.

## 8.12 FUEL PUMP ARRANGEMENT ON SHIPS OPERATING IN EMISSION CONTROL AREAS

**8.12.1** For ships intending to use Heavy Fuel Oil (HFO) or Marine Diesel Oil (MDO) in non-restricted areas and marine fuels with a sulphur content not exceeding 0,1 % m/m and minimum viscosity of 2 cSt in emission control areas, the following arrangements are considered to be in compliance with 8.8.3:

- .1 In non-restricted areas, ships provided with two (2) fuel oil pumps that can each supply

the fuel primarily used by the ship (i.e. HFO or MDO) in the required capacity for normal operation of the propulsion machinery.

- .2 In emission control areas one of the following configurations:

- a) Fuel oil pumps as in .1, provided these are each suitable for marine fuels with a sulphur content not exceeding 0,1 % m/m and minimum viscosity of 2 cSt operation at the required capacity for normal operation of propulsion machinery,
- b) When the fuel oil pumps in .1 are suitable to operate on marine fuels with a sulphur content not exceeding 0,1 % m/m and minimum viscosity of 2 cSt but one pump alone is not capable of delivering marine fuels with a sulphur content not exceeding 0,1 % m/m and minimum viscosity of 2 cSt at the required capacity, then both pumps may operate in parallel to achieve the required capacity for normal operation of propulsion machinery. In this case, one additional (third) fuel oil pump shall be provided. The additional pump shall, when operating in parallel with one of the pumps in .1, be suitable for and capable of delivering marine fuels with a sulphur content not exceeding 0,1 % m/m and minimum viscosity of 2 cSt at the required capacity for normal operation of the propulsion machinery.
- c) In addition to .1, two separate fuel oil pumps shall be provided, each capable of and suitable for supplying marine fuels with a sulphur content not exceeding 0,1 % m/m and minimum viscosity of 2 cSt at the required capacity for normal operation of propulsion machinery.

**Note 1:** For the purpose of this requirements if a marine distillate grade fuel with a different maximum sulphur content is specified by regulation for the area of operation of the ship (e.g. ECA, specific ports or local areas, etc.) then that maximum is to be applied.

**Note 2:** The automatic start of standby pumps, required in Part 13, applies independent of the pump arrangement for ships holding the class notation for unattended machinery space.

**Note 3:** Where electrical power is required for the operation of propulsion machinery, the requirements are also applicable for machinery for power generation when such machinery is supplied by common fuel supply pumps.

**Note 4:** This Regulation shall apply on ships contracted for construction on or after 1 July 2013. The "contracted for construction" date means the date on which the contract to build the ship is signed between the prospective owner and the ship-builder.

## 9 LUBRICATING OIL SYSTEM

### 9.1 LUBRICATING OIL PUMPS OF INTERNAL COMBUSTION ENGINES, GEARS AND COUPLINGS

**9.1.1** For an installation with one propulsion engine at least two lubricating oil pumps, main and standby pump, shall be used for lubrication. One of these pumps may be driven from the propulsion engine.

**9.1.2** Where two **or more** propulsion engines are installed, each with its own lubricating oil pump, at least one complete spare lubricating oil pump of appropriate capacity ready to be connected is to be carried on board.

The common lubricating oil system of propulsion engines is, in each case, subject to special consideration by the *Register*.

**9.1.3** The number and capacity of the oil pumps for three or more propulsion engines are subject to special consideration by the *Register*.

**9.1.4** For **ships** of less than 500 gross tonnage navigating in restricted navigation areas 5 to 8, the standby pump for installation with one propulsion engine or spare pump for installation with two **or more** propulsion engines may be omitted provided that:

- a) where one propulsion engine is fitted, one complete spare lubricating oil pump of appropriate capacity ready to be connected is carried on board, or
- b) where two propulsion engines are fitted each with its own lubricating oil pump, it can be demonstrated during sea trials that the ship is capable of safe navigation and manoeuvring with one propulsion engine out of use.

**9.1.5** Where the turbo-blowers of the propulsion engine have an independent electrically driven lubricating oil pump, provision shall be made for the standby pump of adequate capacity. The lubricating oil system shall be provided with a gravity tank, the capacity of which is sufficient to maintain lubrication of the turboblowers during idle rotation, if the oil pump stops working.

Where two or more propulsion engines are installed, standby pump may be replaced by one complete spare lubricating oil pump of appropriate capacity ready to be connected.

The tank shall be provided with warning alarms which shall operate for low level in the tank and automatic start-up of standby pump shall be ensured at the stoppage of the main pump.

Means shall be provided to enable the oil flow in turbo-blower bearings to be controlled.

**9.1.6** Lubricating oil pumps of main gearings, as well as the pumps supplying the main fluid couplings, shall comply with requirements of 9.1.1-9.1.4 for propulsion engines.

**9.1.7** Each auxiliary engine and emergency diesel-generator (see the *Rules for the classification of ships, Part 9 - Machines, 2.2.9*) shall have an independent lubricating system.

Common lubricating systems of the auxiliary engines are, in each case, subject to special consideration by the *Register*.

### 9.2 LUBRICATING OIL SUPPLY SYSTEM OF INTERNAL COMBUSTION ENGINES AND GEARS

**9.2.1** The ends of drain pipes from the engine crankcase shall be so arranged within the drain tank that they are submerged into lubricating oil all the time of the engine operation.

No communication is permitted between lubricating oil drain pipes of two or more engines.

**9.2.2** The pipes of the lubricating oil system shall not communicate with other piping systems except in emergency case when they are connected to the separators which may be used for fuel oil separation. The connection of lubricating oil pipe and fuel oil pipe shall be provided with the arrangement that will preclude mixing of fuel oil and lubricating oil.

While separating lubricating oil, the precautions shall be taken as to prevent mixing of lubricating oil for the propulsion engine and auxiliary engines.

**9.2.3** The efficient oil cleaning shall be anticipated in the circulating oil system, and provision shall be made:

- .1 on the suction side of the pump of the gears - magnetic filter,
- .2 on the suction side of the pump - one coarse filter,
- .3 on pressure piping - one filter complying to specification of engine or gear manufacturers. For main propulsion machinery two parallel filters or one duplex changeover filter or one self-cleaning filter are to be provided.

Where machinery installations comprises of two or more propulsion engines or reduction gears, each one with its own filter, application of this criterion is not mandatory provided that a one readily accessible and easily replaceable spare filter is available on board.

The application of this criterion is not mandatory for ships of less than 500 gross tonnage navigating in restricted areas 5 to 8, provided that:

- a) where one propulsion engine or reduction gear is fitted, one readily accessible and easily replaceable spare filter is available on board, or
- b) where two or more propulsion engines or reduction gears are fitted each one with its own filter, it can be demonstrated during sea trials that the ship is capable of safe navigation and manoeuvring with one propulsion engine out of use.

**9.2.4** With a common lubricating system of the engine and turbo-blower before turbo-blower sliding bearings, fine filters of a construction which enables cleaning without stopping oil circulation, shall be fitted. A pressure gauge shall be fitted after the filters.

Where machinery installations comprises of two or more propulsion engines, each one with its own fine filter, application of this criterion is not mandatory provided that one readily accessible and easily replaceable spare fine filter is available on board.

**9.2.5** Capacity of each oil filter is to exceed by 10 per cent the maximum capacity of the pump.

**9.2.6** Lubricating oil system shall be fitted with control and measuring instruments.

Pressure gauge, indicating the pressure in the oil cooler, shall be placed at the control station.

Sight-glasses in the piping shall have a suitable degree of fire resistance.

### 9.3 LUBRICATING OIL PUMPS OF STEAM TURBINES

**9.3.1** The lubricating oil system of the propulsion turbine set shall be provided with two oil pumps. Each oil pump shall have a capacity being sufficient to ensure lubrication of the turbine set for the maximum output condition.

At least one of the pumps shall be independently driven.

Where two propulsion turbine sets are arranged in the same machinery space, one independently driven standby pump may be fitted for both turbine sets.

**9.3.2** Lubricating oil pumps shall be of self-priming type and shall be so disposed that reliable start-up is always possible.

**9.3.3** As a rule, the lubricating oil for propulsion turbine sets shall be supplied from the tank by gravity. Precautions shall be taken to ensure the lubrication of the propulsion turbine in the event of damage of the main lubricating oil pump, as well as in the case the turbine comes to the rest at failure in power supply from the main sources of power to the motors of oil pumps.

The use of lubrication system shall be considered by the *Register* in each case.

### 9.4 LUBRICATING OIL SUPPLY SYSTEM OF STEAM TURBINES AND GEARS

**9.4.1** The lubricating oil pipeline, including all branch pipes, shall be made of copper, copper-nickel or other equivalent materials.

**9.4.2** Oil may be taken from the propulsion turbine lubricating system only for control, adjustment and protection needs, as well as for lubricating the propulsion thrust bearing.

**9.4.3** Each lubricating system shall be fitted with audible and visual alarms warning of oil pressure drop and placed at the propulsion turbine control station. In the oil gravity

system the alarms shall operate at such level in the gravity tank as to enable the protection arrangements to cut in the standby or emergency pump during the time left before the tank is emptied.

