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DISTANCE LEARNING MATERIAL FOR SEMESTER 5

## INDIAN MARITIME UNIVERSITY

(A Central University under the Ministry of Shipping)

# DISTANCE LEARNING MATERIAL
# for
# SEMESTER 5

DNS Leading to B.Sc
(Applied Nautical Science)

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## DISTANCE LEARNING MATERIAL
## for
## (SEMESTER 5)

## DNS leading to
## B.Sc. (Applied Nautical Science)

## First Edition, 2013



This Deck Cadet Training Manual has been designed by Anglo Eastern Ship Management Ltd. for Indian Maritime University.

This manual contains the learning material for shipboard tasks for the DNS leading to B.Sc. – Nautical Science Course function 1, 2, 3 in semester 5 as mentioned in Deck Cadet Structured Shipboard Training Programme Record Book.
Function 1. Navigation
Function 2. Cargo Handling and Stowage
Function 3. Controlling the operation of the ship and care for persons on board and Ship Security



While the advice given in this manual has been developed using the best information currently available, it is intended purely as guidance to be used at the user's own risk. No responsibility is accepted by Indian Maritime University and Anglo Eastern Ship Management Ltd or by any person, firm, corporation or organization who or which has been in any way concerned with the furnishing of information or data, the compilation, publication or any translation, supply or sale of this book, for the accuracy of any information or advice given herein or for any omission here from or from any consequences whatsoever resulting directly or indirectly from compliance with or adoption of guidance contained herein even if caused by a failure to exercise reasonable care.

## Acknowledgements

The Indian Maritime University gratefully acknowledges the assistance provided by the following in the development of the Cadet Record Book.:

- Capt. Pradeep Chawla, Managing Director, Group QHSE and Training, Anglo-Eastern Ship Management
- Capt. K. N. Deboo, Director and Principal, Anglo-Eastern Maritime Training Centre
- Capt. Karamjit Singh Sodhi, General Manager- Competence Management, Anglo-Eastern Ship Management
- Capt. Vinayak Mohla, Manager - Competency and Recruitment, Anglo-Eastern Maritime Training Centre
- Capt. Yashpal Sharma, Training Superintendent, Anglo-Eastern Ship Management
- Mr. Shishir Bhatnagar, Training Superintendent, Anglo-Eastern Ship Management
- Anglo Eastern Maritime Training Centre

# General guidelines

The purpose of Deck Cadet Structured Shipboard Training Programme is to help ensure that a Cadet is enabled to and makes the best use of the time at sea. The programme lists practical tasks required to be carried out on board, in accordance with the STCW 2010 provisions relating to minimum standards of competence for officers, particularly in charge of a navigational watch on ships of 500 gross tonnage or more (STCW 2010 - Code Table A-II/1).

STCW A-II/1 provides the framework of the competencies that each watch-keeping deck officer needs to be competent in. Each such competence is sub-divided into a number of tasks. The deck cadet structured shipboard training programme has a list of tasks which have to be practically performed on board the ship.

This Distance learning material is to be used in conjunction with the Cadet Record Book and the Activity Workbook approved by IMU and the Directorate General of Shipping, India for use by the DNS leading to B.Sc. Nautical Science Deck Cadets as part of their Structured Shipboard Training Programme.

This deck cadet training manual contains the learning material for all the associated tasks for function 1 (Yellow), 2 (Green), 3 (Blue) of semester 5 and must be referred to by the cadet when performing the tasks.

The objective of the training material is to consolidate the learning material from various sources in one place for ready reference of the cadet. The learning material provided in this manual will assist the cadet in better understanding and completion of the tasks successfully.

Each task is explained as per the format given below:

- Function
- Competence
- Task number
- Sub task reference number
- Topic
- Task heading
- Objectives
- Index
- Description
- Apply Your Knowledge

The assessment method used in the deck cadet structured shipboard training programme is on board assessment by the Shipboard Training Officer (STO). The assessment tools are practical demonstration and oral questioning by the STO. Oral questioning is a common assessment technique, which is not time consuming and responses to oral questions provide useful evidence of a cadet's technical knowledge and understanding of shipboard procedures and safety requirements.

The purpose and intention is that a cadet should read and understand the learning material provided in this manual and thereafter discuss the relevant task with the STO in order to obtain clarification, confirmation or supplementation as needed prior executing the task.

The Activity Workbook, which is a supplement to this training programme, contains the written assessments for relevant tasks. Completion of tasks requiring documented evidence, such as calculations, lists or procedures are to be recorded in the Activity Workbook to ensure a written record of tasks carried out on board.

## FOREWORD BY THE VICE CHANCELLOR

After the revision of syllabus, the students of the Diploma in Nautical Science (DNS) programme leading to B.Sc. (Nautical Science) were in immediate need of Distance Learning Material (DLM) to use on-board during their 18 months of Structured Shipboard Training Programme (SSTP).

Anglo Eastern Maritime Training Centre, through its team led by Captain K N Deboo, has taken great pains to prepare the DLM for the common benefit of all DNS students of the Indian Maritime University's Campuses and its various Affiliated Institutions. The DLM consists of three volumes, one each for the 3$^{rd}$, 4$^{th}$ and 5$^{th}$ semesters, and has been approved by the Academic Council of IMU. It has been written in a simple and lucid manner with plenty of diagrams. I am sure the cadets will find the DLM very useful to gain a proper understanding of the various tasks that they are required to perform on board the ship as per STCW requirements. I would like to commend Captain K. N. Deboo and his team for their excellent work.

Anglo Eastern Maritime Training Centre has been good enough to grant NOC to IMU to print and distribute the DLM. IMU is distributing the DLM *free of cost* to all DNS students of IMU's Campuses and its various Affiliated Institutions.

Vice Chancellor, Indian Maritime University.

# Preface

Anglo-Eastern Maritime Training Centre has developed the 'Deck Cadet Distance Learning Manual', covering learning material for semesters 3, 4, and 5 of the "Diploma in Nautical Science leading to a BSc (Applied Nautical Sciences) degree" course of the Indian Maritime University. This material is written so as to be self-explanatory and forms as the Distance Learning Material (DLM) for the cadets to use on board during their 18 months of structured shipboard training programme.

The Distance Learning material comprises of 3 manuals, one for each semester. Each manual is further divided into functions as per STCW 78 as amended in 2010, Section A-II/1and A-VI/6-1:
Function 1: Navigation
Function 2: Cargo Handling and Stowage
Function 3: Controlling the operation of the ship and care for persons on board including ship security

The purpose of "Deck Cadet Structured Shipboard Training Programme (SSTP)" is to help ensure that a Cadet is enabled to and makes the best use of the time at sea. The programme lists practical tasks required to be carried out on board, in accordance with the STCW 2010 provisions relating to minimum standards of competence for officers, particularly in charge of a navigational watch on ships of 500 gross tonnage or more (STCW 2010 - Code Table A-II/1).

STCW A-II/1 provides the framework of the competencies that each watch-keeping deck officer needs to be competent in. Each such competence is sub-divided into a number of tasks. The Deck Cadet Structured Shipboard Training Record Book contains a list of tasks which have to be practically performed on board the ship. This Record book alongwith the Activity workbooks have been developed by GlobalMET © and approved by the Indian Maritime University and Directorate General of Shipping for use during the Structured Shipboard Training programme of the DNS leading to BSc (N.S,) course.

The objective of the learning material is to consolidate the learning from various sources in one place for ready reference of the cadet. The authors of this manual have taken great pains to provide the text, written in a simple lucid manner with the help of numerous diagrams and sketches. The learning material provided in this manual is tagged to each task mentioned in the Deck Cadet Record Book so that the cadet can first gain the under-pinning knowledge and have the full understanding of the task prior actually going and performing it. Today the officers on board a ship are extremely busy with their work and find little time to teach the cadet. Hence this DLM material becomes all the more important as it assists the cadet in gaining the complete knowledge and understanding of the topic before he goes on to perform the task and complete it successfully.

Each task as given in the Deck Cadet Structured Shipboard Training Programme Record Book (GlobalMET ©) is explained as per the format given below:

- **Function**
- **Competence**
- **Task number**
- **Sub task reference number**
- **Topic**
- **Task heading**
- **Objectives**
- **Index**
- **Description**
- **Apply Your Knowledge**

The assessment method used in the deck cadet structured shipboard training programme is on board assessment by the Shipboard Training Officer (STO). The assessment tools are practical demonstration and oral questioning by the STO. Oral questioning is a common assessment technique, which is not time consuming and responses to oral questions provide useful evidence of a cadet's technical knowledge and understanding of shipboard procedures and safety requirements.

The purpose and intention is that a cadet should read and understand the learning material provided in this publication and thereafter discuss the relevant task with the STO in order to obtain clarification, confirmation or supplementation as needed prior executing the task.

The Activity Workbook (GlobalMET ©), which is a supplement to the SSTP, contains the written assessments for relevant tasks. Completion of tasks requiring documented evidence, such as calculations, lists or procedures are to be recorded in the Activity Workbook to ensure a written record of tasks carried out on board

Anglo-Eastern is pleased to provide these manuals to the Indian Maritime University (IMU), as we hope that with its use, the cadets will benefit from it and these cadets when they become officers will uphold the good reputation that seafarers have carved for themselves in world shipping.

Capt.K.N.Deboo
Director and Principal
Anglo-Eastern Maritime Training Centre

**First Edition, 2013**



# ACKNOWLEDGEMENTS

Indian Maritime University gratefully acknowledges the effort and contribution of the following in the preparation of this Distance Learning Material:

- Capt. Pradeep Chawla, Managing Director, Group QHSE and Training, Anglo-Eastern Ship Management Ltd.
- Capt. K. N. Deboo, Director and Principal, Anglo-Eastern Maritime Training Centre, Mumbai
- Capt. Karamjit Singh Sodhi, General Manager- Competence Management, Anglo-Eastern Ship Management
- Capt. Vinayak Mohla, Manager- Competency and Recruitment, Anglo-Eastern Maritime Training Centre, Delhi
- Capt. Varun Rawat, Master, Anglo-Eastern Ship Management
- Mr. Yashpal Sharma, Training Superintendent, Anglo-Eastern Ship Management
- Mr. Shishir Bhatnagar, Training Superintendent, Anglo-Eastern Ship Management
- Faculty and staff of Anglo Eastern Maritime Training Centre
- Faculty of Anglo-Eastern Maritime Academy

**This manual contains Distance Learning Material for Semester 5**

- Function 1 - Navigation
- Function 2 - Cargo Handling and Stowage
- Function 3 - Controlling the operation of the ship and care for persons on board including Ship Security

# Semester 5

## Function 1: Navigation

| Sr. No. | Topic | Task No. | Task Description | Page No. |
|---|---|---|---|---|
| | systems | | reporting points on the chart. | |
| | | A2.3.4 | Carry out necessary communication and reporting to the VTIS. | |
| 24. | Bridge resource management | A2.4.2 | Recognize the role of the Pilot in the bridge team. | 106 – 109 |
| | | A2.4.4 | Demonstrate understanding of the concept of challenge and response during questionable decisions and/or actions on the bridge. | |
| | | A2.4.5 | Respond to Master's and Pilot's orders when using engine. | |
| 25. | Bridge resource management | A2.4.3 | Attend bridge team meetings | 110 – 112 |
| 26. | Radar/ ARPA checks, set up procedures and operational use | A3.1.9 | Perform the changeover of the display from sea stabilized to ground stabilized mode. Recognize the advantages and disadvantages of both. | 113 – 115 |
| | | A3.1.10 | Check heading line marker alignment with fore and aft line of the vessel. | |
| 27. | Using radar/ ARPA for collision avoidance | A3.2.6 | Demonstrate understanding of the use of true and relative trails. | 116 – 117 |
| | | A32.8 | Demonstrate ability to detect course and speed changes of other ships. | |
| | | A3.2.10 | Identify advantages and disadvantages of using true and relative vectors. | |
| 28. | Using radar/ ARPA for collision avoidance | A3.2.7 | Carry out manual radar plotting | 118 – 121 |
| 29. | Using radar/ ARPA for collision avoidance | A3.2.9 | Understanding and practicing Trial Maneuvers on Radar | 122 |
| 30. | Use of ECDIS | A4.1.8 | Demonstrate understanding of setting of safety depth/spot soundings. | 123 – 128 |
| | | A4.1.9 | Identify the various inputs to the ECDIS. Select radar and AIS input to the ECDIS and use data provided. | |
| | | A4.1.10 | Confirm vessel position by alternative means. | |
| 31. | Emergencies in port | A5.2.6 | Demonstrate understanding of the contents of vessel's Shipboard Oil Pollution Emergency Plan (SOPEP) | 129 – 134 |
| | | A5.2.7 | Demonstrate understanding of the procedure for alerting port emergency services. | |
| 32. | Distress signals | A6.1.10 | Demonstrate understanding of procedures for cancelling a false distress alert. | 135 – 137 |
| 33. | Distress signals | A6.1.11 | Make entries in the GMDSS log book under supervision. | 138 – 140 |
| | | A6.1.12 | Record the communications, information and actions, including routine equipment checks, in the GMDSS log book. | |
| 34. | Use of English in written and oral form | A7.2.6 | Supervise ratings and communicate with the bridge in English during anchoring, mooring and unmooring operations. | 141 – 144 |
| 35. | Maneuvering information | A9.1.5 | Demonstrate understanding of squat, shallow water and similar effects. Calculate squat for a coastal passage at full speed (open and confined channel). | 145 – 148 |
| 36. | Anchoring and mooring procedures | A9.2.14 | Assist inspection of chain locker. | 149 – 151 |

**Function:** Navigation

**Competence:** Plan and conduct a passage and determine position

**Task number:** A1.4

**Sub-task Reference number:** A1.4.1, A1.4.2, A1.4.3, A 1.4.4

**Topic:** Passage planning

**Task Heading**

- Assist selection of charts and publications for an intended voyage.
- Assist planning of voyage from berth to berth in three legs i.e. berth to pilot, pilot to pilot and pilot to berth. Set courses on Chart.
- Compare a large scale chart with a small scale chart covering same area. Recognize that many details and dangers may not be marked on small scale charts
- Use a gnomonic chart for planning an ocean crossing track and transfer the track to Mercator charts

**Objectives**

- To understand the procedure of passage planning with through understanding of the principles

**Index**

1) Guidelines for passage planning
2) Stages of passage planning
3) Sample format for passage plan
4) Summary chart for passage planning

**Description**

**1) Guidelines for passage planning**

- Passage plan shall be comprehensive, detailed and easy to interpret. The passage plan shall establish priorities and clearly delegate responsibilities to assist watchkeeping officers well in advance. It shall allow the passage to be continuously monitored.

- The complete passage from berth to berth shall be planned providing adequate details along with contingency plans wherever appropriate. The plan may be sub-divided into three parts for easy interpretation, estimations and calculations, the three parts being
  - Departure port berth to pilot dropping point,
  - From departure port pilot to destination port pilot and
  - From destination port pilot to berth.

- The detailed passage plan shall be ready prior vessel's departure. The same shall be approved by the master. If the port of destination is not known or is subsequently altered, the original plan shall be extended/ amended as appropriate.

- There are several factors that may affect the safe navigation of vessels and furthermore factors that may affect the navigation for large vessels or vessels carrying hazardous cargoes. These factors shall be taken into account while preparing the plan and in the subsequent execution and monitoring.

- ➢ The details of the passage plan should be clearly marked and recorded, as appropriate, on charts and in a voyage plan notebook and computer disk.

- ➢ The nautical institue publication "Bridge Team Management" is recommended to be used for passage planning and monitoring . Passage planning forms and checklists are provided in the company SMS manuals which shall be used.

**2) Stages of passage planning**

Passage planning involves four stages as follows:

- **Appraisal**

- ➢ Appraisal is the process of gathering all information relevant to the proposed voyage, including ascertaining risks and assessing its critical areas. Appraisal provides the bridge team a clear and precise indication of all areas of danger, and delineates the areas in which it will be possible to navigate safely. This facilitates a balanced judgment of the margins of safety which must be allowed in the various sections of the intended voyage bearing in mind the condition of the vessel, her equipment and other related circumstances. Prior preparing the passage plan, the navigating officer shall be aware of the following in relation to the intended voyage. The appraisal stage of the passage planning shall be commenced as soon as orders for the next voyage are received.