**9.4.4** The capacity of the gravity tank in the lubricating gravity system shall be not less than a 5-minute consumption of oil when the turbine is running at the rated output.

The tank shall be fitted with an overflow pipe with a sight glass well lighted and visible from the control station. The cross-sectional area of the overflow pipe shall be not less than 1,25 times that of the discharge of the pump.

The possibility of supplying lubricating oil to consumers from the pump, except the tank, shall be provided.

**9.4.5** The lubrication system of the propulsion turbine set shall be fitted with two oil coolers, one of which is a standby cooler.

Where two turbine sets are situated in the same machinery space, one standby oil cooler may be installed for both turbine sets.

Servicing of oil coolers shall be provided according to 10.1.7.

**9.4.6** The lubricating system of the main turbines and their gears shall also comply with the requirements set forth in 9.1.6, 9.2.3 and 9.2.6.

**9.4.7** The branches of the lubricating oil pipeline shall be fitted with throttles for regulating the amount of oil supplied to each consumer.

### 9.5 LUBRICATING OIL TANKS

**9.5.1** Lubricating oil tanks shall be separated from the feed water, boiler water, vegetable oil and oil fuel tanks by cofferdams which shall comply with requirements of the *Rules for the classification of ships, Part 2 - Hull*, 17.3.2.

**9.5.2** Lubricating oil drain tanks of main turbines and main diesel engines of ships of ice categories 1AS, as well as of icebreakers, shall be separated from the bottom shell plating by a cofferdam conforming to the requirements of the *Rules for the classification of ships, Part 2 - Hull*, 7.13.2.

For other ships, the arrangement of cofferdams is recommended.

Where the cofferdams are not available, the drain pipes from crankcases shall have non-return or shut-off valves capable of being operated from above the engine floor plating.

**9.5.3** Provision shall be made for a lubricating oil storage tank. The capacity of this tank shall be sufficient for filling the system with oil to the working condition.

It is advisable to arrange the tank outside the double bottom.

In ships of restricted areas of navigation 5 to 8, the storage tank is not required to be fitted.

**9.5.4** Suction pipes from the tanks situated outside the double bottom shall be fitted with shut-off valves installed directly on the tanks.

Such valves installed on tanks having a capacity of more than 500 lit, which under normal service conditions may be in the open position, shall be capable of being remotely

closed from always accessible places located outside the space containing the tank.

**9.5.5** Arrangements for heating of the lubricating oil shall comply with requirements of 8.3.

**9.5.6** The oil tanks located in machinery space of category A (see the *Rules for the classification of ships, Part 7 - Machinery Installation*, 1.2.5) or in other machinery spaces shall comply with the requirements of 8.5.1 and the *Rules for the classification of ships, Part 17 – Fire protection*, 4.2.3.

## **9.6 ARRANGEMENTS FOR COLLECTION OF LEAKAGE OIL**

**9.6.1** In unattended machinery spaces the same requirements as for fuel oil systems are valid according to 8.5.

## **9.7 LUBRICATING OIL SYSTEM OF GAS TURBINE**

**9.7.1** Gas turbine lubricating shall comply with the requirements of 9.1 to 9.5, where applicable.

**9.7.2** Lubrication system of the gas turbine may be used for cooling the gas chamber pistons.

**9.7.3** Lubricating system of gas chamber pistons shall be separated from other lubricating systems. Lubricants shall comply with the *Rules for the classification of ships, Part 9 - Machines*, 2.7.

## 10 COOLING WATER SYSTEM

### 10.1 PUMPS

**10.1.1** As a general rule, means shall be provided in cooling systems whereby normal operation of propulsion machinery can be sustained or restored even though one of sources of cooling media pressure becomes inoperative.

In that order, the cooling water systems of main engines shall comply with the following requirements:

- .1 A seawater cooling system of one propulsion engine shall include two cooling water pumps, one of, which is standby. The capacity of the standby pump shall be not less than that of the main pump. At least, one pump shall be driven independently.

A fresh water cooling system of one propulsion engine is also to comply with these requirements. One common independent standby pump may be used for both fresh and sea water cooling. Precautions shall be taken to prevent mixing of fresh and seawater.

- .2 One independent standby pump ensuring the operation of each engine running at maximum load shall be installed in a sea water cooling system of two or more propulsion engines, each served by a separate cooling water pump.

A fresh water cooling system shall also comply with these requirements. It is permitted to install one common independent standby pump used for both fresh and sea water cooling, the capacity of which shall ensure cooling of any engine. Precautions shall be taken to prevent mixing of fresh and seawater. Standby pump may be replaced by complete spare pump of appropriate capacity ready to be connected to cooling circuit.

- .3 It is allowed to cool several engines by one independently driven pump. In this case, the capacity of the pump shall be sufficient for simultaneous cooling of all engines when running at maximum load. One standby pump, the capacity of which shall be not less than that of the main pump cooling simultaneously all engines, shall be provided.

The cooling pipe shall have a water control valve at inlet to each engine.

- .4 It is allowed to cool several engines by group of identical pumps. In this case, the total capacity of the pumps shall be sufficient for simultaneous cooling of all engines when running at maximum load. One standby pump, the capacity of which shall be not less than that of each of these pumps shall be provided.

The cooling pipe shall have a water control valve at inlet to each engine.

- .5 In the installations on ships with an automation mark in the class notation, provision shall be made for separate fresh water and sea water standby pumps, the capacity of which shall be not less than that of the main pumps.

- .6 Above mentioned special standby facilities are not mandatory for ships of less than 500 gross tonnage with restricted areas of navigation 5 to 8 provided that:

- a) where one propulsion engine is fitted, the arrangement shall be provided for emergency condition to enable the cooling of the engine by sea water directly. Precautions shall be taken as to prevent overpressure in the cooling system. The requirement for alternative cooling in emergency condition by sea water directly may be dispensed with provided that one complete spare pump of appropriate capacity ready to be connected to cooling circuit is carried on board.
- b) where two or more propulsion engines are fitted each served by a separate cooling water pump, it can be demonstrated during sea trials that the ship is capable of safe navigation and manoeuvring with one propulsion engine out of use.

**10.1.2** The oil and air coolers of the electric propelling motors shall have standby means of cooling, equivalent to the main means.

**10.1.3** Where each of the auxiliary engines is provided with an independent cooling water pump, the standby pumps for these engines are not required.

Where, however, a group of auxiliaries is supplied with cooling water from a common system, one standby pump for sea water and fresh water is sufficient. For ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8, instead of one standby pump, one complete spare pump of appropriate capacity ready to be connected to cooling circuit is to be carried on board.

In a common system of cooling the propulsion and auxiliary engines, standby pumps for cooling the auxiliary engines are not required.

For the diesel generators kept ready for immediate use, continuous priming with hot water shall be provided, where necessary.

**10.1.4** Ballast pumps, other general service pumps operated only for clean water and fire pumps may be used as standby cooling pumps, provided arrangements are made against overpressure in the cooling system.

**10.1.5** An independent pistons cooling system shall include a standby pump with capacity not less than that of the main pump.

**10.1.6** An independent fuel valves cooling system shall include a standby pump with a capacity not less than that of the main pump.

**10.1.7** The oil coolers of main turbo-generators, as a rule, shall use main condenser circulating pump.

Where a separate pump is provided, a stand-by pump of a capacity at least 0,66 capacity of main pump in operation with the calculated power of turbogenerator, shall be provided.

Each common pump may be used as a stand-by pump.

## 10.2 PIPING ARRANGEMENT

**10.2.1** Sea water for cooling system shall be taken from at least two sea inlet boxes, arranged in engine room, one of which is placed at the side and the other at the bottom of the ship. These boxes shall be interconnected.

**10.2.2** It is recommended that the cooling system servicing the auxiliary engines and condensers of auxiliary turbines shall be supplied with water from separate sea inlet box. Where these sea inlet boxes are located in the engine room, the suction of the above mentioned systems shall be connected by means of shut-off valves to the cooling main supplied from sea inlet boxes according to 10.2.1

**10.2.3** Seawater pipes in cargo holds for dry cargoes, including cargo spaces of container ships, ro-ro ships, are to be protected from impact of cargo where they are liable to be damaged.

**10.2.4** For heating of sea inlet boxes in ships with ice strengthening, see also the *Rules for the classification of ships, Part 29 - Polar class ships and Ice class ships*, 8.14.2.

## 10.3 COOLING WATER FILTERS

**10.3.1** On the suction lines of water cooling system servicing the propulsion and auxiliary internal combustion engines, the filters shall be fitted behind the sea inlet boxes.

The sea inlet boxes and piping systems shall be arranged so as to enable the filters to be cleaned without having to stop the cooling pumps.

In a water cooling system of a turbine installation, filters are recommended to be fitted.

## 10.4 COOLING OF INTERNAL COMBUSTION ENGINES

**10.4.1** In a fresh water cooling system of the engine, provision shall be made for an expansion tank where the level of water is higher than the maximum level of water in the engine. The expansion tank shall be connected to the suction piping of the pumps and may be common for the cooling system of several engines.

The tank shall be provided with a device for monitoring the water level.

In the cooling system of engines, the arrangement of the sea water discharge pipes shall be such that the highest cooled spaces of the engines, air coolers and oil coolers are always filled with water and formation of trapped zones is excluded.

**10.4.2** The cooling system shall be fitted with thermometers and temperature control devices.

It is recommended that suitable alarms shall be provided to warn of the limit value of the cooling water temperature.

**10.4.3** Cooling system for the emergency engine shall be in compliance with the *Rules for the classification of ships, Part 9 - Machines*, 2.2.6.

**10.4.4** Where fuel oil or lubricating oil is used in cooling systems of injectors or pistons, this system shall comply with the Sections 8 and 9.

## 10.5 COOLING OF GAS TURBINE SYSTEMS

**10.5.1** Cooling system of gas turbine shall comply with the requirements of 10.4.

**10.5.2** Fresh water shall be used for the cooling system and sea water may be used only in emergency.

**10.5.3** Air cooling system shall comply with the requirements of 14.2.1, 14.2.3 and 14.3.1.

If in case of the of water cooling failure, the turbine operation with 30% of the calculated power is ensured, stand by pump is not necessary.

## 10.6 COOLER INSTALLATIONS EXTERNAL TO THE HULL

**10.6.1** The inlet and outlet connections of external cooler installations are to be in accordance with applicable requirements in 1.4.1.2, 1.5.1.4, 1.5.2.3, 1.5.2.13, 1.5.2.15, 1.5.4.2, 1.5.4.3, 1.5.4.6 and 1.5.4.7.

If flexible hose is fitted, it shall be a "Flexible hose assembly" as defined in 1.3.8.1.2, which was type approved in accordance with provision of 1.3.8. The flexible hose assemblies are subject to satisfactory prototype testing in accordance with 1.3.8.5. In general, they shall be located inboard of the shut-off valve. In addition, flexible hose shall be of fire resistant type within machinery space of category A.

For ships of less than 500 gross tonnage, navigating in restricted areas 5 to 8 and for pipes subject to a pressure not exceeding 0,5 MPa, flexible hose of approved type may be used with clips **made of corrosion-resistant material** and clips thickness of not less than 0,4 mm. **Not less than two clips are to be fitted at each end.**

**10.6.2** A keel cooler installation used for engine cooling must be designed to prevent flooding. Cooling system shall be arranged as closed loop below waterline.

**10.6.3** Shut-off valves are not required for integral keel coolers. A keel cooler is considered integral to the hull if the following conditions are satisfied:

- 1 Cooler channels are welded to the hull with the hull structure forming part of the channel;
- 2 The channel material is fabricated from material of the same thickness and quality as the hull plating. Half round pipe with lesser

thickness will be subject to a special consideration by the *Register*;

- .3 All flexible connections and openings internal to the vessel are located above the deepest load line. Minimum thickness of all piping components shall be in accordance with provision of 1.5.2.11 below deepest load line;
- .4 The forward end of the cooler structure must be faired such that the horizontal length is no less than four times the height of the structure or must be in a protected location.
- .5 Full penetration welds are employed in the fabrication of the cooler structure and its attachment to the hull.

**10.6.4** Where non-integral keel coolers are used, if the shell penetrations are not fully welded, the penetration is to be encased in a watertight enclosure.

Non-integral keel coolers are to be suitably protected against damage from debris and grounding by recessing the unit into the hull or by placement of protective guards. Suitable coating to be applied on cooler tubes in order to reduce marine growth which could reduce the cooling effect.

In addition, non-integral keel coolers are to be suitably protected against galvanic corrosion.

## 11 COMPRESSED AIR SYSTEM

### 11.1 NUMBER AND CAPACITY OF STARTING AIR RECEIVERS

**11.1.1** The arrangement for air starting is to be such that the necessary air for the first charge can be produced on board without external aid.

Compressed air system of propulsion engines shall be of such a construction as to ensure simultaneous starting and reversing of all propulsion engines.

For the starting system of gas turbines see the *Rules for the classification of ships, Part 9 - Machines*, 8.1.9.

**11.1.2** The starting air of the propulsion engines shall be stored in not less than two independent air receivers or in two independent groups of several air receivers. The total capacity of air receivers is to be sufficient to provide, without their being replenished, the full number of starts and manoeuvres indicated in 11.1.3 and 11.1.4. Each of these two air receivers or each group of them shall have a capacity of not less than 50 per cent of the total required.

When other consumers such as auxiliary engines starting systems, control systems, whistle, etc., are to be connected to starting air receivers, their air consumption is also to be taken into account.

In ships of restricted areas of navigation 5 to 8, where an electric siren is used it is permitted to fit one air receiver of a capacity sufficient to meet the requirements of 11.1.3 and 11.1.4.

**11.1.3** The total capacity of the air receivers for starting and reversing of the propulsion engines shall ensure not less than 12 consecutive starts of each engine, alternating between ahead and astern speed.

For ships navigating in Polar waters and Ice class ships, see also the *Rules for the classification of ships, Part 29 - Polar class ships and Ice class ships*, 8.14.1.

**11.1.4** The total capacity of air receivers for starting of the main engines connected to a controllable pitch propeller or some other device, enabling to start without opposite torque, shall be sufficient to provide not less than 6 starts of each engine.

Regardless of the number of starts required for each engine in 11.1.3 and 11.1.4, where there are more than two engines, at least 3 starts of each engine is to be possible. However, the total capacity is not to be less than 12 starts and need not exceed 18 starts.

For any other specific installation the number of starts may be specially considered by the Register depending upon the arrangement of the engines and the transmission of their output to the propellers.

**11.1.5** For starting of the auxiliary engines provision shall be made for at least one air receiver with a capacity sufficient for carrying out 3 starts of each engine.

Where one air receiver is available, it shall be possible to start the auxiliary engines from one air receiver or a group of air receivers of the propulsion engines. In special

agreement with the Register such air receiver may be dispensed with.

**11.1.6** Where the compressed air is necessary for the whistle, it is to be available from two compressed air receivers.

Where propulsion engines are arranged for starting by compressed air, at least one of said receivers is to be starting air receiver. The separate connection, dedicated for this purpose, is to be provided directly from the compressed air main. The capacity of starting air receiver or group of them is to be increased by an amount of air specified below for special air receiver of the typhoon whistle, or air receiver is to be fitted with automatic replenishing means or with warning alarms, which shall operate as soon as the pressure in the air receiver goes down by not more than 0,5 MPa below the working pressure.

Where an air receiver is fitted especially for the typhoon, its capacity shall be determined so that the typhoon will be able to work continuously for 2 min. An hourly performance of compressor shall be not less than that required to provide continuous operation of typhoon during 8 min.

Where an air receiver is anticipated to feed the typhoon and control systems, as well as for other ship purposes, the capacity of the air receiver shall be increased as compared with that designed for typhoon only. Provision shall be made for automatic replenishing or signalling means which shall operate as soon as the amount of air in the air receiver is such as required for typhoon only.

In ships having mark of automation replenishing of air receivers shall be in compliance with the requirements of the *Rules for the classification of ships, Part 13 - Automation*, 4.2.1, 5.1.10 and 6.2.2.

**11.1.7** The air receivers of auxiliary engines indicated in 11.1.5 may be replenished from the propulsion air receivers stated in 11.1.6. Any possibility of back flow shall be excluded.

**11.1.8** Where compressed air is used for starting an emergency diesel-generator, in compliance with the requirements of the *Rules for the classification of ships, Part 12 - Electrical Equipment*, 9.5.1.2, following requirements shall be fulfilled:

- 1 Starting system shall be provided with approved starting device and a compressed air receiver arranged for this purpose only.
- 2 Compressed air in the starting air receiver shall be sufficient for at least three consecutive starts at all times.
- 3 Provisions shall be provided for maintaining required air capacity in the receiver at all times. For this purpose, compressed air starting systems may be maintained by the main or auxiliary compressed air receivers, through a suitable non-return valve, or by an emergency air compressor energised by the emergency switchboard.
- 4 All these starting, charging and compressed air storing devices shall be located in the emergency generator room, in compliance with the requirements of the *Rules for the classification of ships, Part 12 - Electrical Equipment*, 9.2.5.
- 5 When the emergency diesel-generator is started by means of compressed air system

only, two air receivers shall be provided. Capacity of each shall be sufficient for at least three consecutive starts.

## 11.2 COMPRESSORS

**11.2.1** There shall be not less than two main compressors. One of them may be driven from main engine.

The total capacity of all main compressors shall be sufficient to supply within one hour the quantity of air needed to satisfy the provision of 11.1.2, charging the receivers from the atmospheric pressure, to a pressure that is necessary for carrying out the full number of starts and manoeuvres indicated in 11.1.3 and 11.1.4. The capacity of the individual main compressors shall be approximately the same.

The capacity of one independently driven compressor or the combined capacity of independently driven compressors shall not be less than 50 percent of the total capacity required.

For ships navigating in Polar waters and Ice class ships, see also the *Rules for the classification of ships, Part 29 - Polar class ships and Ice class ships*, 8.14.1.

**11.2.2** In ships of restricted areas of navigation 5 to 8, fitted with non-reversible propulsion engines, *Register* may permit installation of one attached compressor.