- ➢ The current condition and state of the vessel, its machinery and equipment along with any operational deficiencies; vessel's loading condition, draught, stresses and stability, and effect of the same on the maneuvering characteristics of the vessel; the nature of cargo and its distribution on board, any hazardous cargo if on board and stowage & securing on board the vessel;

- ➢ The availability of appropriate up-to-date charts and their scale and availability of publications for the voyage; These shall be available to cover the complete intended route and the possible ports enroute which might be called for bunkers/supplies or as port of refuge; Publications including sailing directions, lists of lights, lists of radio signals, mariners' routeing guides, passage planning charts, current and tidal atlases, tide tables etc. and previous passage plans from the vessel's records; the status of last updating through relevant permanent or temporary notices to mariners and radio navigational warnings in force;

- ➢ Recommended publications/ documents to be used for passage planning include:
  - Catalogue of admiralty charts and publications (NP131)
  - Paper chart maintenance record (NP133A)
  - Weekly notices to mariners
  - Cumulative list of admiralty notices to mariners (NP 234A and NP 234B)
  - Annual summary of admiralty notices to mariners (NP 247)
  - Standard nautical charts
  - Load line chart (D6083)
  - The world time zone chart
  - Admiralty routeing charts (NP5124-28)
  - Admiralty routeing guides (NP5500-03)
  - Gnomonic charts
  - Symbols and abbreviations used on admiralty charts, chart 5011 (INT 1)
  - Ocean passages for the world (NP136)
  - Admiralty list of radio signals (NP281 – 286)
  - Admiralty list of lights and fog signals (NP74- 85)
  - Admiralty distance tables (NP350 1-3)
  - Admiralty tide tables (NP 201-204)

- Admiralty tidal stream atlases
- Admiralty manual of tides (NP120)
- Admiralty tidal handbooks (NP122 1-3)
- Co-tidal and co-range charts
- The mariner's handbook (NP100)
- Bridge procedures guide
- Bridge team management - a practical guide
- Ship's routeing
- Nautical tables
- Guide to port entry
- Company specific passage planning guidelines from SMS manuals
- Previous passage plans

➢ On vessels fitted with approved ECDIS equipment, the type of charts raster or vector, their use and limitations, the scale of chart available (limitations such as under/over scaling), the status of last update of charts, and the areas for which the approved charts are not available. Systems that use unofficial chart data should not be used for voyage planning or navigation.

➢ Climatological, hydrographical, and oceanographic data as well as expected meteorological conditions and available information, availability of weather routeing services; Attention is drawn to the routes/areas which might require to be omitted due to prevailing weather/ ice conditions or the routes which might need to be modified for prevailing weather conditions.

➢ Ship's routeing and reporting systems, vessel traffic services likely to be used enroute

➢ Expected traffic conditions likely to be encountered on the passage, sea areas being used for specific marine activities such as naval practices etc.

➢ Areas enroute where services of a pilot are required to be used, information relating to pilotage and embarkation and disembarkation including the exchange of information between master and pilot

➢ Information regarding ports of call, including information pertaining to the availability of shore-based emergency response arrangements and equipment

➢ Marine environmental protection measures with reference to sea areas and local / international regulations, MARPOL special areas, particular sensitive sea areas (PSSA), emission control areas (ECA) and other areas having local environmental regulations (e.g. USA, Ukraine, EU, etc.)

➢ Limitations, if any, due to crossing load-line zones

➢ Special areas such as piracy prone areas falling enroute which require special safeguards such as speeding up of the vessel or other security preparations

- **Planning**

All appropriate information available shall be utilized by the navigational staff to the optimum extent. The detailed passage planning includes the following:

➢ The charts for intended voyage shall be selected from the admiralty chart catalogue, considering the points mentioned above. Due care shall be given to the destination ports. It might happen that the ports of same name are found in different countries. Hence the destination port shall be confirmed using the co-ordinates and/or countries.

- Use of 'Ocean Passages for the World' and 'Routeing Charts' is recommended for planning the open sea ocean passages. For the costal navigation, the 'Admiralty Sailing Directions' shall be used. Sailing directions, also referred to as pilot books, provide essential information on all aspects of navigation in the coastal regions. These are complementary to standard nautical charts and provide colour photography and views of the coasts, information on navigational hazards, buoyage, meteorological data, and details of pilotage, regulations, port facilities and guides to major port entry.

- The intended track of the passage clear of all underwater dangers shall be laid off on appropriate small scale charts first and later transferred to large scale charts. The courses shall be charted with sufficient overlap while transferring courses from one chart to another. Positions from one chart to another shall be transferred preferably using range and bearing from fixed charted targets instead of using latitude/ longitude scale. The planned track should be plotted clear of hazards at as safe a distance as circumstances allow without overlooking the possibility of main engine or steering gear breakdown at a critical moment.

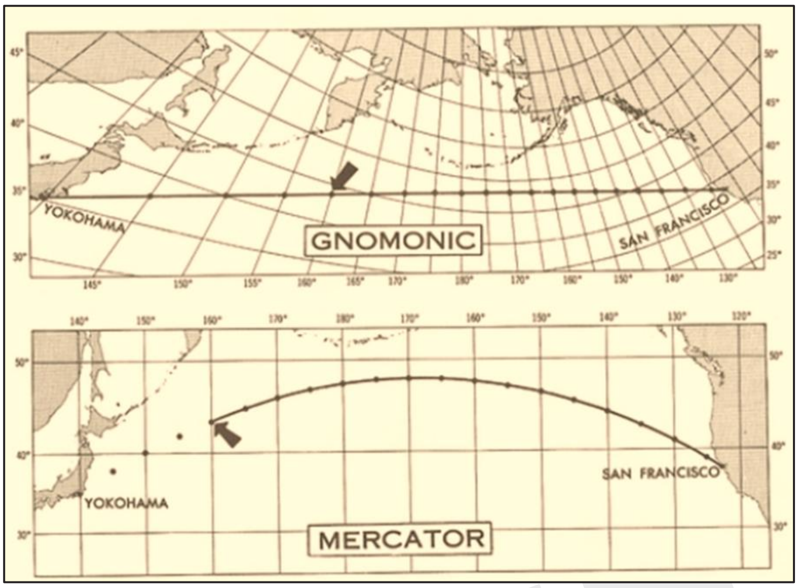
- True direction of the planned course along with the distance to steam shall be indicated against each voyage leg. The areas unsafe for navigation shall be marked as No-Go Areas and highlighted. The underwater dangers, wrecks, shoals etc. shall be highlighted.

- While selecting the route for the passage from pilot point to pilot point, the factors to be considered are:
  - Distance on the selected route and expected steaming time in prevailing weather conditions,
  - Expected bunker consumption, and further availability of bunkering ports enroute for replenishment if required
  - Recommended routes from Ocean passages for the world, sailing directions and routeing charts
  - Expected weather, including ice, in relation to vessel's condition, cargo and crew convenience
  - Proximity of navigational hazards, offshore activities and political/hostile conditions
  - In case of ballast voyages, the planned operations such as hold cleaning/ tank cleaning etc. to be done enroute and the restrictions of special areas in this regard
  - Advise of routeing services/ requirements of charterers/ owners/ managers

- A detailed route plan shall be prepared in the form of a way – point chart. The detailed information regarding various passage legs is mentioned against each route leg. The formats are generally provided in the company specific SMS manuals. A sample format is shown as follows:

| **Waypoint** | | | **Reference Mark** | **Charts** | | **Course** | **Speed/ Engine Order** | **Distance To Go** | | **Time To Go** | | **Minimum Depth** | **Position fixing (Visual Radar GPS)** | | | **Set & Drift** | | **Expected weather** | **Remarks/ Hazards/Contingencies** | **Master's instructions** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **No.** | **Lat.** | **Long.** | | **No.** | **Datum of chart** | | | **To next waypoint** | **Total** | **To next waypoint** | **Total** | | **Frequency** | **1st** | **2nd** | **Set** | **Rate** | | | |
| | | | | | | | | | | | | | | | | | | | | |

- While filling up entries in the above waypoint chart, the following points shall be considered:




- The waypoint number used for each point of course alteration shall be saved in the GPS and mentioned on the chart for quick reference. The same number shall be mentioned in the above way point chart along with the geographical co-ordinates of the same. The first waypoint shall start from the berth, lasting up to the destination port berth as last waypoint.

- Each waypoint shall be given a prominent identification mark for easy reference and noted. This could be a light house, a light buoy, or a prominent island or famous shoal patch.

- The charts to be used for the voyage leg shall be recorded in the above chart along with the chart datum on which the chart is drawn. In cases where the charts of different datum are used, cautionary note shall be marked in the chart and the remarks column of above waypoint chart, mentioning the applicable correction to positions derived from GPS (WGS84 datum).

- The courses and distances between subsequent waypoints is calculated and recorded on charts and above way point chart. Short distances can be picked up from the chart; however, long distances shall be calculated manually.

- While plotting courses across the oceans, great circle sailing is preferred amounting to shortest distances. Gnomonic charts are used to plot great circle courses between the departure and arrival positions, as straight lines. Positions are then taken off at convenient intervals of longitude along this track. These positions are then transferred to a Mercator chart and rhumb line courses are laid off between the successive positions. By sailing along these rhumb lines the track followed will be very close to the actual great circle course without having to change course continuously as would have been necessary, if following a true great circle.

- Safe speed for each voyage leg shall be determined considering the expected state of visibility, expected traffic density, maneuverability of the vessel with special reference to stopping distance and turning ability in the prevailing conditions, expected state of wind, sea and current, and the proximity of navigational hazards, the draft in relation to the available depth and width of navigable water, background lights and availability of operational radar. Speed might need to be altered in specific areas for night passage or while transiting piracy prone areas.

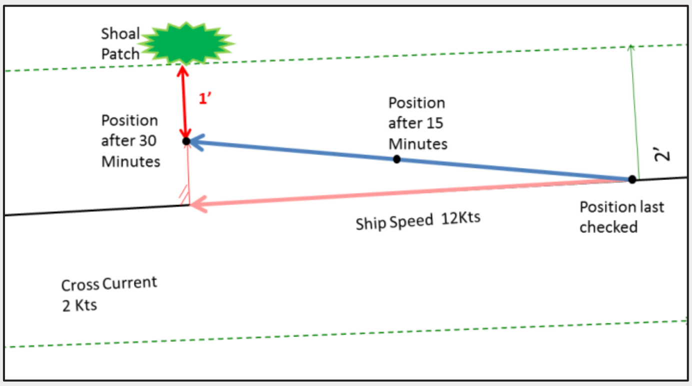
- The positions shall be duly marked on the charts where engine room is to be notified for arrival procedures at port.

- The time to go and ETAs to the pilot points, critical waypoints and other important points as reporting points shall be estimated on the basis of distance and planned speed. Due care shall be taken for the times to be advanced/retarded for time zones across the passage while calculating ETAs.

- In determining the minimum safe depth for navigation the following factors shall be among those taken into account. Based on these considerations the minimum charted depth for the route leg shall be checked and mentioned in the above waypoint chart.
  - ❖ Maximum Draft
  - ❖ Under-keel clearance required
  - ❖ Estimated squat at the planned speed
  - ❖ Height of tide
  - ❖ Estimated increase in draft due to heel while turning
  - ❖ Effect of prevailing weather and sea state
  - ❖ Date of last bottom survey as mentioned on the chart

- The available options for checking vessel's position (visual, radar, GNSS and astronomical fixes) in the route leg shall be checked and mentioned on the waypoint chart. The frequency of position fixing should be such that the vessel does not run into danger during the interval between fixes. The estimated position on the basis of predetermined position fixing interval shall be calculated and projected ahead. Same shall be checked if it allows sufficient time to review the forthcoming hazards. The position fixing frequency shall be determined considering
  - ❖ Proximity of navigational hazards,
  - ❖ Speed of the ship
  - ❖ Draught and displacement
  - ❖ Environmental factors

A vessel is proceeding at 12 kts as shown in picture, navigating through an area where the current is setting across at 2 kts, unknown to navigator. It is intended to pass the shoal patch at a range of two miles. However, the vessel is likely to end up passing it at only 1' range for not checking the position for 30 minutes from the last known position. Better option would be checking the position of the vessel at 15 minutes interval which shall warn the navigator regarding the drift and she can apply corrective helm to pass the shoal patch as planned or at comparatively safer limits.




- Expected sate and rate of current and the effect of the same on vessel's movement shall be duly noted. Locations/ ports bound by tidal restrictions shall be duly marked and information regarding the same shall be readily available.

- Expected weather information as per the latest weather reports and forecasts, and that mentioned in sailing directions, routeing charts and ocean passages shall be noted. Special caution is required for navigation in areas and seasons where tropical / mid latitude disturbances prevail. Vessel needs to be prepared for heavy weather / ice conditions accordingly.

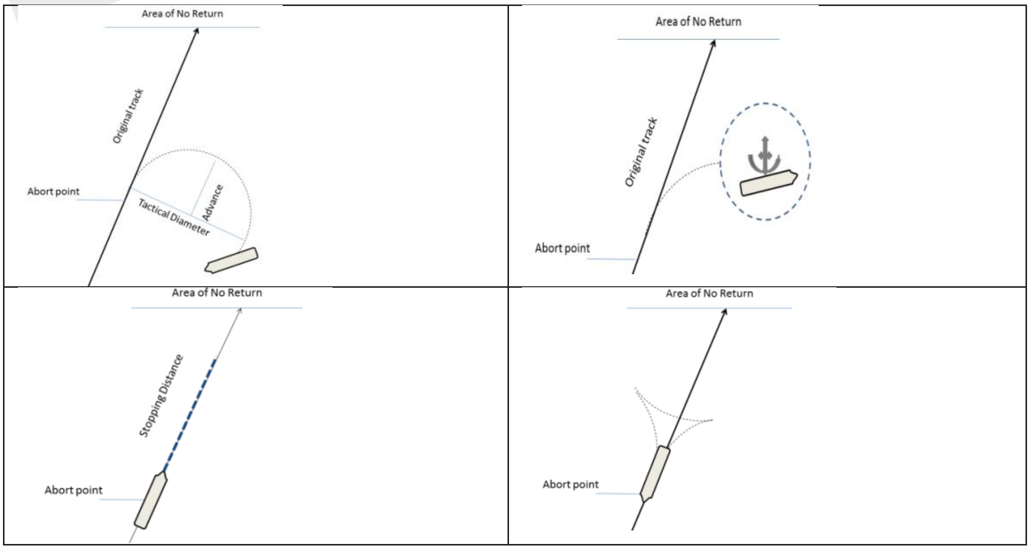
- Contingency plans shall be prepared for alternative action to place the vessel in deep water or proceed to a port of refuge or safe anchorage in the event of any emergency necessitating abandonment of the plan, taking into account existing shore-based emergency response arrangements and equipment and the nature of the cargo and of the emergency itself.

- Contingency plan shall be prepared by doing a detailed passage planning risk assessment for the area. The contingency plan shall be ready for use while planning the passage in restricted waters, detailing the actions to be taken in the worst possible situations. If detailed planning for such situations has been done in advance, the response of the bridge team to any such situation will be better than a panic reaction taken when no thoughts have been given earlier for such problems. The conditions which need such planning may include
    - Poor visibility
    - Heavy radar clutter
    - Missing buoys, or buoys not picked up on the radar
    - Steering or engine breakdown
    - Blackout
    - Alternative routes if the normal route is unavailable

In areas of navigation where proximity of hazards make navigation critical, in case of malfunctioning of the ship's equipment or machinery due to which the ship becomes unable to continue navigation further, Abort points are marked on the planned track. Abort point is a point on the planned track from where the ship can deviate or return to a safe position until she is ready for safe navigation again.

- Depending upon the proximity of navigational hazards, the contingency plans shall be ready suitable in the area of navigation. Prior planning route in areas of critical conditions, abort points and point of no return shall be established and marked on the charts. Abort points shall allow the ship to turn around/ deviate to a safe sheltered area, preferably anchorage with good holding ground, clear of underwater dangers and free of traffic. While deciding on abort point, the turning circle of the vessel shall be considered in relation to available sea room.

- Wheel over positions shall be marked on the chart paying particular attention to the maneuvering characteristics of the vessel. This becomes extremely important in sea areas where huge alterations in course are made and the available sea room is limited. Monitoring the course alterations becomes more convenient in locations where a shore target (a light house) is available for reference.



- Where a radar-conspicuous navigation mark is available, Parallel indexing shall be used to continuously monitor the vessel's position relative to such an object. The parallel index lines are drawn parallel to the course line identifying the clear distance that is planned to be maintained for the nearest land target called the CIR (Cross Index Range). It also serves as a valuable check on the vessel's progress when using an electronic chart. Charts shall be marked as appropriate where parallel indexing can be utilized.

- If the planned route involves transits through canals / straits such as Suez, Panama, Turkish straits, the detailed information regarding the convoy timing, restrictions, reporting and other procedures shall be clearly noted from the relevant publications and the transit shall be planned accordingly. Marine routeing guidance charts covering various congested areas e.g. Singapore Straits, Dover Straits, Gulf of Suez, etc. must be studied and used.

- Areas requiring marine environmental protection considerations shall be duly marked on the chart.

- Suitable approaches to the ports and harbors shall be decided paying due regard to the local national requirements of the ports, general procedures adopted for anchoring, reporting and pilotage. The available depths and width of channels, any tidal restrictions and locks, availability and reliability of navigation marks and buoys, availability of tugs etc. shall be given due consideration to the safety of navigation.

- In pilotage waters, the plan for the pilotage waters shall be amended as required after discussing with the pilot. The plan for berthing / unberthing, approach/ depature from berth and mooring plan shall be discussed with the pilot and preparations made accordingly. Use of anchor while turning, availability of tugs and their power shall be corss checked with the pilot to meet the vessel’s requirements as needed.