The capacity of compressors shall comply with requirements set forth in 11.2.1.

**11.2.3** Where compressed air is necessary to restore propulsion, the arrangements for bringing main and auxiliary machinery into operation are to have capacity such that the starting energy and any power supplies for engine operation are available within 30 minutes of a dead ship condition, as defined in *Rules for the classification of ships, Part 12 - Electrical Equipment*, 1.2.20.

For this purpose it is allowed to use a hand compressor or a diesel-compressor with a hand-started engine, to fill a separate air receiver whose capacity shall be sufficient to start three times one of the diesel-generators or one of the main compressors where they are driven by an internal combustion engine.

A separate air receiver may not be installed where the diesel-compressor or hand compressor is capable of filling the smallest of the air receivers specified in 11.1.5 during the aforesaid time period.

Where the electromotor of one of the compressors specified in this text can be supplied from the emergency diesel-generator, the arrangement described hereinbefore may be omitted.

**11.2.4** The compressors shall be provided with safety arrangements in accordance with the *Rules for the classification of ships, Part 9 - Machines*, 5.1.2.

## 11.3 PIPING ARRANGEMENT

**11.3.1** Pipes intended for filling air receivers shall be led directly from the compressor to the air receiver and shall be completely separate from the starting air pipes.

**11.3.2** Each of the starting air receivers specified in 11.1 shall be capable of being filled from each main compressor specified in 11.2. For air receivers interconnection, see 11.1.7.

**11.3.3** Non-return shut-off valves shall be installed on the discharge pipes, behind each compressor.

The piping supplying starting air to each engine shall have a non-return valve installed before the starting valve.

The non-return valve may be omitted, if provision is made in the engine design for suitable safety devices protecting the piping from the effects of an internal explosion (see the *Rules for the classification of ships, Part 9 - Machines*, 2.9.1).

**11.3.4** The temperature of air entering the receivers, shall not exceed 90°C. Where required, provision shall be made for appropriate coolers.

The compressed gas piping shall not be led under the engine room floor plating.

**11.3.5** The compressed air piping shall be led as straight as possible with a slope for water drainage. The pipes shall not have a slope in the direction of the master starting valve of the engine.

**11.3.6** Suitable arrangements for separating accumulations of oil and water shall be fitted on the pipes between compressors and receivers, unless draining arrangements are fitted on the compressors.

**11.3.7** Means shall be provided to prevent overpressure in any part of compressed air systems.

If air is led from a safety valve or a safety plug of air receivers outside the machinery space, the pipeline cross section shall not be less than twice the cross sectional area of a safety valve or a safety plug.

Suitable arrangements for water drain shall be provided on the pipeline.

**11.3.8** Pneumatic sound devices of the alarm system stipulated by the *Rules for the classification of ships, Part 12 - Electrical Equipment*, 7.4, shall be connected to starting air receiver by means of special piping".

## 12 FEED WATER SYSTEM

### 12.1 PUMPS

**12.1.1** Each main boiler and an essential auxiliary boiler or a group of boilers shall be provided with at least two independent feed pumps.

Auxiliary boilers which are not intended for essential services, as well as the exhaust gas boilers so constructed that they can be left without water when heated by exhaust gases, one feed pump may be accepted.

**12.1.2** For boilers with manual feed regulation the capacity of each pump shall be not less than 1,5 times the rated capacity of the boilers, and for boilers with automatic control systems, not less than 1,15 times their rated capacity.

Where several feed pumps are installed, their adopted capacity shall be such that in the event of failure of any of the pumps the total capacity of the rest of the pumps is not less than the capacity required in the foregoing for each pump.

The capacity of each feed pump of a straight-through boiler shall be not less than the rated capacity of the boiler.

**12.1.3** In the case of steam driven feed pumps, live steam shall be supplied to the separate pipeline having connections from all the boilers fed by these pump.

**12.1.4** The main and essential auxiliary boilers with forced circulation shall be serviced by not less than two circulating pumps, one of which is a standby pump.

### 12.2 PIPING ARRANGEMENT

**12.2.1** In open circuit feed systems the feed pumps and injectors shall be provided with suctions from the hot well and from the feed water storage tanks.

**12.2.2** Every steam generating system which provides services essential for the safety of the ship, or which could be rendered dangerous by the failure of its feedwater supply, shall be provided with not less than two separate feedwater systems from and including the feed pumps, noting that a single penetration of the steam drum is acceptable. See also requirements in the *Rules for the classification of ships, Part 10 - Boilers, heat exchangers and pressure vessels*, 3.3.2.

Where a steam generation system consists of two or more adequately sized boilers, and the feed water for each of these boilers is supplied by a single feed water pipe, the level of redundancy for the piping of the feedwater system may be considered to comply with the requirement above.

Boilers for heating fuel oil and those used for cargo heating which is essential for the safety or integrity of cargo are, in general, regarded as steam generating system "which provides services essential for the safety of the ship" or "which could be rendered dangerous by the failure of its feedwater supply", and therefore are to be provided with not less than *two* separate feedwater systems except for the cases where a steam generation system consists of two or more adequately sized boilers as mentioned above.

Evaluation of whether a steam generating system is considered as "providing services essential for the safety of the ship" or "being rendered dangerous by the failure of its feedwater supply" should be done on a case by case basis."

**12.2.3** Structural measures shall be taken to prevent the feed water being contaminated by oil and oily water.

**12.2.4** Unless overpressure is prevented by the pump characteristics, means shall be provided which will prevent overpressure in any part of the feedwater systems.

**12.2.5** Feed pipes and pumps are to be provided with stop valves so arranged that any one pump can be overhauled while the boilers are operating at full load.

### 12.3 TANKS

**12.3.1** Feed water tanks shall be separated from tanks containing fuel oil, lubricating oil and vegetable oil by cofferdams. These cofferdams shall be in compliance with requirements of the *Rules for the classification of ships, Part 2 - Hull*, 18.3.2.

## 13 STEAM AND CONDENSATE SYSTEMS

### 13.1 APPLICATION

**13.1.1** This Article applies to all steam and condensate systems intended for essential and non-essential services.

Steam systems with a design pressure of 10 MPa or more will be given special consideration.

### 13.2 AVAILABILITY

**13.2.1** Where a single boiler is installed, except otherwise specified the steam system may supply only non-essential services. See also the *Rules for the classification of ships, Part 7 - Machinery installation, 1.5*.

**13.2.2** Where more than one boiler is installed, the steam piping system is to be so designed that, in the event that any one boiler is out of action, the steam supply to essential services (as defined by the *Rules for the classification of ships, Part 12 - Electrical equipment, 1.2*) can be maintained.

### 13.3 STEAM LINES AND ARRANGEMENTS

**13.3.1** Every pipe and fitting which may be exposed to the condition of steam conveying is to be designed, constructed and installed such as to withstand the maximum working stresses to which it may be subjected.

**13.3.2** If design temperature of the steam piping system exceeds 350°C, calculations of thermal stresses are to be submitted to *Register* – see 1.3.4.2.

**13.3.3** The connections on boilers and safety valves are to comply with the applicable requirements of the *Rules for the classification of ships, Part 10 - Boilers, Heat exchangers and Pressure Vessels, Section 3*.

**13.3.4** In the steam line supplying machinery and arrangements designed for a lower pressure than the boiler pressure, reducing valves shall be fitted and requirements of 1.3.5.2 shall be complied with.

Identically, if a steam pipe or fitting may receive steam from any source at a higher pressure than that for which it is designed, a suitable reducing valve and the arrangement as required in 1.3.5.2 shall be fitted.

**13.3.5** In order to avoid overpressure in steam lines due to excessive steam production, in particular in systems where the steam production cannot be adjusted, provisions are to be made to allow the excess steam to be discharged to the condenser by means of an appropriate dump valve.

**13.3.6** Where two or more boilers are connected to a common steam line, a non-return valve shall be fitted on the steam pipe of each boiler before connection to the common line. These valves may not be fitted if the stop valves of the boilers are of non-return shut-off type.

**13.3.7** The blow-down and the scum valves of two or more boilers may be connected to a common discharge, provided a non-return valve is fitted between each boiler and a common discharge.

**13.3.8** Steam for the ship's whistle shall be supplied through a separate line directly from the main boiler. This requirement does not apply to ships having, besides steam whistle, pneumatically or electrically operated sound signal means.

**13.3.9** The machinery connected with the steam lines shall be relieved of the stresses caused by thermal expansion pipes, by means of pipelines provided with compensators for thermal expansion or pipes bends.

**13.3.10** The branches of the steaming system and steam smothering system of the fuel oil tanks shall be fitted with shut-off non-return valves for each tank.

**13.3.11** As far as practicable, the steam pipelines within the engine and boiler rooms shall be led in the upper parts of these spaces, in a position accessible for observation and servicing. In general, the steam lines shall not be led near the fuel oil tanks and the electric equipment.

Routing of steam lines under the floor plating of engine and boiler rooms, with the exception of boiler heating coils and blow-off pipes, is not permitted.