- Depending upon the reason and expected duration of stay, suitable anchorages shall be selected and marked in the vicinity of port. Anchor plan shall be prepared depending upon the size of vessel, draft and depth, nature of anchoring ground, type of anchor, expected weather conditions, and available sea room for swinging.

- Guide to port entry is a comprehensive port guide information resource. These feature data for ports worldwide which is authenticated by the authorities and agents. The details are provided for individual ports. The use of guide to port entry is recommended from the operational and commercial aspect of the ship’s call. This includes the arrival procedures, reporting requirements, available local vessel husbandry facilities and the details of cargo handling facilities etc.

- Mariner’s routing guide charts are available which are recommended to be used for certain specific sea areas. Routeing Guides provide important passage planning information in addition to details of traffic separation schemes for the major shipping areas of the English Channel, North Sea, Baltic, Gulf of Suez, Malacca and Singapore Straits.

- The information on chart shall not obscure any of the printed information for the area. Overcrowding of information in the working areas of the chart can be avoided by recording the information away from the track and drawing attention to it by a line or reference letter.

- Passage planning on electronic charts is carried out in a similar way to paper charts to identify radar conspicuous targets, no-go areas, parallel index lines (essential for the monitoring stage), transit marks, clearing bearings, etc. It is prudent for a simulated passage to be run prior to the vessel’s departure to ensure that the route does not enter any alarm preset danger areas that may have been overlooked.

- Companies may specify particular ship types to maintian certain distance from the nearest coastline while navigaing close to coast. Same shall be considered while charting courses.

- Due consideration shall be given to transit through areas where the local regulations are in force for specific purposes. Example is right whale reporting areas, where it is treated illegal to approach any right whale closer than 500 yards.

- **Execution**

Execution and monitoring are simultaneous processes. The passage as planned is followed and the vessel's progress along the planned track is is continuously monitored for any deviations observed or alterations if required.

- Having finalized the passage plan, as soon as time of departure and estimated time of arrival can be determined with reasonable accuracy, the passage should be executed in accordance with the plan.

- Bridge shall be organized systematically. All watch-keepers shall be briefed regarding the particular voyage and associated navigation, preferably in the Bridge Team Meeting.

- The composition of the bridge watchkeeping team shall be carefuly checked. Suffiecient number of personnel shall be allotted depending upon the navigational situation. The situations may require posting of extra lookouts, helmsmen on bridge. The watchkeeping officers and crew shall be well-rested in accordance with applicable STCW regulations. Companies may have watch arrangements levels specified for different navigation stuations which shall be complied with.

- Factors to be taken into account when executing the plan include
  - condition and reliability of the vessel's navigational equipment
  - ETA at critical points for tide heights and flow
  - Meteorological conditions and forecast, as well as weather routeing information
  - Daytime versus night-time passing of danger points, and any effect this may have on position fixing accuracy
  - Traffic conditions, especially at navigational focal points

- Vessel's position shall be cross checked regularly by all available means. Over reliance on only one means may prove dangerous. The options available include observations through terrestrial, celestial and electronic means.The following symbols are recommended for marking position fixes

GPS Fix: △
Radar / Visual Fix: ⊙
DR Position: X

- The navigating officers must ensure that the Navtex and the Sat C EGC are set for the correct Navareas for receiving the warnings.Close watch shall be maintained on prevailing meteorological conditions and weather warnings. All vessels shall, as far as possible, send weather reports to coast radio stations.

- The functioning and correct reading of the instruments used should be checked. The necessary correction to the equipment readings shall be applied as applicable before using the data.

- Prior to entering congested, restricted and pilotage waters, especially after long open sea passages, the passage plan shall be discussed in detail with all the navigating officers and chief engineer. The plan shall further be discussed with the pilot and if any amendments are made, the same must be brought to the notice of the Bridge Team including the pilot.

- Miscellaneous SMS checklists shall be followed for various navigational procedures.

- During maneuvering, transiting restricted waters, heavy weather or condition which might require immediate use of engines, the engine room shall be informed well in advance. Usually for safety reasons, two generators are run in parallel in such conditions.

- In areas or the weather conditions requiring the vessel to be hand steered, two steering gear units shall be run simultaneously. Again engine room shall be informed regarding the same prior such change over. The matter becomes extremely important for vessels running on shaft generator, which are not designed to bear the excessive load for electricity. Failure to change over may lead to tripping of the shaft generator and blackout.

- Vessel shall participate in the position reporting system such as AMVER. Local systems such as INSPIRES etc. should also be followed as appropriate.

- De-briefing meeting for the bridge team shall be conducted upon completion of passage and any important information/ observations discussed.

- **Monitoring**

- Monitoring of the vessel's progress along the pre-planned track is a continuous process. The officer of the watch, whenever in any doubt as to the position of the vessel or the manner, in which the voyage is proceeding, should immediately inform master and, if necessary, take appropriate action for the safety of the vessel.

- The safe progress of the ship along the planned tracks should be closely monitored at all times. This will include
  - Regularly fixing the position of the ship, particularly after each course alteration; close and continuous monitoring of the vessel's position ensures that different methods of determining the position are used to check against error in any one system, ensuring navigation clear of hazards and avoiding grounding
  - Positions obtained by electronic positioning systems must be checked regularly by visual bearings and transits whenever available; Account must be taken of any system errors and the predicted accuracy of positions displayed by electronic position fixing systems
  - Visual fixes should, if possible, be based on at least three position lines;
  - Transit marks, clearing bearings and clearing ranges (radar) can be of great assistance
  - Buoys should not be used for position fixing but may be used for guidance when shore marks are difficult to distinguish visually; in these circumstances their positions should first be checked by other means;
  - When changing charts, the position fix from the chart in use must be transferred to the new chart
  - Cross-checking of individual human decisions so that errors can be detected and corrected as early as possible
  - Monitoring information available from plots of other traffic carefully used to ensure collision avoidance in compliance with COLREGs
  - During pilotage ensuring that the intentions of a pilot are fully understood and acceptable to the vessel's navigational staff
  - The performance of navigational equipment should be checked at regular and frequent intervals during the watches and prior to sailing, prior to entering restricted or hazardous waters

- The echo sounder shall be used as a valuable check of depth at the plotted position.

- The charted positions of offshore installations should be checked against the most recent navigational notices.

- Radar shall be used to advantage in monitoring the position of the vessel by the use of parallel indexing to monitor that a vessel is maintaining its track in restricted coastal waters.

- Navigating officers must not become over-reliant on ECDIS. Frequent checks should be made of the ECDIS position fixing system (normally GPS) by the use of other means. Such checks should include use of radar to check the accuracy of the charted position and Visual cross bearings.

- The full functionality of ECDIS cannot be achieved when operating in the raster chart display (RCDS) mode and thus the system should always be operated in ECDIS mode. Data input from the gyrocompass, speed log, echo sounder and other electronic equipment should be periodically monitored to ensure accuracy.

- Each time the vessel's position is fixed and marked on the chart in use, the estimated position at a convenient interval of time in advance should be projected and plotted. With ECDIS or RCDS care should be taken to ensure that the display shows sufficient "look-ahead" distance and that the next chart can be readily accessed.

- The OOW shall never lose situational awareness while being busy with other functions. If situation demands, additional manpower should be called without hesitation.

- The bridge team must guard against complacency, especially when transiting repetitive, frequent passages.

### 3) Sample format for passage plan

| **PASSAGE PLAN** | |
|---|---|
| **Vessel: M.V./M.T. _________________________** | |
| **VOYAGE FROM ____________________ TO ____________________ (Loaded/ Ballast)** | |
| **Draft – Forward _________________ Aft _________________** | |
| **REFERENCE CHARTS & PUBLICATIONS REQUIRED FOR VOYAGE** | |
| CHARTS USED: | |
| ROUTEING CHARTS USED: | |
| LIST OF LIGHTS USED: | |
| LIST OF RADIO SIGNALS USED: | |
| LIST OF SAILING DIRECTION VOLUMES USED: | |
| TIDE TABLES / TIDAL STREAM ATLAS USED: | |
| CO-TIDAL CHARTS USED: | |
| **CHARTS/ PUBLICATIONS UPDATE STATUS** | |
| Voyage charts corrected upto NTM | Wk - |
| Sailing Directions for the passage corrected up to & including weekly NTM | Wk - |
| ALLFS for the passage corrected up to & including weekly NTM | Wk - |
| ALRS for the passage corrected up to & including weekly NTM | Wk - |
| Passage charts corrected for : | Wk - |
| Temporary & Preliminary notices | Wk - |
| Navtex Stations | |
| Metareas | |
| Nav Area messages | |
| Radio Navigational Warnings | |

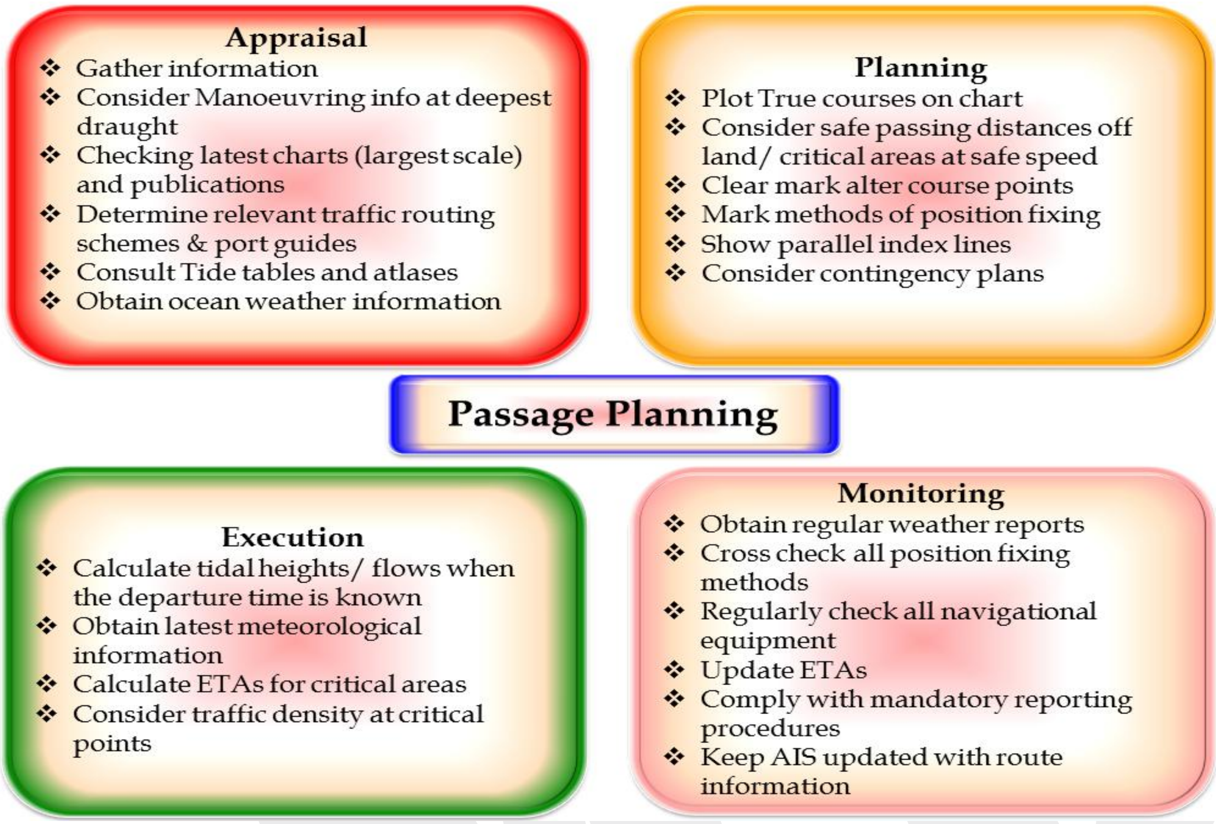
| **Way Point Chart (as discussed earlier)** | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

| **Port Information** | | | |
|---|---|---|---|
| **Departure Port** | | **Arrival Port** | |
| Name | | Name | |
| Location | | Location | |
| Time | | Time | |
| Maximum permissible Draft and density | | Maximum permissible Draft and density | |
| Reporting requirements | | Reporting requirements | |
| VHF Channels | | VHF Channels | |
| Pilotage | | Pilotage | |
| Any restrictions | | Any restrictions | |
| Agents | | Agents | |
| Other important information | | Other important information | |
| Tides | | Tides | |

| **Vessel information** | |
|---|---|
| Maneuvering characteristics | |
| Expected Squat tables | |

| **Signatures:** | | | |
|---|---|---|---|
| **Prepared By:** | | **Approved by:** | |
| OOW1 | | OOW2 | |
| OOW3 | | | |

### 4) Summary chart for passage planning




### Apply Your Knowledge

1. List the charts and publications needed on a passage from Montreal, Canada to Sfax, Tunisia.
2. Assist the navigation officer to prepare the passage plan for the next voyage.

**Function:** Navigation

**Competence:** Plan and conduct a passage and determine position

**Task number:** A1.5

**Sub-task Reference number:** A1.5.2 (A1.5.2.1, A1.5.2.2, A1.5.2.3, A1.5.2.4)

**Topic:** Electronic systems of position fixing and navigation

**Task Heading**

- Demonstrate the following with respect to the operation of GPS
  - Calculate distances and create / edit a route using GPS
  - Create / insert way points
  - Set limits and use the GPS alarms; i.e. HDOP, Cross track, arrival waypoint, anchor watch, etc.
  - Set and use rhumb line / great circle mode.

**Objectives**

- Knowledge of various terms used in GPS route planning and use of these functions and alarms

**Index**

1) Waypoint
2) Route
3) Calculation of distance and bearing
4) Arrival alarm
5) Anchor watch alarm
6) Cross track error (XTE) alarm
7) Lost signal or HDOP alarm

**Description**

**1) Waypoint**

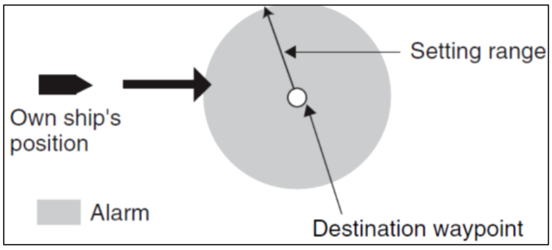
- A waypoint means a particular location in a voyage, to start the voyage, intermediate on the way, or the destination positions. This is generally mentioned in latitude and longitude co-ordinates. A waypoint is generally the point on the route where the course needs to be altered. It is usually depicted by a number. The positions are picked up from the navigation chart and once saved in GPS, the number is marked on the chart.

**2) Route**

- A route from one place to another is a passage through various sea areas for the ship to safely transit. This involves several course changes, requiring a series of waypoints one after another.
- Routes need to be carefully checked while planning passage for safe transit of ship through various sea areas. Waypoints once checked are fed into the GPS in the form of waypoints. The waypoint are further grouped in the form of various routes and saved in the equipment.
- Once the route is saved and activated, the GPS calculates the total distance to go (DTG) to the next waypoint or the final destination as selected by user. Further, it

picks up the current speed of the vessel and calculates the time to go (TTG) to the next way point of the final destination as required.

**3) Calculation of distance and bearing**

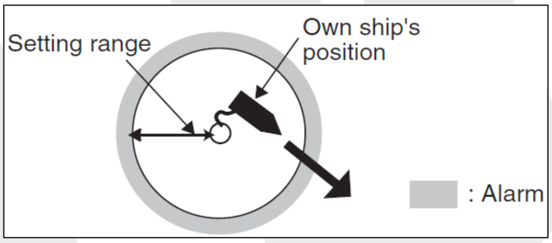



- Between two waypoints the GPS calculates the distance and true course.
- For short distances the distances are calculated using rhumb line calculations.
- For large distance in oceans, great circle distances (shortest) are calculated. To enable this function the user has to select the great circle option from the GPS menu.

4) **Arrival alarm**

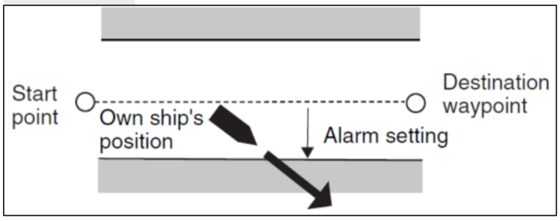
The arrival alarm informs the user that the vessel is approaching a destination waypoint. The area that defines an arrival zone is marked by a circle for which the radius range is set by the user. The alarm will be released when the vessel enters the circle.

5) **Anchor watch alarm**




The anchor watch alarm informs that the vessel is moving beyond the accepted limits from the anchor position, whereas it should beat rest. Anchor watch alarm is set in GPS by manually feeding the actual anchor position as the centre and the maximum radius of swing circle as the alarm range. The alarm triggers when the vessel is out of this alarm circle.