**13.3.12** Steam lines are not to pass through accommodation spaces, unless they are intended for heating purposes.

### 13.4 STEAM LINES IN OIL TANKERS CARGO AREA

**13.4.1** On oil tankers, the steam temperature within the cargo area is not to exceed 220 °C, complying with the requirements of 4.2.9. On gas carriers and chemical tankers, the maximum temperature is to be adjusted to take into account the temperature characteristic of the cargoes.

**13.4.2** When heating coils are fitted in compartments likely to contain either fuel oil or liquid or dry cargoes, arrangements such as blind flanges are to be provided in order to disconnect such coils in the event of carriage of dry or liquid cargoes which are not to be heated.

**13.4.3** The number of joints on heating coils is to be reduced to the minimum consistent with dismantling requirements.

**13.4.4** The branches of the steaming system and steam heating system of the cargo oil tanks shall be fitted with shut-off non-return valves for each tank.

**13.4.5** To reduce the risk of liquid or gaseous cargo returns inside the engine or boiler rooms, steam heating systems of cargo tanks are to satisfy either of the following provisions:

- a) they are to be independent of other ship services, except cargo heating or cooling systems, and are not to enter machinery spaces, or
- b) they are to be provided with an observation tank dedicated for the condensate from cargo area, arranged in accordance with 13.8.3.2.

**13.4.6** Live and exhaust steam pipes are generally not to pass through cargo holds, unless special provisions are made with *Register's* agreement.

**13.4.7** Where steam pipes pass through cargo holds in pipe tunnels, provision is to be made to ensure the suitable thermal insulation of such tunnels.

## 13.5 BLOW-OFF ARRANGEMENTS OF STEAM LINES

**13.5.1** Pipelines conveying live steam shall have condensate drain arrangements to protect the machinery against water hammer.

**13.5.2** The open ends of the pipelines for steam line blow-off shall be led below the flooring of the engine and boiler rooms (see 1.6.3.8).

## 13.6 TURBINE STEAM LINE CONNECTIONS

**13.6.1** When the inlet steam pressure exceeds the pressure for which the exhaust casing and associated piping up to the exhaust valves are designed, the turbine casing is to be fitted with suitable relief valves to prevent damage by excessive steam pressure at the low-pressure end if the exhaust valve is closed accidentally.

Unless otherwise specified, a sentinel valve or equivalent shall be provided at the exhaust end of all turbines, to warn the operator of over-pressure. The valve discharge outlets are to be visible and suitably guarded if necessary.

**13.6.2** Bled steam connections are to be fitted with non-return valves or other approved means to prevent steam and water returning to the turbines.

**13.6.3** Efficient steam strainers are to be provided close to the inlets to ahead and astern high pressure turbines or, alternatively, at the inlets to maneuvering valves.

**13.6.4** Where required by the manufacturer of the auxiliaries, steam strainers are also to be fitted in the steam lines supplying these auxiliaries.

## 13.7 CALCULATION OF THERMAL EXPANSION OF STEAM PIPES

**13.7.1** Calculation of thermal expansion of steam pipes shall be based on the methods generally adopted in structural mechanics for computing statically indeterminate beam systems, performed manually, or by means of an electronic computer or by means of a model method.

**13.7.2** Calculation of thermal expansion of steam pipes shall include a summary table of stresses and safety factors for all the pipe ranges dealt with in the calculation.

Steam pipes working on temperatures which do not cause stress relaxation, shall, as a rule, be calculated for thermal expansion taking into account the prestressing in cold condition and during its instalment on the platform.

Steam pipes working under conditions of stress relaxation shall be calculated in cold condition for a 100%

prestressing, considered as great as the displacements due to full thermal expansion (displacements of supports included) but with an opposite sign. Where a steam pipe in hot condition undergoes displacements, it shall be calculated in view of these displacements, and, after that, for a 100% prestressing in cold condition (displacements of supports included).

**Note:** The temperatures which cause the pipes to relax are as follows:  
- 350°C and over - for carbon steel pipes  
- 420°C and over - for alloy steel pipes.

**13.7.3** In the calculation of thermal expansion the pipe fittings and joining parts (elbows, T-joints, etc.) may be assumed rigid and need not be calculated.

**13.7.4** The internal forces in steam pipes shall be calculated depending on the pipe cross-sectional area, including the positive manufacturing tolerances for pipe wall thickness. The same sizes shall be used for determining the stresses from displacements. The stresses caused by internal pressure, shall be determined depending on pipe cross-sectional area, including the negative manufacturing tolerance for pipe wall thickness.

**13.7.5** For all types of butt joints of steam pipes welded with a back sealing run at the root, butt joints welded from both sides and made by automatic submerged arc welding, including joints welded on a removable backing ring, with surface dressing, the efficiency factor in the formula for stress calculation of piping may be assumed equal to 1, i.e.  $\phi = 1$ .

**13.7.6** The three components of reaction for a plane frame in general and the six components for a space frame shall be determined by methods applied in calculation of statically indeterminate beam system.

**13.7.7** The flexibility coefficient  $k$  of the curved portion shall be determined by the formulae:

$$\text{For } \lambda \geq 0,4 \quad k = \frac{10 + 12 \cdot \lambda^2}{1 + 12 \cdot \lambda^2} \quad (13.3.7-1)$$

$$\text{for } 0,2 \leq 0,4 \lambda < 0,4 \quad k = \frac{1,65}{\lambda} \quad (13.3.7-2)$$

where:

$$\lambda = \frac{s \cdot R}{r^2} \quad - \quad \text{geometrical coefficient of bent pipe;}$$

$s$  - wall thickness of straight pipe, [mm];

$R$  - bending radius of the curved portion, [mm];

$r$  - average radius of cross-section of a straight pipe, [mm];

**13.7.8** In calculating the steam pipes for thermal expansion, the maximum stresses shall be determined as follows:

- equivalent stress for a straight pipe conveying hot steam subjected to working pressure, as well as for cold pipe not subjected to internal pressure;
- total local stress acting on the inside of a bent pipe conveying hot steam subjected to working pressure, as well as for cold pipe not subjected to internal pressure.

Bent pipes with  $\lambda \geq 1.44$  may be regarded as straight, when determining the equivalent stress, and need not to be calculated for the total local stress.

When the assembled steam pipeline is subjected to a hydraulic test on board ship, the resultant stresses shall be

determined also for a cold pipeline at the hydraulic test pressure.

**13.7.9** The resultant stress in a straight pipe when exposed to internal pressure and to the bending and torsional moments are determined by the formula

$$\sigma_r = \sqrt{\sigma_a^2 + \sigma_2^2 + \sigma_3^2 - \sigma_a \sigma_2 - \sigma_a \sigma_3 - \sigma_2 \sigma_3 + \sigma_\tau^2} \quad (13.3.9)$$

where:

- $\sigma_a$  – total normal stress from bending and internal pressure, [N/mm<sup>2</sup>],
- $\sigma_2$  – circumferential stress due to internal pressure, [N/mm<sup>2</sup>],
- $\sigma_3$  – radial stress due to internal pressure, [N/mm<sup>2</sup>],
- $\sigma_\tau$  – shearing stress, [N/mm<sup>2</sup>].

**13.7.10** The total local stress acting on the inside of a bent pipe shall be determined in all cases of bending (in plane and perpendicular to curvature plane of a bent pipe) as a sum of bending stresses and circumferential stress due to internal pressure.

**13.7.11** Safety factors, relating to the yield point or to tensile strength, used for determination of permissible stresses, to which the resultant and local stresses are compared are as follows:

- 1,2 – for plane frame;
- 1,5 – for space frame.

## 13.8 CONDENSATE SYSTEMS

### 13.8.1 Condensers

**13.8.1.1** Each propulsion turbine set shall be fitted with an independent condenser installation ensuring a stable vacuum under all rated operating conditions.

Auxiliary turbines may have a common condenser installation. In running conditions, waste steam from the auxiliary turbo-generators may be discharged into the main condenser or into the stages of the propulsion turbine set.

### 13.8.2 Pumps

**13.8.2.1** The main condenser shall be cooled by two sea water pumps one of which is a standby pump.

The capacity of standby pump shall be not less than 30 per cent of rated quantity of circulating water for all consumers.

Any pump of sufficient capacity may be used as a standby pump.

In twin-screw ships it is allowed to use one standby sea water pump for cooling the condensers of both turbine sets.

Where, for servicing the main condenser, provision is made for simultaneous operation of both pumps, the capacity of each pump shall be not less than 50 per cent of the rated quantity of circulating water for all consumers. No standby sea water pump is required in this case.

**13.8.2.2** Where the auxiliary condenser is common for all the turbo-generators, it shall be serviced by two circulating pumps one of which is a standby pump. Any pump of a sufficient capacity may be used as a standby pump.

**13.8.2.3** Scoop circulating of cooling water may be allowed, provided there is a circulating pump with a capacity sufficient to ensure full astern conditions speed. The standby circulating pump shall meet the requirements of 14.2.1.

**13.8.2.4** The condensate system of a steam turbine installation shall be serviced by two condensate pumps, one of which is a standby pump.

The capacity of each pump shall be not less than 1,25 of the maximum permissible amount of the condensed steam.

For the propulsion turbines with two main condensers arranged in the same engine room, the standby condensate pump may be common for both condensers.