6) **Cross track error (XTE) alarm**




The XTE alarm warns the navigator that the vessel is off its intended route line. The intended route is planned and track is marked by the route line between two way points. Two border lines on either sides of this route line mark an area, defined by two waypoints, which shall not be crossed. An audible and visual alarm is released when the ship crosses this area.

**7) Lost signal or HDOP alarm**

HDOP stands for “Horizontal Dilution of Precision” and is an indication of the quality of the satellite constellation. At least 3 satellites are required for a 2-dimensional fix from the GPS. The receiver continuously shows the GDOP value at any time. An alarm triggers when the GDOP value is below acceptable parameters.

**Apply Your Knowledge**

1. Read the equipment specific manual available on board your good vessel and under supervision learn to plan a route.
2. Learn and set the anchor watch alarm while anchoring.
3. Under supervision of a navigating officer, plan a short open sea route, feed waypoints in the GPS, and note down the courses and distances between each waypoint. Record the total distance and the above data.

4. Under supervision of a navigating officer, select two coordinates on an ocean chart and calculate rhumb line (RL) and great circle (GC) courses and distances between them. Plot both RL and GC courses on the chart and record the courses and distances.

**Function:** Navigation

**Competence:** Plan and conduct a passage and determine position

**Task number:** A1.5

**Sub-task Reference number:** A1.5.3

**Topic:** Electronic systems of position fixing and navigation

**Task Heading**

- Demonstrate understanding of the principle and use of DGPS

**Objectives**

- Understanding operation of DGPS and practice use of the equipment correctly.

**Index**

1) Differential GPS
2) Satellite based augmentation systems

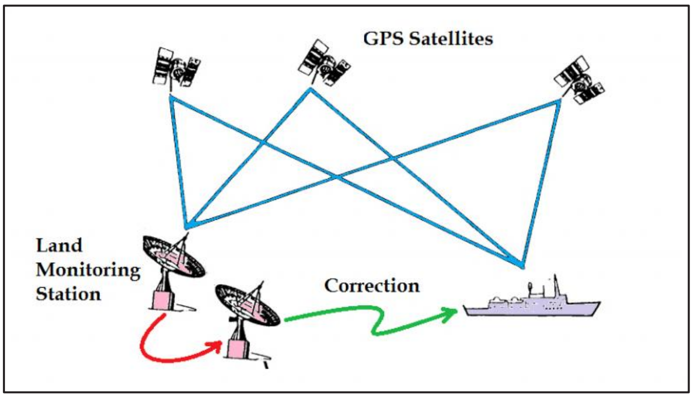
**Description:**

**1) Differential GPS**

- Differential global positioning system (DGPS) is an accuracy enhancement technique which uses a network of land based station in accurately known locations around the coasts. These stations are fitted with normal GPS receivers and they continuously compare the GPS fix with their own accurate position.

- Any difference between the two is coded in form of differential corrections and transmitted to the GPS receivers of ships in the vicinity (100 nautical miles). It is assumed that the errors experienced by the differential station will be the same as those experienced by the ships in the vicinity. To receive the correction calculated by the shore station, ships need to be fitted with DGPS receivers.

- On coming within the range of the DGPS station, the correction is automatically received in a special circuit, decoded and applied thereby displaying a fix much more accurate as compared to the GPS fix. DGPS offers position Accuracy of $\pm$1m. DGPS facility is available only in the vicinity of shore based DGPS stations.




- DGPS positions based on terrestrial corrections are also affected by certain errors. 'Multipath' errors in DGPS can be significant. Hence it is important that in very restricted waters, alternate means of position fixing (e.g. radar) are also used to verify the ship's position.

**2) Satellite based augmentation systems**

- Satellite based augmentation systems is any system that aids GPS by providing accuracy, integrity, availability, or any other improvement to positioning, navigation, and timing that is not inherently part of GPS itself. Different augmentation systems have been developed by both the public and private sectors.

- In SBAS, the monitor stations do not provide single isolated corrections but from all stations. Rather, the ranging and integrity monitor stations (RIMS) together develop a correction map for a wide area. From the measured data of the RIMS, a 'map' of the "Total Electron Content" (TEC) in the ionosphere for the area covered by the RIMS station is calculated. This TEC map is transmitted to a geostationary satellite that itself acts like a GPS satellite, that means can be used for position determination but also provides the receiver with the information it needs for the correction of the ionosphere effects. Every single receiver then corrects its own position itself by use of this data.

- NDGPS (Nationwide Differential GPS System) is a ground-based augmentation system that provides increased accuracy and integrity of GPS information to users on U.S. land and waterways. The system consists of the maritime differential GPS System operated by the U.S. Coast Guard and an inland component funded by the department of transportation.

- WAAS (Wide Area Augmentation System), a satellite-based augmentation system operated by the Federal Aviation Administration (FAA), supports aircraft navigation across North America. Although designed primarily for aviation users, WAAS is widely available in receivers used by other positioning, navigation, and timing communities.

- The "European Geostationary Navigation Overlay Service" (EGNOS) is the first pan-European satellite navigation system. It augments the US GPS satellite navigation system and makes it suitable for safety critical applications such as flying aircraft or navigating ships through narrow channels. Consisting of three geostationary satellites and a network of ground stations, EGNOS achieves its aim by transmitting a signal containing information on the reliability and accuracy of the positioning signals sent out by GPS. It allows users in Europe and beyond to determine their position to within 1.5 metres. EGNOS is a joint project of ESA, the European commission and Eurocontrol, the European organisation for the safety of air navigation. It is Europe's first activity in the field of Global Navigation Satellite Systems (GNSS) and is a precursor to Galileo, the full global satellite navigation system under development in Europe. The EGNOS open Service has been available since 1 October 2009.

- Japan is developing Multi-functional Transport Satellite (MTSAT)-based Satellite Augmentation System (MSAS) and Quasi-Zenith Satellite System (QZSS).

- The GPS aided Geo-augmented navigation system (GAGAN) is a planned implementation of a regional satellite-based augmentation system (SBAS) by the Indian government. Project is being implemented by the "Airport Authority of India" with the help of the "Indian Space Research Organization" (ISRO).

**Apply Your Knowledge**

1. Observe two positions fix by two alternative means, one being DGPS and other by visual or radar fix and compare the accuracy.

**Function:** Navigation

**Competence:** Plan and conduct a passage and determine position

**Task number:** A1.5

**Sub-task Reference number:** A1.5.4, A1.5.5

**Topic:** Electronic systems of position fixing and navigation

**Task Heading**

- Identify other satellite navigation systems under development
- Demonstrate understanding of the principle of Enhanced Loran (eLoran)

**Objectives**

- Knowledge of alternative satellite navigation systems

**Index**

1) GLONASS
2) Galileo
3) Regional navigation systems
4) eLORAN

**Description**

**1) GLONASS**

- The "Global Navigation Satellite System" (GLONASS) is a Russian system based on a constellation of active satellites which continuously transmit coded signals in two frequency bands received by users on the earth's surface to identify their position and velocity in real time based on ranging measurements.

- The system is a counterpart to the United States "Global Positioning System" (GPS) and both systems share the same principles in the data transmission and positioning methods. GLONASS is managed for the Russian Federation Government by the Russian space forces and the system is operated by the Coordination Scientific Information Center (KNITs) of the Ministry of Defense of the Russian Federation.

- The operational space segment of GLONASS consists of 21 satellites in 3 orbital planes, with 3 on-orbit spares. The three orbital planes are separated 120 degrees, and the satellites within the same orbit plane by 45 degrees. Each satellite operates in circular 19,100 km orbits at an inclination angle of 64.8 degrees and each satellite completes an orbit in approximately 11 hours 15 minutes.

> Serious accidents have occurred because of over-reliance on satellite positioning equipment. Checking the position using other means, including visual observations, would have prevented the accident.

- The GLONASS system was brought into operational testing in 1993. To 1995 the whole orbit group of 24 satellites was formed. Reduction in funding for space industry in 1990 led to degradation of the GLONASS constellation. Details of GLONASS are given in Admiralty List of Radio Signals Volume 2.

**2) Galileo**

- Galileo is Europe's own global navigation satellite system, providing a highly accurate, guaranteed global positioning service under civilian control. Galileo is a joint initiative of the European Commission (EC) and the European Space Agency (ESA). It is inter-operable with GPS and GLONASS. By being inter-operable with GPS and Glonass, Galileo will be a cornerstone of global satellite navigation.

- By offering dual frequencies as standard, Galileo will deliver real-time positioning accuracy down to the meter range. ESA's first two navigation satellites, GIOVE-A and –B, were launched in 2005 and 2008 respectively, reserving radio frequencies set aside for Galileo by the International Telecommunications Union and testing key Galileo technologies. On 21 October 2011 came the first two of four operational satellites designed to validate the Galileo concept in both space and on Earth. Two more shall follow in 2012. Once this In-Orbit Validation (IOV) phase has been completed, additional satellites will be launched to reach Initial Operational Capability (IOC) around mid-decade.

- When Galileo, Europe's own global satellite navigation system, is fully operational, there will be 30 satellites in Medium Earth Orbit (MEO) at an altitude of 23 222 kilometres. By placing satellites in orbits at a greater inclination to the equatorial plane than GPS, Galileo will achieve better coverage at high latitudes.

- Ten satellites will occupy each of three orbital planes inclined at an angle of 56° to the equator. The satellites will be spread evenly around each plane and will take about 14 hours to orbit the earth. One satellite in each plane will be a spare; on stand-by should any operational satellite fail. The inclination of the orbits was chosen to ensure good coverage of polar latitudes, which are poorly served by the US GPS system.

**3) Regional navigation systems**

**Beidou**
China's indigenous satellite navigation system Beidou is planned to be expanded into the global compass navigation system.

Six more satellites are scheduled to be launched to further expand the service area of Beidou system to most parts of Asia-Pacific region.

**IRNSS**
The Indian Government in May 2006 has approved a project to implement an "Indian Regional Navigation Satellite System" in the next six to seven years. It will consist of a constellation of seven satellites and a large ground segment. Three of the seven satellites in IRNSS constellation will be placed in geostationary earth orbit and four in geosynchronous orbits inclined at 29° to the equatorial plane. All the seven satellites will have continuous radio visibility with Indian control stations.

The entire IRNSS system will be under Indian control. The space segment, ground segment and user receivers will be built in India. The independent, indigenously developed IRNSS is expected to provide an absolute position accuracy of better than 20 meter over India and the region extending to about 1,500 to 2,000 km around it.

**QZSS**
The system developed by Japan makes it possible to provide high accuracy satellite positioning service covering close to 100% of Japan, including urban canyon and mountain terrain. The "Quasi-Zenith Satellites System" (QZSS) uses multiple satellites that have the same orbital period as geostationary satellites with some orbital inclinations

(their orbits are known as “Quasi-Zenith Orbits”). These satellites are placed in multiple orbital planes, so that one satellite always appears near the zenith above the region of Japan.

Through the development and deployment of this system, it is aimed to enhance Japan’s satellite positioning technology and contribute to building safe and secure society with enhanced satellite based positioning, navigation and timing technologies.

**4) e LORAN**

- LORAN C is based on the measurement of time difference between the receptions of transmitted pulses. The ground-wave coverage is typically between 800 and 1200 miles, although the accuracy of positional information will depend upon the relative position of the transmitters. LORAN coverage is limited to North America, Europe, the Middle East, SE Asia and parts of the Pacific Rim.

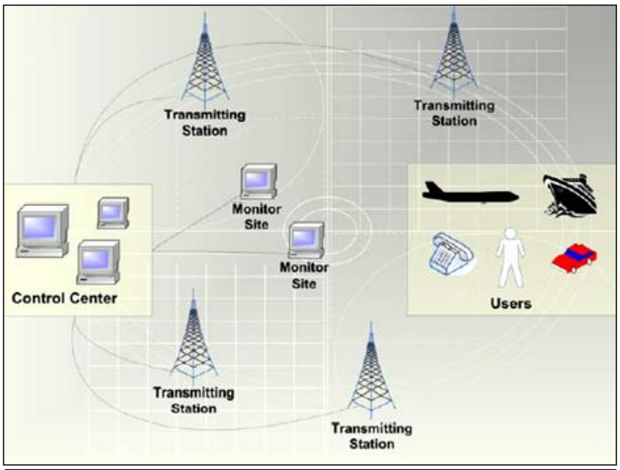
- Enhanced LOng-RANge Navigation (eLORAN) is an internationally standardized positioning, navigation, and timing (PNT) service. eLoran is an independent, dissimilar, complement to Global Navigation Satellite Systems (GNSS). It allows GNSS users to retain the safety, security, and economic benefits of GNSS, even when their satellite services are disrupted.

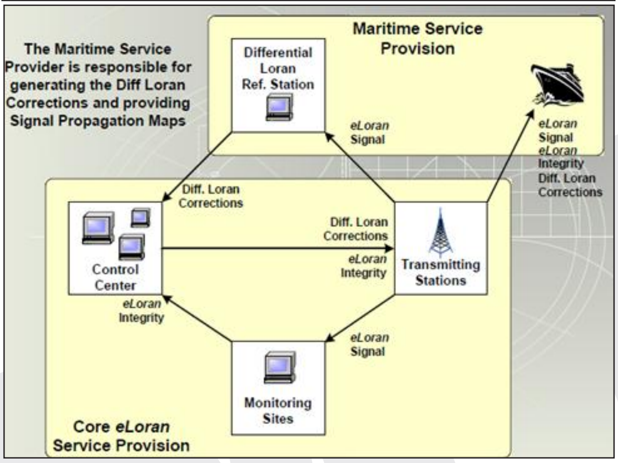
- The principal difference between the *eLoran* transmitted signal and the traditional Loran-C signal is the addition of a data channel. The data channel conveys corrections, warnings, and signal integrity information to the user’s receiver via the Loran transmission.

- The data transmitted will include the identity of the station; an almanac of Loran transmitting and differential monitor sites, absolute time based on the Coordinated Universal Time (UTC) scale; leap-second offsets between *eLoran* system time and UTC, warnings of anomalous radio propagation conditions including early sky waves, warnings of signal failures, messages that allow users to authenticate the *eLoran* transmissions, Differential Loran corrections, to maximize accuracy for maritime and timing users and differential GNSS corrections.

- *eLoran* signals travel over the surface of the earth (*ground waves*), they are subject to small propagation delays that depend on the electrical conductivity of the ground. To achieve the high level of accuracy required for aviation approaches, harbor entrance and approach maneuvers, and to recover precise time, these propagation delays must be measured and the corrections must be applied. User and system monitor receivers will store and employ these signal propagation corrections to maximize the accuracy and also provide integrity for the solutions they deliver.

- It will provide bridge officers with all the information they need on a single display. In order to make these critical e-navigation services available, the system will require a supply of position and timing data of exceptionally high accuracy and reliability.




Source: http://www.loran.org/

**Apply Your Knowledge**

1. Check the eLORAN details and stations in ALRS.

**Function:** Navigation

**Competence:** Plan and conduct a passage and determine position

**Task number:** A1.6

**Sub-task Reference number:** A1.6.3

**Topic:** Echo sounders

**Task Heading**

- Locate the spares of echo sounder equipment. Demonstrate understanding of the maintenance requirements, including changing of recorder stylus and belt (if applicable).

**Objectives**

- Identifying the various parts of echo sounder and understanding their maintenance procedures

**Index**

1) Introduction
2) Checks and maintenance
    a) General
    b) Transducer
    c) Replacement of recording paper
    d) Zero line adjustment
    e) Recording stylus adjustment
    f) Feed stylus adjustment
    g) Stylus belt

**Description**

**1) Introduction**

Other than routine dusting and cleaning, digital echo sounders are mostly maintenance free requiring annual servicing as specified by the manufacturer. On board maintenance of the analog echo sounders shall be carried out as per the manufacturer's instructions. The echo sunder transducer inspection and maintenance, along with the equipment calibration is carried out in dry docks. Most of the other routine on board maintenance procedures are as follows.

**2) Checks and maintenance**

**a) General**

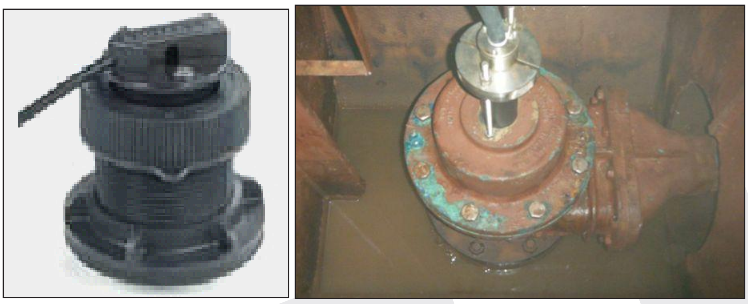
- The cabinet and display screen shall be kept clean; the surfaces shall be wiped with a clean damp cloth. For heavier cleaning, a clean, damp cloth which has been dipped in a solution of a mild dish detergent and water can be used. However the cloth shall be wrung out firmly before wiping the unit. Cleaning solutions containing spirit or alcohol shall never be used.

- Electrical connections shall be periodically checked for being secure and that no cables are frayed or worn.

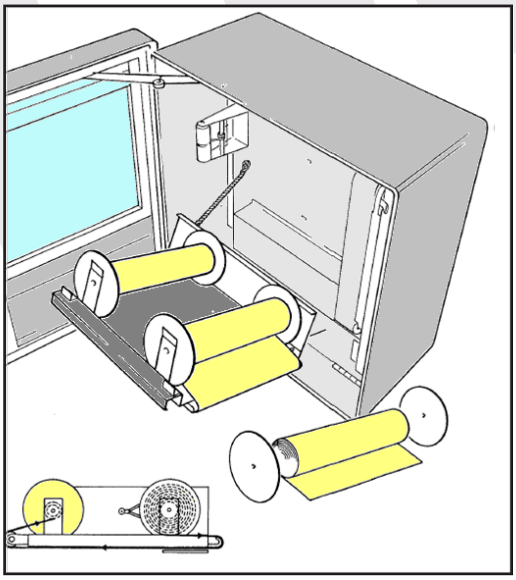
- ❖ Spare parts, mostly fuses, are supplied with installation or same can be procured from marine supply store. The fuses specified for the unit shall only be used. Use of a wrong fuse can result in fire and damage the equipment.

**b) Transducer**

Transducer shall be checked and cleaned during dry-docking. Harsh abrasive or a solvent shall not be used to clean the transducer. The transducer need to be protected while the ship's bottom is grit blasted. Marine life on the transducer face results in a gradual decrease in sensitivity. The transducer face shall be checked for cleanliness each time the vessel is dry-docked. Any marine growth shall be carefully wiped with a piece of wood or fine-grade sandpaper. The valve for transducer opening should be checked for water tightness if the transducer is renewed. Transducer cable shall be checked for damage. Power cable, transducer cable plug shall be tightly fastened.



**c) Replacement of recording paper**



- ❖ Echo sounder shall be switched off.
- ❖ The stylus belt shall be rotated till the recording stylus is located at the back.
- ❖ The top front of the paper cassette shall then be held from top and pulled out slowly allowing it to swing down carefully.
- ❖ Pull out the end disc knob for the magazine and remove the used paper roll.
- ❖ The empty spool then shall be transferred from right to left side and making sure that the end supporting disc enters the spool.
- ❖ A new roll of recording shall be inserted as shown in the picture.
- ❖ The end of the paper shall then be thread into the slot in the paper spool and turn the spool to tighten the roll.
- ❖ Having done as above, the paper cassette is lifted and locked in the recorder.

**d) Zero line adjustment**

The hall board crews are provided to move the scale plate to adjust the zero line to meet the scale zero.

**e) Recording stylus adjustment**

The recording stylus has a magazine of thin steel wire which must be pulled out when the tip is worn down. This is usually done every time a new roll of paper is inserted. The echo sounder is switched off and the cabinet door opened. The stylus belt is then rotated till the stylus is in the front. The stylus shall then be removed from its belt holder and be replaced with a replacement stylus.

**f) Feed stylus adjustment**

If the feed stylus doesn't touch the board very well, the recording work may be off. To adjust, switch off the echo sounder and check the touch between the feed stylus and the board. If only a small quantity of steel thread touch the board or absolutely no touch, the feed stylus should be bent with a pair of pliers.

**g) Stylus belt**

Stylus belt is set to run on the rotators at the specific speed. The speed of rotation varies with the range scale in use. The belts are usually checked during the servicing of the unit. However, in between if it is observed to be damaged or lose, same shall be checked visually. Repeated shifting of zero line also may be due to the deformation of the belt. In case of any such observations, equipment servicing shall be arranged. The belt shall be changed if required with the belt of same specifications.

**Apply Your Knowledge**

1. How do you change the paper on echo sounder? What care and maintenance will you do to keep the equipment in good working condition?

**Function:** Navigation

**Competence:** Plan and conduct a passage and determine position

**Task number:** A1.8

**Sub-task Reference number:** A1.8.4

**Topic:** Steering control systems

**Task Heading**

➢ Demonstrate setting up of the "course recorder" for heading and GMT.

**Objective**

➢ To understand the importance and functioning of course recorder

**Index**

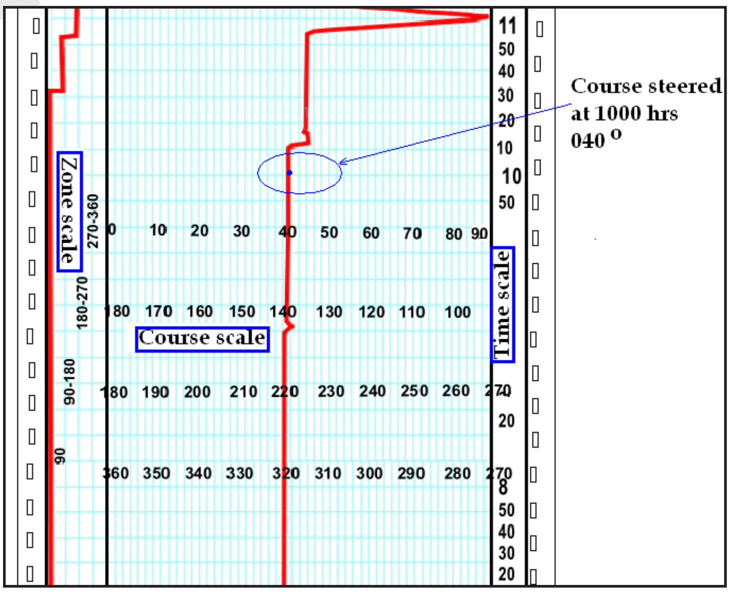
1) Course recorder
2) Course recorder paper
3) Working
4) Checks and entries on course recorder

**Description**

**1) Course recorder**

Course recorder is an automatic graphic record keeping device fitted on the ship's bridge provided to record of all gyro courses steered by the ship throughout the voyage. It provides evidence of the courses steered by the ship, which is one of the important factors checked during any marine accident occurred during navigation. Seeing the course recorder trace against a time scale, it can easily be checked the courses being steered, effects of weather such as yawing, alterations, and up to a good extent the rate of turn. It has a built in clock which keeps time accurately.

**2) Course recorder paper**

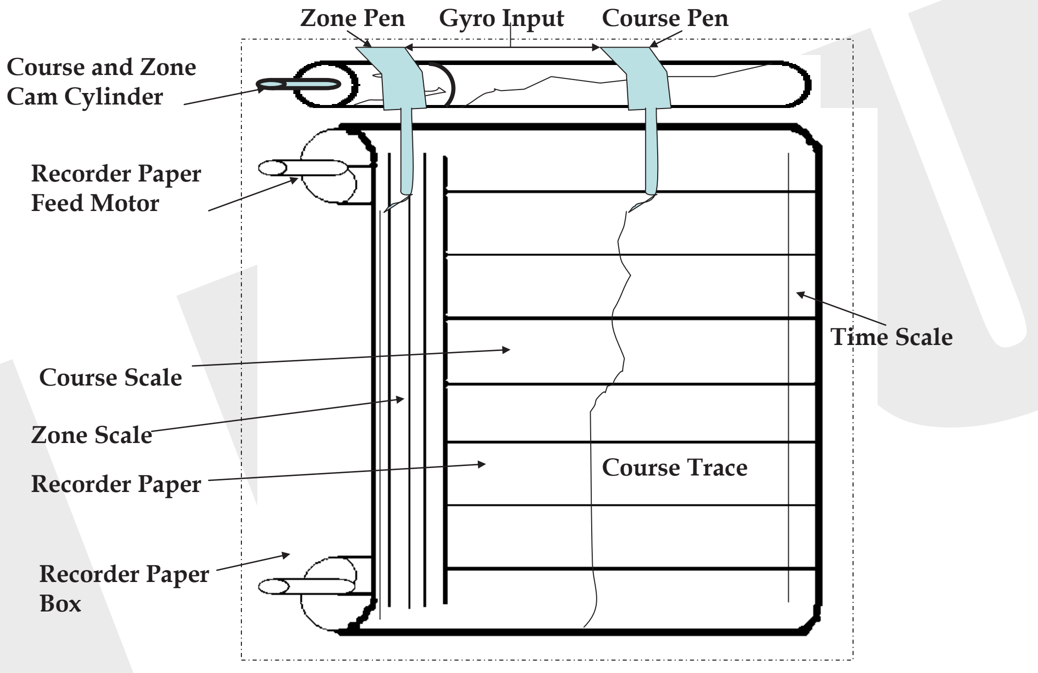



➢ The course recorder paper is a grooved graph paper, usually of thermal quality, where the pen leaves a marked when rubbed on paper. The grooves on either side of the paper facilitate paper drive by the paper feed motor. The graph is divided in to three sections, the time scale, the course zone scale and the course scale.

➢ The time scale marks the time. The zone scale specifies the course scale to be used for reading the course.

### 3) Working

The course recorder paper is run continuously by the paper feed motor. This is in synchronization with the recorder clock. There are two pens provided namely the zone pen and the course pen which mark traces on the recorder paper. These two are run horizontally across the recorder paper by the course and zone cam cylinder. This cylinder has groves engraved on the cylinder which drive the pen. The cylinder gets the input from the gyro compass and pens are moved by the cylinder groove accordingly. The groves on for the zone pen set it in the correct course zone and the grooves for the course pen move it to the respective heading. The recorder paper has a printed time scale on it. Before switching on, the two pens shall be raised and the paper then rolled to the correct GMT time line under the pen tip. Once switched on, the recorder paper moves as per a fixed rate as marked on the time scale getting input from the built in clock and continuously traces the ship's course steered. The recorder paper is of thermal nature and is supported by a plate from back. The recorder pens when switched on rub on this paper making a trace.




Course Recorder

### 4) Checks and entries on course recorder

- Before the start of the voyage, the date and time of switching on course recorder, the voyage number, and the port of departure shall be marked on the recorder paper.
- The clock on the course recorder must be checked by the OOW every watch and synchronized if in error. The recorder should be set to GMT.
- The trace should be marked each noon, at "Start of Sea passage" (SSP) and at "Finished with Engines" (FWE).
- The pens for the ink type recorders shall be checked regularly.
- Sufficient spare paper rolls shall be kept on board at all times.

- Weather conditions, wind, state of sea and swell whether head swell or beam swell may be recorded on the chart. Weather and rudder adjustments on the steering may also be recorded.

- The recorder clock should be checked for error against correct GMT and any error should be noted. In case the error is large, it should be corrected by adjusting the paper. If the error in the clock is very large and requires frequent adjustments - it is better to get the course recorder serviced by authorized technicians as frequent adjustment of the paper may give wrong recordings and this will not be acceptable.

- Any additional procedures shall be followed as advised in the user's manual.

- Equipment specific user's manual shall be followed for starting/ stopping procedures.

**Apply Your Knowledge**

1. Observe the course recorder trace after you practice hand steering the vessel and discuss the accuracy of steady course maintained.

**Function:** Navigation

**Competence:** Plan and conduct a passage and determine position

**Task number:** A1.8

**Sub-task Reference number:** A1.8.5

**Topic:** Steering control systems

**Task Heading**

- Demonstrate understanding of the procedures for the changeover for autopilot from gyro compass to transmitting magnetic heading device if fitted.

**Objective**

- To understand the purpose of transmitting heading device (THD) / transmitting magnetic heading device (TMHD) and procedure for changeover of autopilot to TMHD

Please read this task in conjunction with tasks A1.8.1, A1.8.2, A1.8.3

**Index**

1) THD and TMHD
2) Changeover procedure from gyro to TMHD in autopilot

**Description**

**1) THD and TMHD**

- A transmitting heading device (THD) is an electronic device, which provides information about the ship's true heading. The THD receives a heading signal from the compass and generates a suitable output signal for other devices. All displays with the exception of the sensor and all outputs of heading indicate true heading. THD are designed to operate at least from 70º south latitude to 70º north latitude.

- A transmitting magnetic heading device (TMHD) is an electronic device which uses the geomagnetic field to obtain and transmit information about the ship's heading. The TMHD is designed to transmit heading information to other equipment. It comprises of a sensing part which provides for a sensing function of detecting any heading information connected to the transmitting device. Transmitting part receives heading information from the sensing part and converts to the required accurate signal. TMHD are usually mounted under the magnetic compass.

- Transmitting magnetic heading devices (TMHD) may comprise of:
  - a standard magnetic compass equipped with a magnetic sensor and electronics for generating a suitable output signal for other devices. The compass used should be the standard magnetic compass or
  - an electromagnetic compass consisting of the sensor part and electronics for generating a suitable output signal for other devices or
  - any type as defined above and additionally equipped with a rate gyro to improve dynamic performance.

- A fore-and-aft mark is inscribed on the magnetic sensor housing, which is installed in parallel to the ship's fore-and-aft line. The accuracy of the fore-and-aft mark is within +

0.5° to the fore-and-aft direction of the housing. If a rate gyro is installed it is marked in the same way and additionally be marked with top or bottom.

- All displays and outputs of TMHD need to be corrected for true heading by applying variation and deviation. The system allows for automatic compensation if variation for the area and the complete deviation card details are fed to the device beforehand.

- An alarm is provided to indicate malfunctions of the THD or a failure of the power supply.

- The mounting arrangements of the magnetic sensor are so fitted to allow for correction of any misalignment, up to + 5°, with respect to the fore-and-aft line.

**2) Changeover procedure from gyro to TMHD in autopilot**

- Some of the autopilots are provided with an additional option of steering with reference to magnetic compass in case of gyro failure. A transmitting magnetic heading device may be installed on such ships.

- Procedure for change over from gyro to magnetic
  - Equipment manufacturer's instructions shall be followed as mentioned in user's manual for changing over auto pilot sensing to TMHD from gyro.
  - Prior change over the course to steer shall be checked along with the corresponding magnetic heading.
  - Steering shall be changed to hand steering and vessel steadied on the desired magnetic course.
  - Magnetic course to be steered shall be set in the autopilot panel by course setting knob.
  - Auto pilot settings shall be checked and adjusted if required. Off-course alarm shall be set for the corresponding magnetic heading.
  - The steering mode shall be changed over to magnetic by the changeover knob.
  - The course steered shall be observed for some time and regularly during the watch.
  - Careful check shall be kept on the changes in variation and ship's deviation in order to set correct course to steer.

**Apply Your Knowledge**

1. List the various auto-pilot settings to obtain optimum track in different weather conditions.
2. Read the operator's manual on board and practice changing over procedures of autopilot to TMHD (if fitted). Discuss the benefits and limitations of autopilots having TMHD feature.

**Function:** Navigation

**Competence:** Plan and conduct a passage and determine position

**Task number:** A1.8

**Sub-task Reference number:** A1.8.6

**Topic:** Steering control systems

**Task Heading**

- Demonstrate understanding of the procedures for the change over for emergency steering. Steer from local control.

**Objective**

- To understand the provision of steering the vessel from steering gear compartment.

Please read this task in conjunction with tasks A1.8.1~3 and A5.1.2.8

**Index**

1) Steering system
2) Emergency steering systems for steering from steering gear compartment
3) Procedure of steering from the steering gear compartment

**Description**

**1) Steering system**

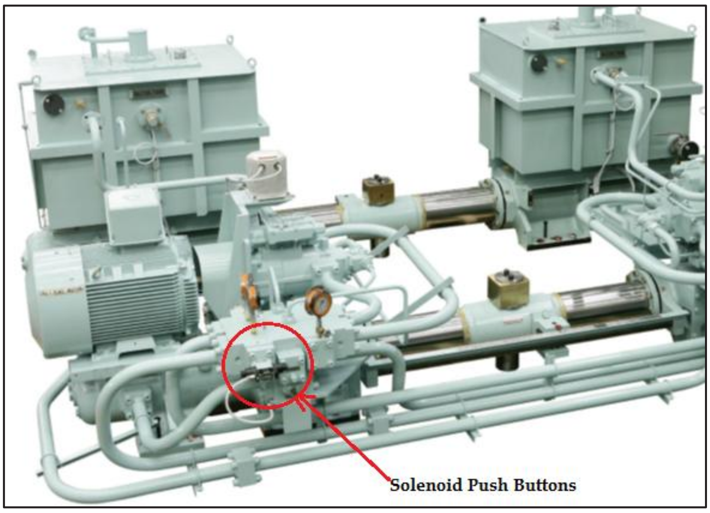
- The steering system comprises of three parts namely the transmission system, control unit and the power unit.

**2) Emergency steering systems for steering from steering gear compartment**

- Various types of emergency steering systems are provided on different ships. The instructions for changing over to emergency steering are displayed on the bridge.

- **Two common systems** which may be found on board are :

❖ **Solenoid operated push buttons**
The steering gear power unit comes in operation when the steering orders are received by the telemotor systems. The telemotor activates the solenoid valves provided in the path of pressurized hydraulic fluid, which in turn allows the pressurized fluid to flow in desired direction. This turns the tiller either by system of rams or in rotary vane system chambers.