### 13.8.3 Condensate observation tanks

**13.8.3.1** Any condensate from the steam heating pipes provided for fuel oil tanks and bunkers, cargo tanks and fuel oil or lubricating oil heaters is to be led to an observation tank or some other device of similar efficiency located in a well-lighted and readily accessible position.

**13.8.3.2** The observation tanks for the condensate returns coming from cargo area mentioned in 13.4.5, shall be located within the cargo area. However, this tank may be placed inside the engine room in a well-ventilated position remote from boilers and other sources of ignition. Its air pipe is to be led to the open deck and fitted with a flame arrester.

### 13.8.4 Piping arrangements

**13.8.4.1** The arrangement of pipes and their connections shall comply with requirements of 10.2 and 10.3.

**13.8.4.2** The condensate collector, discharge pipe and condensate pump shall be so arranged as to preclude flooding of the lower rows of pipes and to ensure the required pressure and smooth delivery of condensate to the pump. Provision shall be made for a handhole for cleaning the collector.

**13.8.4.3** The nozzles of the ejectors of the condenser installations shall be protected against damage and clogging. For this purpose, a metal screen shall be installed on the steam pipeline.

### 13.8.5 Instrumentation

**13.8.5.1** The condenser system for steam turbine installations shall be fitted with the following gauges, alarm and signal devices:

- .1 a condensate level indicator for the condenser;
- .2 vacuum and vacuum pressure gauges for the condenser and ejector coolers;
- .3 a pressure gauge for the steam pipeline to ejector;
- .4 thermometers for the cooling water discharge pipes of the condenser and ejector coolers;

- .5 salinometers with light and sound alarms indicating condensate salinity.

## 14 HYDRAULIC SYSTEMS

### 14.1 APPLICATION

**14.1.1** Unless otherwise specified, this Article applies to all hydraulic power installations intended for essential services. Essential services should be considered as defined in the *Rules for the classification of ships, Part 12 - Electrical equipment, 1.2.*

The hydraulic installations intended for steering gears are to comply also with the requirements of the *Rules for the classification of ships, Part 9 - Machines, 6.2 and 7.*

**14.1.2** Hydraulic power installations not serving essential services but located in spaces where sources of ignition are present are to comply with the provisions of 14.3.2, 14.3.3, 14.3.4, 14.4.4, 14.4.5 and 14.5.3. In addition, the requirements specified in the *Rules for the classification of ships, Part 17 - Fire protection, 4.2.4* shall be complied with.

**14.1.3** *Low pressure or low power* hydraulic installations are those with a design pressure of less than 2,5 MPa and hydraulic power packs of less than 5 kW. Such installations will be a subject to special consideration by the *Register*.

**14.1.4** *Very high pressure* hydraulic installations are those with a design pressure exceeding 35 MPa. Such installations will be a subject to special consideration by the *Register*.

### 14.2 BASIC DESIGN REQUIREMENTS

**14.2.1** As far as practicable, hydraulic systems are to be so designed as to:

- avoid any overload of the system
- maintain the actuated equipment in the requested position (or the driven equipment at the requested speed)
- avoid overheating of the hydraulic oil
- prevent hydraulic oil from coming into contact with sources of ignition.

**14.2.2** As a rule, hydraulic systems are to be so designed that, in the event that any one essential component becomes inoperative, the hydraulic power supply to essential services can be maintained. Partial reduction of the propulsion capability may be accepted, however, when it is demonstrated that the safe operation of the ship is not impaired.

**14.2.3** When a hydraulic power system is simultaneously serving one essential system and other systems, it is to be ensured that operation of such other systems, or a single failure in the installation external to the essential system, is not detrimental to the operation of the essential system.

The requirement above applies in particular to steering gear.

**14.2.3** Hydraulic systems serving lifting or hoisting appliances, including platforms, ramps, hatch covers, lifts, etc., are to be so designed that a single failure of any component of the system may not result in a sudden undue displacement of the load or in any other situation detrimental to the safety of the ship and persons on board.

### 14.3 GENERAL

**14.3.1** For the purpose of this requirements, a power unit is the assembly formed by the hydraulic pump and its driving motor.

An actuator is a component which directly converts hydraulic pressure into mechanical action.

**14.3.2** Oils used for hydraulic power installations are to have a flashpoint not lower than 150°C and be suitable for the entire service temperature range.

The hydraulic oil is to be replaced in accordance with the specification of the installation manufacturer.

**14.3.3** In general, the hydraulic power units are to be located outside machinery spaces containing the boilers, main engine, its auxiliaries or other sources of ignition. This applies in particular for hydraulic equipment delivering pressure over 25 bar to the following equipment:

- controllable pitch propellers or main transverse thrust units
- clutches
- turbine maneuvering steam valves
- exhaust gas valves of diesel engines or gas damper control systems
- hydraulically operated valves and pumps.

**14.3.4** Where justified that the arrangement required in 14.3.3 is not practical, at least the following is to be provided:

- Shields or similar protections are to be fitted around such hydraulic equipment as in order to avoid any accidental oil spray or mist to the hot surfaces or other sources of ignition.
- The low level alarm required for hydraulic tanks of these circuits is to be triggered as soon as possible.
- The automatic stop of hydraulic pumps is to be operated in the same circumstances, except where this stop can lead to propulsion stop.

### 14.4 PUMPS AND ACCESSORIES

**14.4.1** Hydraulic power installations are to include at least two power units so designed that the services supplied by the hydraulic power installation can operate simultaneously with one power unit out of service. A reduction of the performance may be accepted.

Low power hydraulic installations not supplying essential services may be fitted with a single power unit, provided that alternative means, such as a hand pump, are available on board.

**14.4.2** Pressure reduction units used in hydraulic power installations are to be duplicated.

**14.4.3** Suitable filter or other means for effective filtration shall be fitted in the hydraulic oil circuit.

Where filters are fitted on the discharge side of hydraulic pumps, a relief valve leading back to the suction or to any other convenient place is to be provided on the discharge side of the pumps.

**14.4.4** Where necessary, appropriate cooling devices are to be provided.

**14.4.5** Safety valves of sufficient capacity are to be provided at the high pressure side of the installation.

Safety valves are to discharge to the low pressure side of the installation or to the service tank.

**14.4.6** Cocks are to be provided in suitable positions to vent the air from the circuit.

**14.4.7** Provisions are to be made to allow the drainage of the hydraulic oil contained in the installation to a suitable collecting tank.

## **14.5 HYDRAULIC TANKS AND OTHER COMPONENTS**

**14.5.1** Service tanks intended for hydraulic power installations supplying essential services shall have at least:

- a) level gauge complying with 5.5.2
- b) a temperature indicator
- c) a level switch
- d) free volume, at least 10% of the tank capacity.

**14.5.2** Hydraulic power installations supplying essential services are to include a storage tank of sufficient capacity to refill the whole installation should the need arise in case of necessity.

For hydraulic power installations of less than 5 kW, the storage means may consist of sealed drums or tins stored in satisfactory conditions.

**14.5.3** For hydraulic accumulators where provided, the hydraulic side which can be isolated is to be fitted with a relief valve or another equivalent device offering equivalent protection in case of overpressure.

## **14.6 CONTROL AND MONITORING**

**14.6.1** Arrangements are to be made for connecting a pressure gauge where necessary in the piping system.

**14.6.2** Unless otherwise specified, alarms and safeguards for hydraulic power installations serving essential services, shall include at least:

- low level alarm before the quantity of lost oil reaches 100 litres, or 70 % of normal volume, whichever is the less.
- automatic stop of the auxiliary at another 10% oil volume lost after the alarm (does not apply for steering gears)

For ships of restricted areas of navigation 5 to 8, partial exemption of this requirement could be accepted, subject to special consideration by the *Register*.

## 15 SYSTEMS WITH THERMAL FLUIDS BASED ON MINERAL OILS

### 15.1 PUMPS

**15.1.1** At least two circulating pumps shall be provided for thermal oil one of which shall be a stand-by pump.

**15.1.2** Gauges shall be fitted at the thermal oil outlets.

**15.1.3** A transfer pump shall be provided for filling the system as well as thermal oil transfer.

**15.1.4** Thermal oil pumps shall be provided with disconnecting switches in compliance with the requirements of the *Rules for the classification of ships, Part 12 - Electrical Equipment, 5.7.*

### 15.2 EXPANSION TANKS

**15.2.1** An expansion tank shall be provided in thermal oil systems.

Tank capacity shall be at least 1,5 times greater than the increased volume of the thermal oil resulted from its heating to the working temperature. An expansion tank shall be fitted at the highest level of the thermal oil system.

**15.2.2** The expansion tank shall be provided with the level indicator in compliance with the requirements of 5.5.2.

The level indicator shall be marked for the lowest permissible thermal oil level.

**15.2.3** The expansion tank shall be provided with an overflow pipe leading to the oil storage tank or overflow tank.

**15.2.4** The overflow tank shall be provided with the high and low level alarm. When the level of oil is below the permissible limit, the heating of thermal oil shall be automatically stopped.

**15.2.5** The expansion tank of the system in the area of inert gas shall be provided with gauges and safety valves (relief valves).