However when the system from bridge becomes inoperational, it shall be switched off from bridge steering stand. Control shall then be established from steering gear compartment. The solenoid valves on the hydraulic line are the operated locally in the steering gear compartment by push buttons. The solenoid valves have two spring loaded push buttons on either side. The button is pushed towards the side desired and rudder turned. The push buttons continue to allow fluid flow as long as the buttons are kept pressed. When the button is released, the rudder will continue to remain at the angle left. To bring the ruder to amidships or towards other side, the push button provide to the other side shall be pushed.

❖ **Manual steering wheel in the steering gear compartment**

Alternative system in some ships for steering from steering gear compartment is provided in the form of a steering wheel. This steering wheel allows the local control of the steering gear from steering gear compartment. It requires an engagement pin to be engaged to bring the system in operation. However, prior engaging the local steering wheel pin, the remote control of steering from navigation bridge shall be switched off.

**3) Procedure of steering from the steering gear compartment**

- Steering failure is an emergency situation and company SMS procedures as provides contingency plan for the situation which shall be followed. All officers on board shall be familiar with the steering procedure for steering the vessel from steering gear compartment.
- The wheel house and steering gear compartment shall be suitably manned.
- Communication shall be established between the steering gear compartment and wheel house. A sound powered or electric telephone is usually provided in the compartment.
- Prior establishing steering control from steering gear compartment, both steering systems from wheel house shall be switched off.
- Steering gear hydraulic pumps shall be switched on from local control from the steering gear compartment.
- The gyro heading of the gyro repeater shall be checked with the bridge gyro compass.
- Wheel orders are taken from wheel house on telephone or other means provided and are relayed to the person steering locally.
- The rudder is turned as discussed above using solenoid valve/ steering wheel as applicable.
- The rudder angle is monitored from the local panel on the steering gear.
- Once accomplished, rudder order is confirmed to wheel house. Same shall be cross-checked in the rudder angle indicator on bridge.
- Care shall be taken to ensure the communication is not affected by the background noise. Personal protection equipment shall be used as required.
- The hydraulic oil level in the tanks shall be closely monitored along with other machinery for any overheating or abnormal noise.

> Emergency steering drills shall take place at least once every three months in order to practice emergency steering procedures. These drills shall include direct control from within the steering gear compartment, the communications procedure with the navigation bridge and, where applicable, the operation of alternative power supplies.

**Apply Your Knowledge**

1. Describe in detail the emergency steering on board your ship. Explain how you will change over from normal steering to emergency steering.

**Function:** Navigation

**Competence:** Plan and conduct a passage and determine position

**Task number:** A1.9

**Sub-task Reference number:** A1.9.9, A1.9.10

**Topic:** Meteorology

**Task Heading**

- Interpret weather reports and warnings. Assess information obtained from weather faxes, including positions of lows, highs, fronts, winds, wave heights and periods, warning areas, storm warnings, fog and other warnings.
- Estimate the predicted positions and path of the weather systems with respect to the ship's position and predict weather expected enroute.

**Objectives**

- Understanding the various sources of weather reports on board and interpreting these reports and forecasts

Please read this task in conjunction with task A2.2.2

**Index**

1) Introduction to World-Wide Navigational Warning Service (WWNWS)
2) NAVTEX
3) INMARSAT-C Safety NET - EGC
4) Weather facsimile
5) Weather warnings on VHF
6) International Ice Patrol
7) Voluntary observing ships (VOS)
8) Weather routeing and forecasting

**Description**

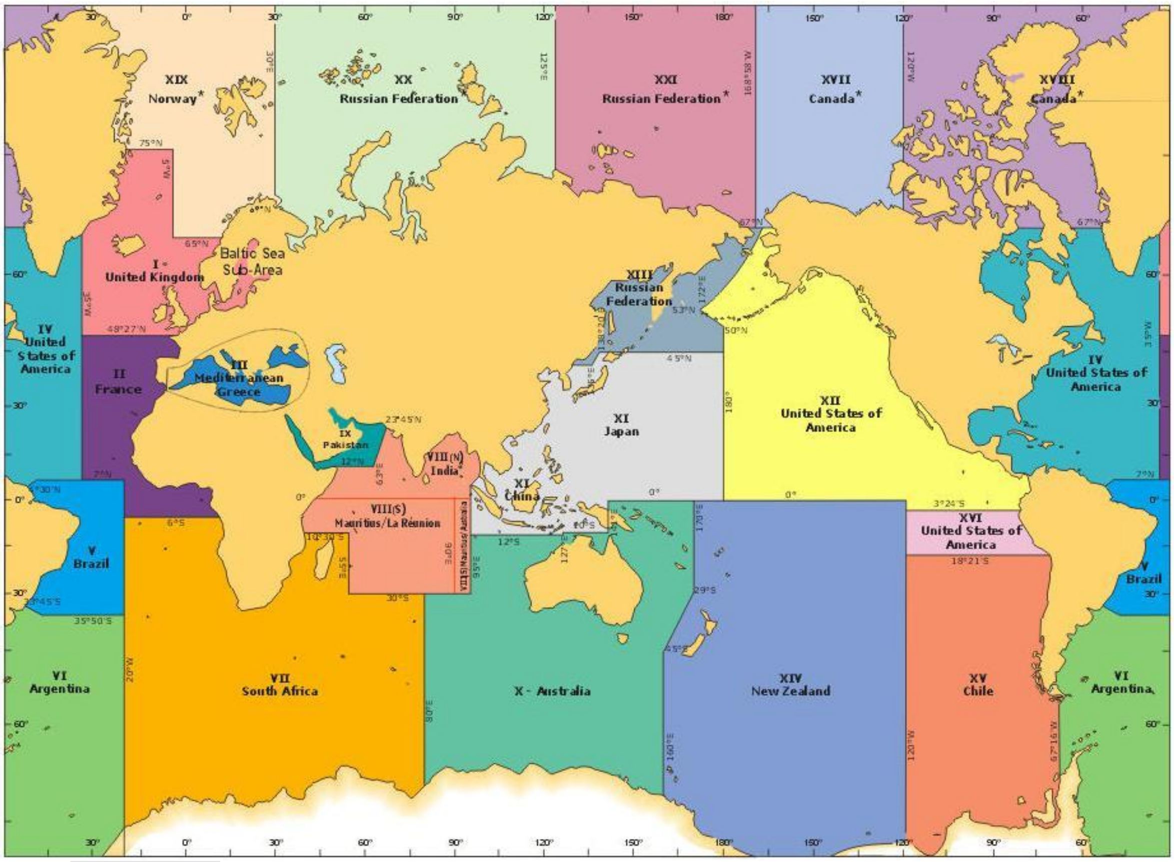
**1) Introduction to World-Wide Navigational Warning Service (WWNWS)**

- The "Global Maritime Distress and Safety System" (GMDSS) was developed by the "International Maritime Organization" (IMO), with responsibility for ship safety and the prevention of marine pollution, in co-operation with the "International Telecommunication Union" (ITU) and other international organizations, notably the "World Meteorological Organization" (WMO), the "International Hydrographic Organization" (IHO) and the COSPAS-SARSAT partners. The GMDSS requirements were added in Chapter IV of SOLAS and it came in force on 1 February 1999.
- The World Meteorological Organization (WMO) is a specialized agency of the United Nations dedicated to meteorology, operational hydrology (water) and other related geophysical sciences such as oceanography and atmospheric chemistry.WMO undertakes to monitor global weather and climate this task through the national meteorological and hydrological services of its member's countries. These countries own and operate the systems for collecting, processing and analyzing information from thousands of observation systems, including satellites and ships.
- The "World-Wide Navigational Warning Service" (WWNWS) is a global service for broadcasting navigational warnings. It is established jointly by IHO and IMO. The Maritime Safety Information (MSI) includes navigational warning, meteorological

warnings etc. and is broadcasted via NAVTEX and SafetyNET. Area coordinators have been assigned this responsibility of the MSI broadcast in separate areas.

- For broadcast purposes, the world's oceans are divided into 21 areas of responsibility, called Navareas. Same are called Metareas for the purpose of meteorological information, each under the responsibility of a national meteorological service. Each Metarea is further subdivided for detailed coverage for meteorological purpose.
- Navigational warnings are of three types:
  - ➢ NAVAREA warnings,
  - ➢ Coastal warnings,
  - ➢ Local warnings

**NAVAREAs/ METAREAs of the World**




## 2) NAVTEX

Reference shall be made to task A2.2.2 for details regarding NAVTEX.

## 3) INMARSAT-C SafetyNET - EGC

- Meteorological warnings are available on the INMARSAT-C's Enhanced Group Calling (EGC) system that is served by SafetyNET. System is named EGC the information sent is available only to selective EGC receivers.
- The ocean regions are named as Atlantic Ocean region - East (AOR –E), Atlantic Ocean region –West (AOR- W), Pacific Ocean Region (POR) and Indian Ocean region (IOR). Each region is covered by one Inmarsat Satellites, total four in number.
- The four ocean regions cover navigable waters except Polar Regions beyond about 76° N and 76° S.

**Sample EGC weather report**

FQAU20 ABRF 110012
IDQ10007

UPDATED
SECURITE

HIGH SEAS FORECAST FOR METAREA 10
NORTH EASTERN AREA EQUATOR TO 28S, 142E TO 170E
ISSUED BY THE AUSTRALIAN BUREAU OF METEOROLOGY, BRISBANE
FOR 23 HOURS FROM 0000UTC 11 April 2012

PART 1 WARNINGS
Nil.

PART 2 SITUATION
At 110000UTC.
Trough near 02S142E to 06S158E to 20S164E to 28S168E, expected near Eq148E to 04S157E to 20S166E to 26S170E at 111100UTC and Eq149E to 03S157E to 17S165E to
23S170E at 112300UTC.

PART 3 FORECAST
Northeast of trough.
SW to NW winds 10 to 15 knots west of 156E, tending NW to NE 10 to 15 knots east of 156E. Slight seas. Low NE to SE swells. Scattered showers and isolated thunderstorms tending occasional within 120NM of trough.

Southwest of trough and north of 10S.
S to SE winds 10 to 20 knots. Slight to moderate seas. A low NE swell. Scattered showers and isolated thunderstorms.

Southwest of trough and south of 10S.
S to SE winds 25 to 33 knots. Rough to very rough seas. A moderate S to SE swell. Isolated showers and thunderstorms, mainly north of 23S.

WEATHER BRISBANE

- **EGC weather report format**
  - Date and time of the message in UTC
  - Identifier of land earth station sending the message
  - Unique number identifying the message
  - The priority of the message
  - The header and text of message such as navigational warning/ METAREA warning etc
  - Message close by the name of the station

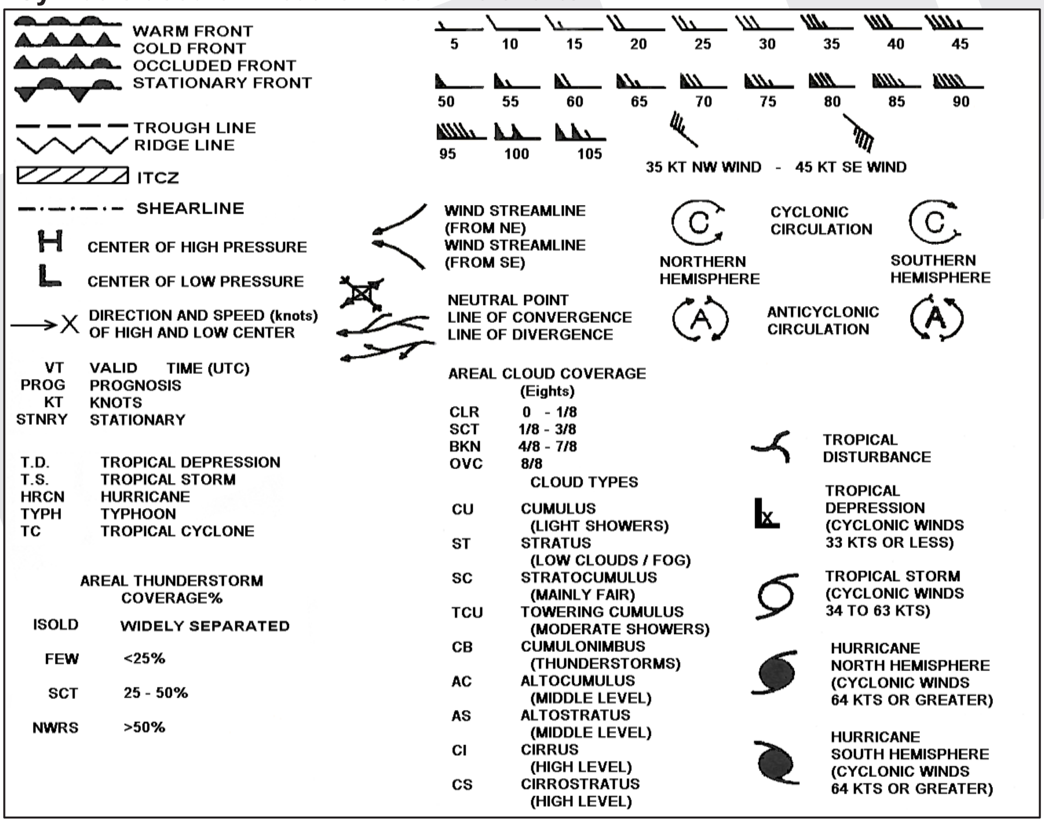
**4) Weather facsimile**

- This section shall be read in conjunction with the task A2.2.2 with regards to weather facsimile instrument.
- Weather facsimile or radio facsimile also known as HF FAX is a means of broadcasting graphic weather maps, ice charts and other graphic images via HF radio. Maps are received using a dedicated radio-fax receiver .The information is presented in graphic

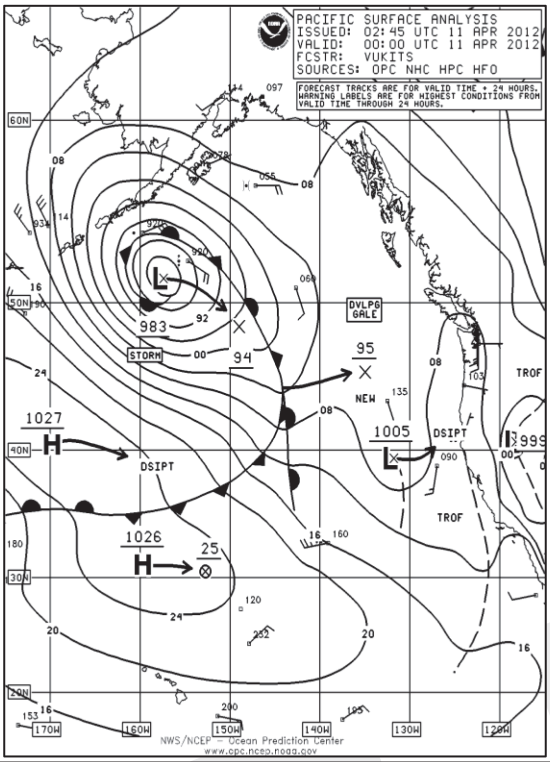
form printed on the base map of area in Mercator projection or stereographic projection for higher latitudes.

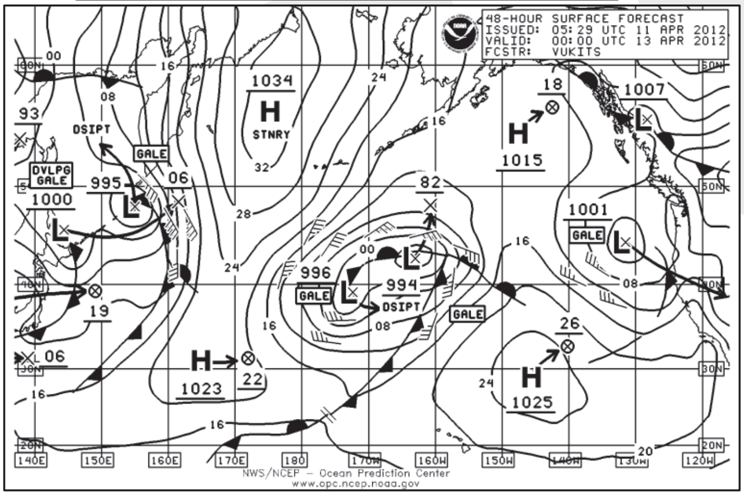
- Admiralty list of radio signals Vol 3 is the reference source for weather broadcast information through weather facsimile. The frequencies employed, times of transmission, the scale and limit of charts and the type of information available is listed in this publication.
- Three primary types of weather charts are issued: upper air charts, surface charts and sea state charts. Additional charts include sea surface temperatures, tropical streamline and surface analyses, and meteorological satellite imagery. The surface charts and the Ice charts are of utmost use to mariners.
- The surface analyses charts depict isobars, surface winds, frontal systems, low and high pressure center positions.
- Each charts type is further available in two forms:
  - Analysis – showing the actual situation existent at a given time, based on actual reports received.
  - Prognosis – showing the predicted situation at a specified time based on present indications, as deduced by experts on subjects.
- Mariners can then make their own inferences on how specific weather systems will impact their vessels. Weather facsimile is an important tool that can aid in the independent decision making process for crew safety, protection of the ship, prevention of cargo damage, and maintaining schedules.

**Symbols used on weather facsimile charts:**




**Surface analysis chart and surface prognosis chart / forecasts**




**5) Weather warnings on MF/VHF**

In some coastal states forecasts and storm warnings of interest to the mariner are also issued on VHF and MF from the local centers of MRCC and by coastguard. The details regarding the channels and broadcast schedules are available locally.

**6) International Ice Patrol**

- International Ice Patrol monitors the iceberg danger near the Grand Banks of Newfoundland and provides the iceberg limit to the maritime community.
- The iceberg analysis is published in text bulletins and a graphical chart by 0000UTC and when changing conditions require a revision. NAIS iceberg bulletin and NAIS iceberg chart are sent to mariners via SafetyNET, NAVTEX, Simplex Teletype over Radio (SITOR), email, and the world-wide web.

- During the ice season, from February 1st through July 31, the U.S. Coast Guard International Ice Patrol actively patrols the area of the Grand Banks of Newfoundland for the extent of iceberg danger.
- During the off season the responsibility is transferred to the Canadian Ice Service, who works closely with the International Ice Patrol under the North American Ice Service. This partnership ensures accurate products are delivered to mariners year-round.

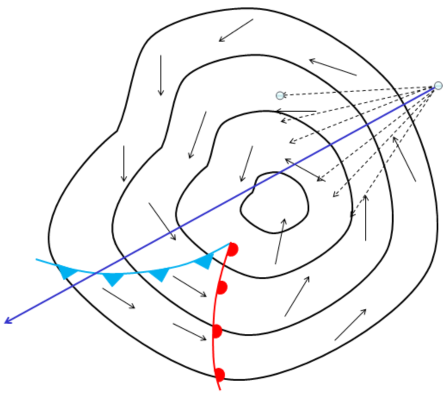
**7) Voluntary observing ships (VOS)**

- The VOS meteorological reports provide vital real time feedback on ocean weather conditions to weather forecasters. This data is used to improve the quality of the forecasts and warnings issued through the SafetyNET Maritime Safety Information and the international NAVTEX services for mariners at sea.
- In accordance with the provisions of SOLAS regulation V/5, the ships are encouraged to collect meteorological data at sea and transmit in the form of weather reports.
- Ships are equipped with fairly basic sensors to measure air and sea temperature, pressure and sometimes wind. The other meteorological parameters, i.e. cloud, visibility, weather and wave or state of sea are provided by visual estimate from a ship officer.
- Under GMDSS, meteorological observations from ship can be sent free of charge via the Inmarsat satellite system using transmission code 41. The cost of transmission is paid by the meteorological service of the receiving country.
- When in the vicinity of a tropical cyclone or of a suspected tropical cyclone, ships shall try to transmit their weather observations at more frequent intervals.

**8) Weather routeing and forecasting**

- In tropical regions such as North Indian Ocean and China Sea, climatological routeing is quite successful as seasonal variations are fairly regular and systematic in these areas. Climatological routeing is the route plan made on the basis of the expected weather as per the seasonal weather trends. In the Southern Atlantic, South Pacific and Indian Ocean also, it is the only method recommended due to lack of sufficient observations. In temperate latitudes of North Atlantic and North Pacific, day to day changes of weather are so drastic due to fronts and frontal depressions, that seasonal routeing is inadequate. So the ideal route for a particular passage is different from the previous and hence the method of weather routeing is followed.

- **Method of weather routeing**



  - ➢ A weather facsimile is required for weather routeing.
  - ➢ Ship's performance curves shall be prepared from old records and logbooks.
  - ➢ The prognosis wave charts are then received from weather facsimile.
  - ➢ Tracks for 12h/ 24h intervals are plotted as radial lines, from the ship's intended shortest track.
  - ➢ The current for duration is then applied and the locus 1 is plotted.
  - ➢ From this locus, courses of large deviation from the intended track are rejected and locus 2 is plotted in the similar fashion as above.
  - ➢ After drawing a number of loci as above, the best route to destination is selected on the basis of most favorable weather conditions in terms of the safe and economical transit.
  - ➢ Shore based routeing services are also available for the above. Details are provided in ALRS volume 3.

- **Stability of air**
  Atmosphere is said to be stable when the distribution of temperature and humidity with height are such that any small displacement of a parcel of air invokes forces that tend to restore the parcel to its former level.

  Atmosphere is said to be unstable when the distribution of temperature and humidity are such that any small displacement of a parcel of air invokes forces that tend to move it further away from its former level.

- **Forecasting surface wind**
  It can be done by measuring the distance between two isobars (4mbar) difference and seeing it with difference to the latitude in the given table which gives the geostrophic wind. This wind speed is accurate as surface wind speed if the isobars are parallel. If curvature is there, then correction is to be applied which is given in tables.

- **Forecasting sea temperature and sea fog**
  Forecasting sea temperature is important to forecast sea fog. The sea temperature is predicted by the temperature gradient which can be obtained from routeing charts. In areas where large steep temperature gradients occur, sudden temperature changes may be encountered. High fog frequency can be expected in these areas. Formation of sea fog depends on small changes in air temperatures, upon the magnitude and sign of temperature difference between sea and air temperature and the wind speed. When the dew point of air is higher than the sea surface temperature, sea fog may be expected. A wind speed 3 knot is most favourable. Temperature inversion can be made out by funnel smoke hanging about in horizontal streaks, caused by considerable cooling of lower layers of air already present. This condition may lead to shallow fog formation.

**Apply Your Knowledge**

1. Check if your vessel is using any of the Weather Routeing services. Identify the specific alterations advised by the service recommending the ship to deviate from the normal route.

**Function:** Navigation

**Competence:** Plan and conduct a passage and determine position

**Task number:** A1.9

**Sub-task Reference number:** A1.9.11

**Topic:** Meteorology

**Task Heading**
- Identify procedures to reduce the adverse effects of heavy seas.

**Objectives**
- Understanding heavy weather conditions and preventive actions for minimising adverse effects

**Index**



**Description**

**1. Introduction**

- At sea, experiencing heavy weather is not uncommon. Ships are suitably constructed and strengthened to withstand stresses which the ship will be exposed to at sea. However, sea conditions, cargo distribution on the vessel and age of the vessel are factors which are dynamic in nature, varying from time to time, which necessitate prudent response to tackle heavy weather conditions.

- With respect to heavy weather, the preparedness can be covered under heads as mentioned below.

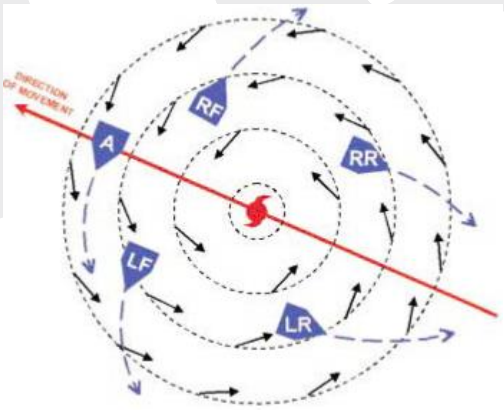
**2. Preparing for heavy weather – ship keeping**

- Heavy weather precautions must be taken BEFORE onset of heavy weather.
- Inform master, engine room and the crew of approaching weather conditions.
- All movable objects on deck and below deck shall be secured. Particular attention is to be paid to securing of derricks and cranes, movable objects in accommodation / deck stores / mast houses and under-deck stores, galley and cold stores. Special attention should to be paid to securing paint, lubricant and chemical stores.
- Cargo lashings shall be checked and tightened.
- All mooring ropes on the mooring winches shall be secured and covered.
- Spurling pipe steel-covers shall be checked in position, cemented over and covered.
- The brake shall be well tightened to ensure the anchor cable does not slip. Bow stopper shall be used under heavy weather conditions to avoid chain slipping.
- Gangways shall be secured and gangway motors covered with canvas covers.
- Close all watertight doors, portholes and deadlights including duct keel opening in engine room, if any and trim all ventilators, hatches are securely battened down, secure air pipes, booby hatch covers, ventilator flaps and openings in closed position.

- All eductor valves / overboard discharge valves forward checked and ready for de-watering.
- Bilge pumping arrangements shall be checked for working condition so that in case of accidental flooding of holds, stores, peak tanks, cofferdams, chain lockers, etc. same can be pumped out without difficulty.
- Life boats and liferaft lashings shall be checked and tightened. Lifeboat equipment checked for lashings.
- Signal halyards and other relevant cordage shall be slackened.
- Safety lines, hand ropes shall be rigged where necessary. Exposed deck areas made dangerous by the weather shall be avoided by crew and no one shall be allowed to go to such area without prior consent from navigation bridge.
- If the crew is required to enter the open deck areas affected by heavy weather, the course shall be adjusted in such a way to provide a safe lee-side to such personnel on deck.
- Prudent seamanship shall always be exercised to reduce risk of damage in heavy weather.

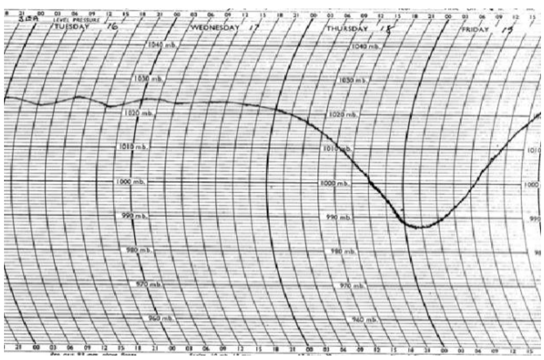
**3. Watchkeeping and ship handling**

- Proper lookout, and if required, additional lookouts shall be posted in heavy weather. Fog signals shall be sounded when visibility is restricted.
- Hand steering shall be engaged in due time.
- Present and forecast weather condition shall be closely monitored.
- If necessary, courses shall be adjusted and speed reduced to avoid heavy weather damage.
- Structural damage is likely to occur when pitching in heavy seas and it is thus even more important to ensure that an early and substantial reduction of speed and or course alteration is made in order to successfully weather heavy seas on the bow.




*www.nhc.noaa.gov/marinersguide.pdf*

- Ship's stability data shall be cross checked while voyage planning.
- Vessel shall not be let into synchronous rolling or pitching.
- Fully developed tropical storms must be given a berth of at least 200 nautical miles.
- When navigating near the tropical cyclone, it is important to first analyse the own position with respect to the right hand and left hand semi circles and the dangerous quadrant to decide on the follow up.
- Great caution must be exercised in crossing ahead of a tropical storm, especially near the latitudes, where re-curving of the storms can be expected.
- Company SMS navigation checklists for heavy weather shall be followed by OOW. A record should be maintained of all events. Hourly log-entries of meteorological conditions prevailing and vessel's behaviour made.



**4. Monitoring and reporting weather**

- All pertinent weather reports shall be obtained. A close study of local weather conditions as observed shall be done on the vessel in order to track the approaching storm or dangerous conditions for avoiding

- Monitor weather frequently, try and receive weather reports from all available sources such as Sat –C, weather fax and Navtex.
- Weather facsimile plotters shall be checked for checking synopsis (current status) and prognosis (forecast).
- Barometer readings shall be checked and recorded at regular intervals.
- Barograph trace shall also be observed for seeing the diurnal variation of pressure.
- The track of the tropical cyclone shall be regularly monitored and ship's route shall always be planned keeping the vessel out of the projected danger zone. Utmost care shall be taken when nearing the area where the storm re-curves.
- Services of weather routeing organisations when considered beneficial shall be used. However, it shall be noted that forecasts and recommendations of these sources are based on historical data and anticipated barograph trace, movement of weather systems. Whilst they may provide useful guidance, they shall not be used as a substitute for careful observation of prevailing weather conditions.

**5. Heavy weather damage**

- In case of heavy weather damage, an accurate risk assessment must be made of the extent of damage and its impact on the structural integrity and stability of the vessel.
- Heavy weather damage could include the following:
  - Structural damage
  - Equipment damage
  - Cargo damage
  - Personal injury
  - Environmental pollution
- If the vessel has sustained structural damage, which may affect the watertight integrity of the vessel, then additional measures as required for flooding/structural failure should be initiated.
- Emergency SMS checklist shall be followed.
- Relevant company offices must be informed immediately in all cases initially a first information and then with a detailed report.

**Apply Your Knowledge**

1. Identify the strengthening members on the hull forward and aft provided to withstand the heavy weather forces.
2. Discuss the phenomenon of synchronous rolling and identify its hazards.

**Function:** Navigation

**Competence:** Plan and conduct a passage and determine position

**Task number:** A1.9

**Sub-task Reference number:** A1.9.12

**Topic:** Meteorology

**Task Heading**

➢ Derive meteorological information from routeing charts and demonstrate the use of wind roses

**Objectives**

➢ Understanding and interpreting the information available from routeing charts. The information available from routeing charts and its interpretation is described in detail.

This task supplements the task A1.3.4.10

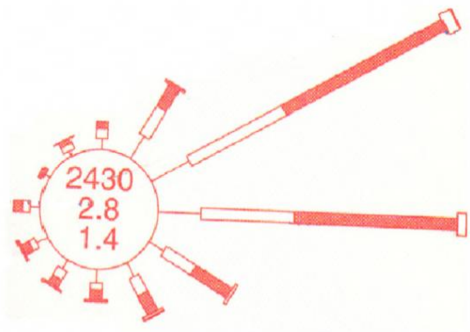
**Index**

1) Routeing charts
2) Wind rose
3) Ocean currents
4) Recognized shipping routes between major ports, with distances and load line zones
5) Low visibility and frequency of storms, sea and air temperature, air pressure

**Description**

- **Routeing charts**

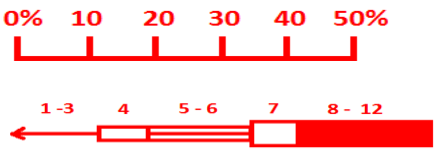
- The UKHO series of routeing charts provides a comprehensive resource for Mariners. These charts are drawn with the data mainly collected from "World Meteorological Organization" (WMO) and their publications such as ocean meteorological atlases, current atlases etc. These charts are essential for use in planning passages across oceans.
- Each of these charts has twelve versions, one for each month, total sixty in number. Seeing any single chart the expected meteorological and oceanographic conditions in the respective ocean during the indicated month of the year can be known.
- These charts are to be used in conjunction with the publication admiralty ocean passages for the world (NP 136).
- Across the outline of the surrounding land areas and the positions of the major ports, these charts provide expected meteorological information across oceans, which includes:
    - ➢ Data on wind speed, direction and force,
    - ➢ Data on ocean currents
    - ➢ Recognized shipping routes between major ports, with distances
    - ➢ Incidence of low visibility and frequency of storms
    - ➢ Data on sea and air temperature, air pressure
    - ➢ Ice limits



  - Limits of load line zones and the locations of ocean weather ships
- Five routeing charts numbered as follows cover oceans of the world as follows.
  Chart number Name of the ocean
  - BA5124 North Atlantic Ocean
  - BA5125 South Atlantic Ocean
  - BA5126 Indian Ocean
  - BA5127 North Pacific Ocean
  - BA5128 South Pacific Ocean

- **Wind rose**

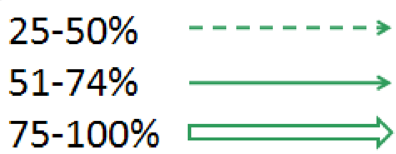
- Wind rose is a circular diagram on the routeing chart showing the prevailing winds in a particular location due a certain month of the year. The arrow direction indicates the direction of the wind. The thickness of the arrow indicates the wind force.




- The length of each red or white bar sticking out of the rose gives the proportion of observations in each of five wind ranges: Force 1-3 / 0-10 knots, Force 4 / 11-16 knots, Force 5-6 / 17-27 knots, Force 7/ 28-34 knots and force 8-12 / above 34 knots.
- The length of the arrow indicates percentage frequency on the scale. The frequency scale is 2 inches long corresponding to 100%. From the head of the arrow to the circle is 5% and provides a ready means of estimating the percentage frequency of winds in the shown direction and speed.
- At the centre of the wind rose, the upper figure shows the number of observations; the middle figure gives the percentage frequency of variable winds and the lower figure the calms in each rose location.
- The wind rose show in the adjoining figure has been computed from 2,430 observations as shown by the number in the circle. The two numbers in the circle below this figure give the percentage of variable winds which is 2.8 % in this case and the probability of no wind respectively (1.4%).

- **Ocean currents**

- The arrows in green colour mark the predominant direction of sea- surface currents for the quarter of the year as mentioned on the chart.
- The constancy of the probability is shown by the type of arrow as mentioned in the adjoining figure.




- Where the number of observations is insufficient, the probable direction is shown by dotted arrow.
- The figures in between the current arrows show the mean rate in knots. Symbols > or < preceding the rate figure of current indicate the prevailing rates are slightly higher or lower than the mentioned numbers.