**15.2.6** Provision shall be made for a device for vapours and gases passing through piping to the expansion tank.

### 15.3 OIL STORAGE TANKS

**15.3.1** Capacity of oil storage tank shall be sufficient to fill up with thermal oil the part of the system having the greatest volume.

**15.3.2** Where the oil storage tank is used for the discharge of thermal oil from the system, its capacity shall be sufficient to accept the discharged thermal oil and the oil storage stated under 15.3.1.

In that case the oil storage tank shall be so positioned as the thermal oil can be discharged from the system into it.

### 15.4 LAYOUT OF PIPES

**15.4.1** The thermal oil pipes shall be laid in compliance with the requirements stated in 1.6 and 8.2.

### 15.5 VENT PIPES

**15.5.1** Vent pipes of the thermal oil tanks shall comply with the requirements stated in 5.1.

### 15.6 ARRANGEMENTS FOR COLLECTION OF THERMAL OIL LEAKAGE AND ITS DISCHARGE

**15.6.1** Arrangements for collection of leakage of thermal oil shall be in compliance with 8.5.

**15.6.2** Where the shut-off device stated in the *Rules for the classification of ships, Part 10 - Boilers, Heat exchangers and Pressure Vessels, 3.5.7,* is not provided with remote control, provision shall be made for quick discharge of thermal oil from the system.

The thermal oil shall be discharged into drain tank or a storage tank specified in 15.3.2.

**15.6.3** Provision shall be made for the exhaust gas boilers that in case of oil thermal leakage is not permitted to enter into the engine.

### 15.7 COOLING OF THERMAL OIL

**15.7.1** Provision shall be made for cooling of thermal oil for the thermal oil systems which are provided with the exhaust gas boilers.

### 15.8 BOILERS FOR HEATING OF THERMAL OILS

**15.8.1** Boilers for heating of thermal oils shall be in compliance with the *Rules for the classification of ships, Part 10 - Boilers, Heat exchangers and Pressure Vessels, 3.5.*

### 15.9 INSULATION

**15.9.1** Insulation of piping and equipment shall comply with the requirements of the *Rules for the classification of ships, Part 7 - Machinery Installations, 1.11.9.*

### 15.10 HEATING OF LIQUID CARGO

**15.10.1** The thermal oil system may be used for heating of liquid cargoes with the flash point lower than 60°C, only if there is an intermediate system located in the cargo zone.

### 15.11 TESTS OF PIPING IN THERMAL OIL SYSTEMS

**15.11.1** The piping of thermal oil system shall be tested in accordance with 17.2 as the fuel oil pipes.

## 16 SCUPPERS, INLETS AND DISCHARGES

### 16.1 GENERAL

**16.1.1** Unless instructed otherwise, the requirements in this Section shall be applied in conjunction with the applicable requirements in 1.5.

**16.1.2** Sufficient number and appropriate size of scuppers are to be provided to allow drainage of water that is likely to accumulate in spaces not located in the ship's bottom.

### 16.2 SCUPPERS AND DISCHARGES

**16.2.1** Except as provided in paragraph 16.2.9, this Regulation applies to each separate discharge led through the shell plating either from spaces below the bulkhead deck of passenger ships and the freeboard deck of cargo ships or from within superstructures and deckhouses on the freeboard deck fitted with doors complying with the requirements in LL 2003 Reg. 12.

The above mentioned discharges shall be provided with one automatic non-return valve fitted with a positive means of closing it from above the bulkhead deck of passenger ships and the freeboard deck of cargo ships.

Where the inboard end of the discharge pipe is located at least 0.01L above the Summer Load Line, the discharge may have two automatic non-return valves without positive means of closing, provided that the inboard valve is situated above the **level of the Tropical Load Line** and is always accessible for examination under service conditions

Where that vertical distance exceeds 0.02L, a single automatic non-return valve without positive means of closing may be accepted.

Where a valve with positive means of closing is fitted, the operating position above the bulkhead deck of passenger ships and the freeboard deck of cargo ships shall always be readily accessible and means shall be provided for indicating whether the valve is open or closed.

**16.2.2** One automatic non-return valve and one sluice valve controlled from above the freeboard deck instead of one automatic non-return valve with a positive means of closing from a position above the freeboard deck, is acceptable.

**16.2.3** Where two automatic non-return valves are required, the inboard valve shall always be accessible for examination under service conditions (i.e. the inboard valve shall be above the level of the Tropical Load Line).

If this is not practicable, the inboard valve need not be located above the Tropical Load Line, provided that a locally controlled sluice valve is fitted between the two automatic non-return valves.

**16.2.4** Where sanitary discharges and scuppers lead overboard through the shell in way of machinery spaces, a locally operated positive closing valve at the shell, together with a non-return valve inboard, is acceptable. The controls of the valves shall be in an easily accessible position.

**16.2.5** The position of the inboard end of discharges shall be related to the Summer Timber Load Line when a timber freeboard is assigned.

**16.2.6** The requirements for non-return valves are applicable only to those discharges which remain open during the normal operation of ship. For discharges which are to be kept closed at sea, a single screw down valve operated from the deck is acceptable.

**16.2.7** The acceptable arrangements of scuppers, inlets and discharges are shown in Table 16.2.7.

**16.2.8** Scuppers led through the shell from enclosed superstructures used for the carriage of cargo shall be permitted only where the edge of the freeboard deck is not immersed when the ship heels 5° either way.

In other cases the drainage shall be led inboard in accordance with the requirements of SOLAS currently in force.

**16.2.9** In machinery spaces, main and auxiliary sea inlets and discharges in connection with the operation of machinery shall 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 shall be provided with indicators showing whether they are open or closed.

**16.2.10** Scuppers and discharge pipes originating at any level and penetrating the shell either more than 450 mm below the freeboard deck or less than 600 mm above the Summer Load Line shall be provided with a non-return valve at the shell.

This valve, unless required by 16.2.8, may be omitted if the piping is of substantial thickness complying with the requirements of 16.3.

**16.2.11** Scuppers leading from superstructures or deckhouses not fitted with doors complying with the requirements of LL 2003 reg. 12 shall be led overboard.

**16.2.12** All shell fittings and valves required by this regulation shall 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 shall be of steel or other equivalent material and in compliance with the requirements of the *Rules for the classification of ships, Part 25 – Metallic Materials*.

### 16.3 SCUPPER AND DISCHARGE PIPES

**16.3.1** Where substantial thickness is not required for scupper and discharge pipes, following shall apply:

- .1 for pipes having an external diameter equal to or less than 155 mm, the thickness shall not be less than 4.5 mm;
- .2 for pipes having an external diameter equal to or more than 230 mm, the thickness shall not be less than 6 mm.

Intermediate sizes shall be determined by linear interpolation or in compliance with table 1.3.4.3, column 4.

**16.3.2** Where substantial thickness is required for scupper and discharge pipes, following shall apply:

- .1 for pipes having an external diameter equal to or less than 80 mm, the thickness shall not be less than 7 mm;
- .2 for pipes having an external diameter of 180 mm, the thickness shall not be less than 10 mm;

- .3 for pipes having an external diameter equal to or more than 220 mm, the thickness shall not be less than 12.5 mm.

Intermediate sizes shall be determined by linear interpolation.

**Table 16.2.7**  
Overboard discharge arrangements

Discharges coming from enclosed spaces below the freeboard deck or on the freeboard deck		Discharges coming from other spaces	
		outboard end > 450mm below FB deck or < 600mm above SWL (see requirements 16.2.10)	otherwise (see requirements 16.2.11)
Discharges coming from enclosed spaces below the freeboard deck or on the freeboard deck  Alternatives (see requirements 16.2.1) where inboard end > 0.02L above SWL	Discharges through machinery space > 0.01L above SWL		
	General requirement see item 16.2.1 where inboard end < 0.01L above SWL	Superstructure or Deckhouse Deck FB Deck SWL	
Symbols: ▽ inboard end of pipes ↘ outboard end of pipes ↙ pipes terminating on the open deck		○ non return valve without positive means of closing ⊗ non return valve with positive means of closing locally ⊕ valve controlled locally	⊥ remote control * / control of the valves are to be in an approved position   normal thickness    substantial thickness

## 17 HYDROSTATIC TESTS

### 17.1 GENERAL

**17.1.1** The piping systems generally and their components are to be a subject to relevant hydrostatic test performed in accordance with the provision of this Section.

**17.1.2** The pneumatic tests are to be avoided as much as possible. Where such testing is absolutely necessary in lieu of the hydraulic pressure test, relevant procedure is to be submitted to the *Register* for acceptance prior to testing.

**17.1.3** The certification requirements for piping systems and their components are summarised in Table 17.1.3.

**17.1.4** Within the scope of testing of piping system components during manufacturing, following shall be included, but not limited to:

- a) bilge and fire pumps are to undergo a performance test.
- b) rotors of centrifugal feed pumps for main boilers are to undergo a balancing test.
- c) centrifugal separators used for fuel oil and lubricating oil are to undergo a running test, normally with a fuel water mixture.

### 17.2 HYDROSTATIC TESTS OF PIPING

**17.2.1** Piping of Class I and Class II (defined in 1.2.3), as well as steam, feed water, compressed air and fuel oil pipes having a design pressure over 0,35 [MPa] (irrespective of Class), after completion and final machining but before insulation and coating shall be subjected to a hydraulic test, in the presence of a Surveyor of the *Register*, with the following test pressure:

$$p_{is} = 1,5 \cdot p \quad [\text{MPa}] \quad (17.2.1-1)$$

where:

$p$  – design pressure (see 1.1.4.2), [MPa].

The test pressure for steel pipes and integral fittings intended for design temperatures over 300°C shall be determined from the following formula:

$$p_{is/t} = 1,5 \cdot \frac{\sigma_{d100}}{\sigma_{dt}} \cdot p \leq 2p \quad [\text{MPa}] \quad (17.2.1-2)$$

where:

$\sigma_{d100}$  – permissible stress at 100°C.

$\sigma_{dt}$  – permissible stress at design temperature.

Where during the test, excessive stress arises in certain lengths of the pipeline, then, in agreement with the *Register*, the value of test pressure as obtained from formula (17.2.1-2) may be reduced to 1,5  $p$ .

In no case shall the stresses arising during the test exceed 0,9 of the yield point of the material at the temperature of testing.

**17.2.2** When, for technical reasons, it is not possible to carry out complete hydraulic tests for all sections of piping, proposals shall be submitted for approval to the *Register* for testing of certain closing lengths of piping, particularly in respect to the closing seams.

In certain circumstances, a combined hydrostatic – pneumatic strength test may also be applied, where the system is partially filled with water and the free space above is pressurized with a test gas (typically air or nitrogen). When pneumatic tests cannot be avoided, the safety precautions in IACS Rec. 140, Part F, are to be observed.

**17.2.3** Pressure testing of small bore pipes (less than 15 mm) of any Class may be omitted at discretion of the *Register*, depending on the application of these pipes.

**17.2.4** All the piping systems shall be checked for tightness in operating conditions in the presence of a Surveyor to the *Register*, except for the heating coils in tanks and liquid fuel lines which shall be tested by 1,5  $p$ , but not less than 0,4 [MPa].

Pneumatic tightness testing may be carried out on water sensitive systems, in lieu of hydrostatic testing.

**17.2.5** In case where hydraulic tests of an assembled piping system are carried out on board, testing of piping for strength and tightness may be combined.

**17.2.6** The plastic pipelines in all piping systems covered by classification, shall be tested in accordance with sub-items no. 1.7.6.9 and 1.7.6.10.

### 17.3 HYDROSTATIC TESTS OF VALVES AND FITTINGS

**17.3.1** The valves and fittings non-integral with the piping system, intended for Class I and Class II piping (defined in 1.2.3) are to be tested in accordance with recognized standards, but testing pressure is not to be less than 1,5 times the design pressure.

Where design temperature is more than 300 °C, testing pressure shall be determined in accordance with 17.2.1.

**17.3.2** The valves and fittings intended for a design pressure of 0,1 MPa and less, as well as for vacuum, shall be tested by a pressure not less than 0,2 [MPa].

**17.3.3** The test pressure for the valves and cocks fitted on hull plating below the load line are to be tested by hydraulic pressure not less than 0,5 [MPa].

**17.3.4** After assembly, the valves and fittings shall be checked for tightness by hydraulic pressure equal to the design pressure.

**Table 17.1.3 – Certification requirements for piping systems and their components**

Item (5)		Tests for the materials (1)		Product certification (1)			
		Tests required (7)	Type of material certificate (2)	During manufacturing (NDT)	After completion	Design approval (10)	Type of product certificate (2)
Raw pipes	class I, ND ≥ 50 class II, ND ≥ 100	[1.2.3] [1.3.1]	C (3)	[1.3.7.1] (4)	[17.2]	DA (13)	C (3)
	class I, ND < 50 class II, ND < 100		W				W (3)
Valves and fittings	class I, ND ≥ 50 class II, ND ≥ 100	[1.2.3] [1.3.1]	C	[1.3.7.1] (4)	[17.3]	DA (13)	C (3)
	class I, ND < 50 class II, ND < 100		W				C (3)
Pipes, valves and fittings: • at ship side • on the collision bulk • in flammable oil tanks, being exposed to static pressure	ND ≥ 100	[1.2.3] [1.3.1]	C (3)	[1.3.7.1] (4)	[17.3.3]	DA (13)	C (3)
	ND < 100	[1.5.4.7]	W				
Prefabricated pipes and piping segments	classes I and II with ND ≥ 65 or t ≥ 10			[1.3.7.1] (6)	[17.2]	DA	C (3)
	classes I and II with ND < 65 or t < 10			[1.3.7.1] (6)	[17.2]	DA (13)	W
	class III if design pressure exceeds 0,35 MP, for media as follows: • flammable oil pipes • steam and feed water • compressed air				[17.2]	DA (13)	W
- Flexible hoses and joints [1.3.1.8], [1.3.8] - Expansion joints [1.3.1.8], [1.3.7.4] - Mechanical joints [1.3.7.4], [1.10]					[1.10], [1.11] [17.2], [17.3]	TA	C (3)
- Plastic pipes and fittings [1.7]; [1.7.7]	essential service	[1.7.5] [1.7.7]	C (3)		[1.7.6.10]	TA	C (3)
	non-essential service	[1.7.2.3] [1.7.7]					
- Air pipe closing devices [5.1.6]						TA	C (3)
Pumps and air compressors which are installed within the piping systems covered by this Part of the Rules  General design requirements specified in the Rules, Part 9, [5.1 & 5.2]	serving a class I piping system	[1.2.3] [1.3.1]	C (3)	[1.3.7.1] (4) (8)	[17.1.4], Pt.9 [5.2.3.1]	DA (11)	C (3)
	serving a class II piping system	[1.2.3] [1.3.1]	W	[1.3.7.1] (4) (8)	[17.1.4], Pt.9 [5.2.3.1]		C (3)
	<b>bilge, fire and ballast pumps</b>	[1.2.3] [1.3.1]	W	[1.3.7.1] (4) (8)	[17.1.4], Pt.9 [5.2.3.1]	DA (11)	C (3)
	feed pumps for main boilers	[1.2.3] [1.3.1]	C (3)	[1.3.7.1] (4) (8)	[17.1.4], Pt.9 [5.2.3.1]	DA (11)	C (3)
	main boilers forced circulation pumps	[1.2.3] [1.3.1]	C (3)	[1.3.7.1] (4) (8)	[17.1.4], Pt.9 [5.2.3.1]	DA (11)	C (3)
	Serving the class III piping systems, where design pressure exceeds 0,35 MP, for media as follows: • flammable oils • steam and feed water • compressed air	[1.2.3] [1.3.1]	W		[17.1.4], Pt.9 [5.2.3.1]	DA (11)	C (3)
	serving a class III piping system in general						W
- Centrifugal separators - general design requirements specified in the Rules, Part 9, [5.4]					[17.1.4], Pt.9 [5.4.2.2]	DA (12)	C (3)
- <b>Fixed fire-extinguishing systems (water / foam / powder / gas based)</b>					[17.2], [17.3]	TA (14)	C / W (15)
- <b>Equivalent fixed fire-extinguishing systems (water / gas based)</b>					[17.2], [17.3]	TA (14)	C / W (15)

Table 17.1.3 - continued

**Certification requirements for piping systems and their components**

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|---|
| <p>(1) [x.y.z] = test required, as per referent regulation. In general, the material are to comply with 1.2.3 and 1.3.1</p> <p>(2) C = class certificate; W = works' certificate</p> <p>(3) or alternative type of certificate, acceptable for the <i>Register</i> depending on the Survey Scheme</p> <p>(4) for welded construction.</p> <p>(5) ND = Nominal diameter of the pipe, valve or fitting, in [mm], t = thickness in [mm]<br/>Class of piping systems is to be determined as defined in 1.2.3</p> <p>(6) for welded connections.</p> <p>(7) where required by the table, material tests are to be carried out for the components subject to pressure, such as valve body, pump and compressor casings, etc. They are also to be carried out for the assembling bolts of feed water pumps and forced circulating pumps serving main boilers. Requirements for material testing are detailed in the <i>Rules for the classification of ships, Part 25 – Metallic Materials</i>.</p> <p>(8) for main parts, before assembling.</p> <p>(9) for other pumps and compressors, see additional Rules relevant for related system.</p> <p>(10) TA = Type Approval is required; DA = Design assessment of the product is required, which may be carried out either for a specific unit or within the scope of Type Approval.</p> <p>(11) if not already addressed within the scope of the piping system approval.</p> <p>(12) as per separators technology - applicable only to pressure vessels as part of Class I and Class II piping systems.</p> <p>(13) for valves, pipes and fittings built in accordance with a recognised standard DA is not required.</p> <p>(14) the approval system documentation shall be provided by the holder of the TA class certificate. In the case of a discrepancy between the provisions of the applicable International and National statutory regulations and those of the <i>Rules of the Register</i>, normally the former take precedence. A valid certification to MED 2014/90/EU is to be recognised for classification purpose.</p> <p>(15) certification as per conditions set in TA and/or in 17.2, 17.3.</p> |
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