- **Recognized shipping routes between major ports, with distances and load line zones**

- Recommended routes between ports are shown considering the weather conditions expected enroute.
- The distances shown are great circle route distances in sea miles. Use of ocean passages for the world and the admiralty distance tables and load line zones chart is recommended further for getting the suitable detailed information.
- The load line zones applicable for the time of the year in the sea area are also shown on the chart. These are shown by thick long lines with different shades on two sides as shown in the figure below.

- **Low visibility and frequency of storms, sea and air temperature, air pressure**

- Incidences of low visibility and fog, frequency of storms and winds of force 7 and more, data on mean sea temperatures, mean air temperatures and dew point temperatures in degrees Fahrenheit, mean air pressure in milli-bars is shown on small sub-sections printed on the main chart.
- The values are shown on the charts by the help of curves. For any intermediate position, the values can be interpolated.
- The ice limits are shown on the routeing chart by curves bounding the regions.

**Apply Your Knowledge**

1. Refer to the Routeing charts for the region and Ocean passages for the world; check the shortest route and the recommended route from Fujairah (UAE) to Mombasa (Kenya) in the month of August. Discuss the differences observed with your Shipboard Training Officer.

**Function:** Navigation

**Competence:** Plan and conduct a passage and determine position

**Task number:** A1.9

**Sub-task Reference number:** A1.9.13, A1.9.14

**Topic:** Meteorology

**Task Heading**

- Calculate tides for a standard and a secondary port from the tide tables and obtain:
  iii. Height of tide for a given time
  iv. Time on a given date for a particular height of tide.
- Determine the direction and the rate of tidal stream at locations marked on chart by tidal diamond (symbol ◊) and also obtain tidal information from software in use.

**Objectives**

- To learn the basics of tides, related calculations to estimate the time and heights of tide at different ports and the rate and direction of tidal streams

Please read this task in conjunction with task A1.3.4.8

**Index**

1) Tides
2) Tidal terminology
3) Effect of weather on tides
4) Admiralty tide tables – layout and Use
5) Calculation I – Daily predictions of high water and low water for standard ports
6) Calculation II – Height of tide at a given time (standard port)
7) Calculation III – Time for desired height of tide on a given date (standard port)
8) Calculation IV - Tidal predictions for secondary port
9) Use of co-tidal / co-range charts
10) Use of tidal diamonds and tidal stream tables on the chart
11) Use of admiralty tidal stream atlases
12) Admiralty tidal publications

**Description**

**1) Tides**

Tides are the periodic rise and fall in the level of seas. In mid ocean, where the depth of water is large, the tidal range is small, but where the waters are shallow, the tidal range increases. Various theories have been put forward for the cause of tides. The equilibrium theory advanced by Sir Isaac Newton is generally accepted as the major basis on which tides occur, since the actual tides observed are normally in general agreement with the tides computed according to this theory.

**2) Tidal terminology**

**a) Spring tide**

At full and new moons when the sun is in conjunction and opposition with the moon, these two tide raising forces act in the same line producing very high high waters and very low low waters. The range of tide would then be large. These are known as spring tides.

b) **Neap tide**

When the moon is in quadrature, the tide raising forces due to the sun and that due to the moon, act in direction 90° to each other. The solar tide then tends to produce a high water at points where low water occurs due to the lunar tide and vice versa. Thus at such times, the luni-solar high waters are not very high and the luni-solar low waters are not very low. Therefore the range of tide then is not very large. These are called neap tides.

When the moon is in the first or third quarters of its orbit around earth, the luni-solar high water will occur before moon's transit. The tide is then said to **PRIME**.

During the second and the last quarter of moon's orbit, the luni-solar high water occurs after the moon's transit. The tide is then said to **LAG**.

c) **Equinoctial and solstitial tides**

At the equinoxes in March and September, when the declinations of the moon and the sun are both zero, the semi-diurnal, luni-solar tide raising force will be at its maximum, thus causing the equinoctial tides. Tides higher than normal spring tides will occur.

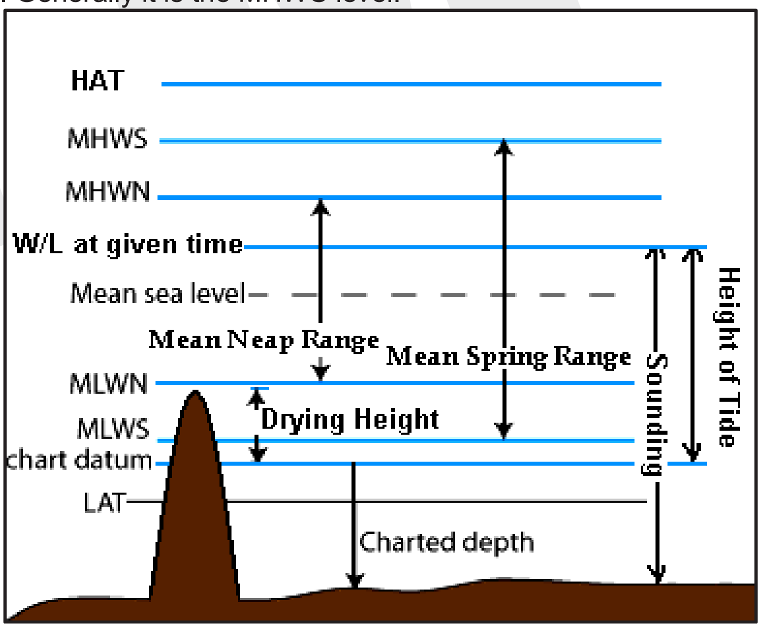
At the solstices in June and December, when the declinations of the moon and the sun are both at maximum, the diurnal luni-solar tide raising force will be at the maximum, thus causing the solstitial tides. Spring tides lower than normal will occur.

d) **Chart datum**

The low water reference level to which all depths indicated on the chart and all heights of features which are periodically covered and uncovered by the sea is called chart datum. The datum is so chosen that the tide will not usually fall below that level.

e) **Height datum**

This is the datum from which heights of all shore structures as such as light houses is measured. Generally it is the MHWS level.




f) **Height of tide**

It is the vertical distance between the chart datum and the sea level at that time.

g) **High water**

The highest level reached by sea during tidal oscillations.

**h) Low water**
The lowest level reached by sea during tidal oscillations.

**i) Mean high water springs**
(MHWS) is the average height, throughout the year, of two successive high waters during 24 hours in each semi lunation, when the range of tide is greatest.

**j) Mean high water neaps**
(MHWN) is the average height, throughout the year of two successive high waters during a period of 24 hours, in each semi-lunation when the range of tide is least.

**k) Mean low water springs**
(MLWS) is the average height, throughout the year, of two successive low waters during 24 hours in each semi lunation, when the range of tide is greatest.

**l) Mean low water neaps**
(MLWN) is the average height, throughout the year of two successive low waters during a period of 24 hours, in each semi-lunation when the range of tide is least.

The values of MHWS, MHWN, MLWN and MLWS vary from year to year in a cycle of approx. 18.6 years.

**m) Highest and lowest astronomical tide**
(HAT & LAT) are the highest and lowest tides that are possible to predict at standard ports, under average meteorological conditions and under any combination of astronomical conditions. HAT and LAT are not extreme levels as there are occasions such as storm surges which may cause considerably higher or lower levels to occur.

**n) Flood tide**
It is the inflow of water due to a rising tide.

**o) Ebb tide**
It is the outflow of water due to a falling tide.

**p) Tidal stream**
It is the periodical horizontal movement of sea water due to the tide raising forces of the sun and the moon.

**q) Slack water**
It is the period when the tidal stream is at its weakest.

**r) Mean sea level**
Mean sea level (MSL) is the average level of the sea surface over a long period, preferably 18.6 years, or the average level which could exist in the absence of tides.

**s) Mean tide level**
It is calculated as the mean of heights of MHWS, MHWN, MLWN and MLWS for a port.

**3) Effect of weather on tides**

Meteorological conditions which differ from average cause corresponding differences between the predicted and actual tide. Tidal predictions are computed for average barometric pressure. A low barometric pressure tends to raise the sea level whereas a high pressure tends to lower the sea level. A difference of average 34m bar can cause a difference in height of about 0.3m. The change caused due to barometric pressure seldom exceeds 0.3m.

The effect of wind on sea level largely depends on the topography of the coast line. Wind tends to raise the sea level in the direction towards which it is blowing. The winds blowing off the land have the effect of lowering the sea level. Also, when blowing along the coast line, winds tend to set up long waves which travel along the coast. Raising sea level at crests and lowering in troughs. These waves are also known as storm surges.

## 4) Admiralty tide tables – layout and use

Admiralty tide tables are published annually in four volumes for a worldwide coverage as follows:

Volume 1 - United Kingdom and Ireland (including European Channel Ports)
Volume 2 - Europe (excluding United Kingdom and Ireland), Mediterranean Sea and Atlantic Ocean.
Volume 3 - Indian Ocean and South China Sea (including Tidal Steam Tables)
Volume 4 - Pacific Ocean (including Tidal Stream Tables)

The tide tables are laid out in three parts.

- Part I – Daily tidal predictions for the selected standard ports are mentioned in this part of the tide tables. The front cover of each publication shows an alphabetical index for the standard ports covered in the volume and the respective page numbers.

- Part II – It contains data for tidal predictions at a large number of secondary ports in the form of time and height differences with reference to standard ports mentioned in Part I.

  The data for the ports is given in a serial number for the ports. The secondary ports are shown under the header of the respective standard ports.

- Part III –It mentions the harmonic constants for use with the simplified harmonic method of tidal Prediction. The end of the publication includes the pages with a geographical index in the alphabetical order mentioning the name of the port and the respective serial number. The standard ports are mentioned in bold letters in the list.

## 5) Calculation I – Daily predictions of high water and low water for standard ports

Example – Calculate the time and heights of high and low waters at Dover on 2nd Mar.

Solution –

i. Refer to the geographical index pages of the admiralty tide tables – Vol I.
ii. Check the serial number for the port.
iii. Dover being a standard port is mentioned in bold letters.
iv. The respective page of predictions shows as follows.
v. Tide timings and heights for the port of Dover for 2nd Mar can be read as follows:

**ENGLAND – DOVER**

**LAT 51°07′N LONG 1°19′E**

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

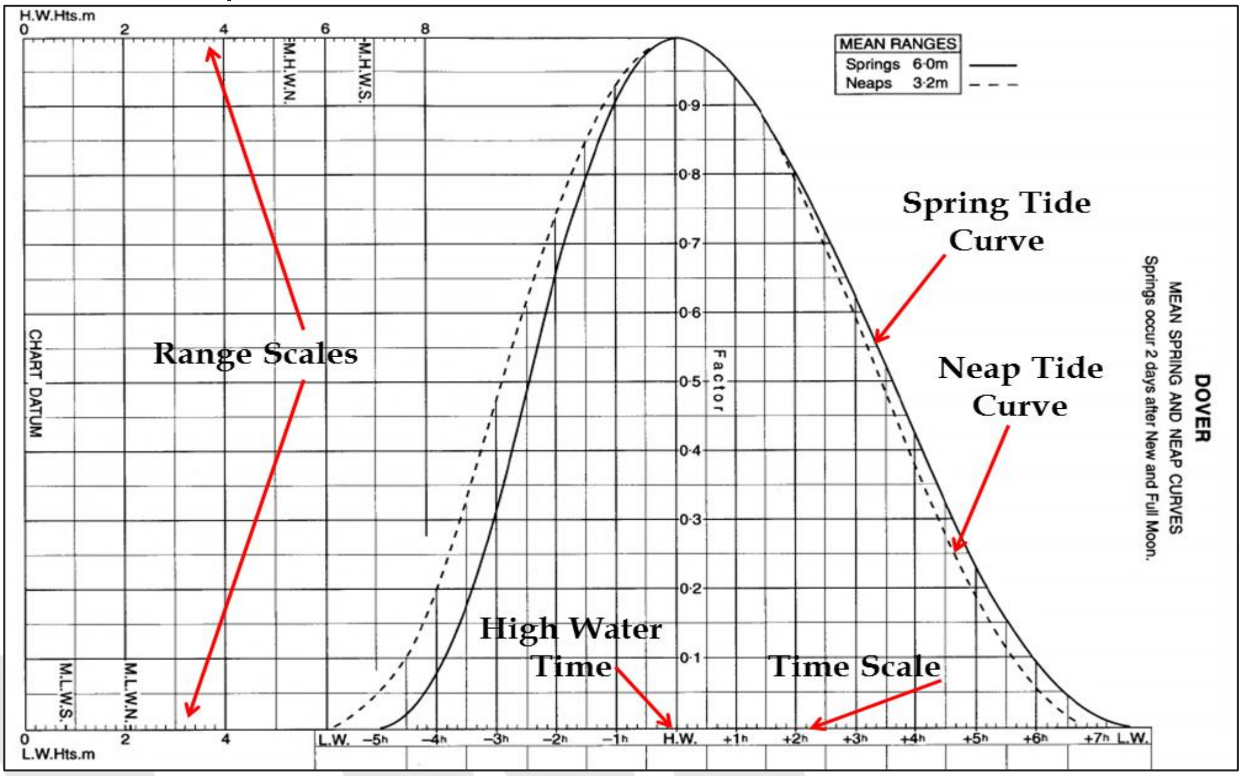
| FEBRUARY | Time | m | | Time | m | MARCH | Time | m | | Time | m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 0246 | 2.2 | **16** | 0224 | 1.9 | **1** | 0200 | 2.4 | **16** | 0209 | 1.9 |
| | 0818 | 5.4 | | 0802 | 5.8 | | 0737 | 5.1 | | 0758 | 5.6 |
| TU | 1515 | 2.0 | W | 1507 | 1.6 | W | 1436 | 2.2 | TH | 1457 | 1.8 |
| | 2050 | 5.5 | | 2041 | 5.8 | | 2014 | 5.3 | | 2033 | 5.7 |
| **2** | 0350 | 1.9 | **17** | 0341 | 1.5 | **2** | 0312 | 2.1 | **17** | 0333 | 1.6 |
| | 0916 | 5.7 | | 0910 | 6.1 | | 0845 | 5.4 | | 0909 | 6.0 |
| W | 1612 | 1.7 | TH | 1626 | 1.3 | TH | 1539 | 1.9 | F | 1622 | 1.4 |
| | 2139 | 5.8 | | 2141 | 6.2 | | 2110 | 5.6 | | 2133 | 6.1 |
| **3** | 0442 | 1.6 | **18** | 0455 | 1.1 | **3** | 0410 | 1.7 | **18** | 0450 | 1.1 |
| | 0959 | 5.9 | | 1009 | 6.4 | | 0932 | 5.7 | | 1005 | 6.3 |
| TH | 1700 | 1.5 | F | 1736 | 1.0 | F | 1632 | 1.5 | SA | 1727 | 1.0 |
| | 2219 | 6.1 | | 2232 | 6.5 | | 2151 | 6.0 | | 2222 | 6.5 |
| **4** | 0525 | 1.4 | **19** | 0559 | 0.8 | **4** | 0458 | 1.4 | **19** | 0550 | 0.8 |
| | 1035 | 6.1 | | 1059 | 6.6 | | 1008 | 6.0 | | 1050 | 6.5 |
| F | 1741 | 1.3 | SA | 1832 | 0.8 | SA | 1718 | 1.3 | **SU** | 1819 | 0.8 |
| | 2254 | 6.3 | O | 2317 | 6.8 | | 2227 | 6.2 | | 2303 | 6.7 |

| Time | Height of Tide |
|---|---|
| 0312h | 2.1m |
| 0845h | 5.4m |
| 1539h | 1.9m |
| 2110h | 5.6m |

**Notes:**

- All predicted heights of tide are in meters.
- Times of high water/ low water are mentioned for time zones same as the official standard times kept at the port. In case daylight saving times are maintained in the region during the months, same need to be applied to get the correct time of high and low water.
- The tidal curves diagram for the port is as shown below.

**Tidal curve for a port**




**6) Calculation II – Height of tide at a given time (standard port)**

Example – Calculate the height of tide at Dover on 2nd Mar, at 1400hrs.

Solution –

i. Reference is drawn to the same pages of tide prediction as used in previous example.

ii. Tidal predictions for DOVER- England on 2nd Mar

| Time | Height of Tide (m) |
|---|---|
| 0312 | 2.1 |
| 0845 | 5.4 |
| 1539 | 1.9 |
| 2110 | 5.6 |

iii. Time 1400 lies between the times mentioned as follows:

| | |
|---|---|
| 0845h | 5.4m |
| 1539h | 1.9m |

iv. The height of low water is 1.9m. This is marked on the left hand side graph, lower range scale, marked as point ‘A’. Height of high water is 5.4m marked on the upper range scale 5.4m as point ‘B’. Points A and B are joined by a straight line.

v. At 1400hrs, the tide is falling tide. So the tidal curve is to be selected on the downward sloping side.

vi. The Ranges of tides at Dover are –
For Spring tide – 6.0m – shown by the continuous curve on the graph
For Neap tide – 3.2m – shown by the pecked curve on the graph

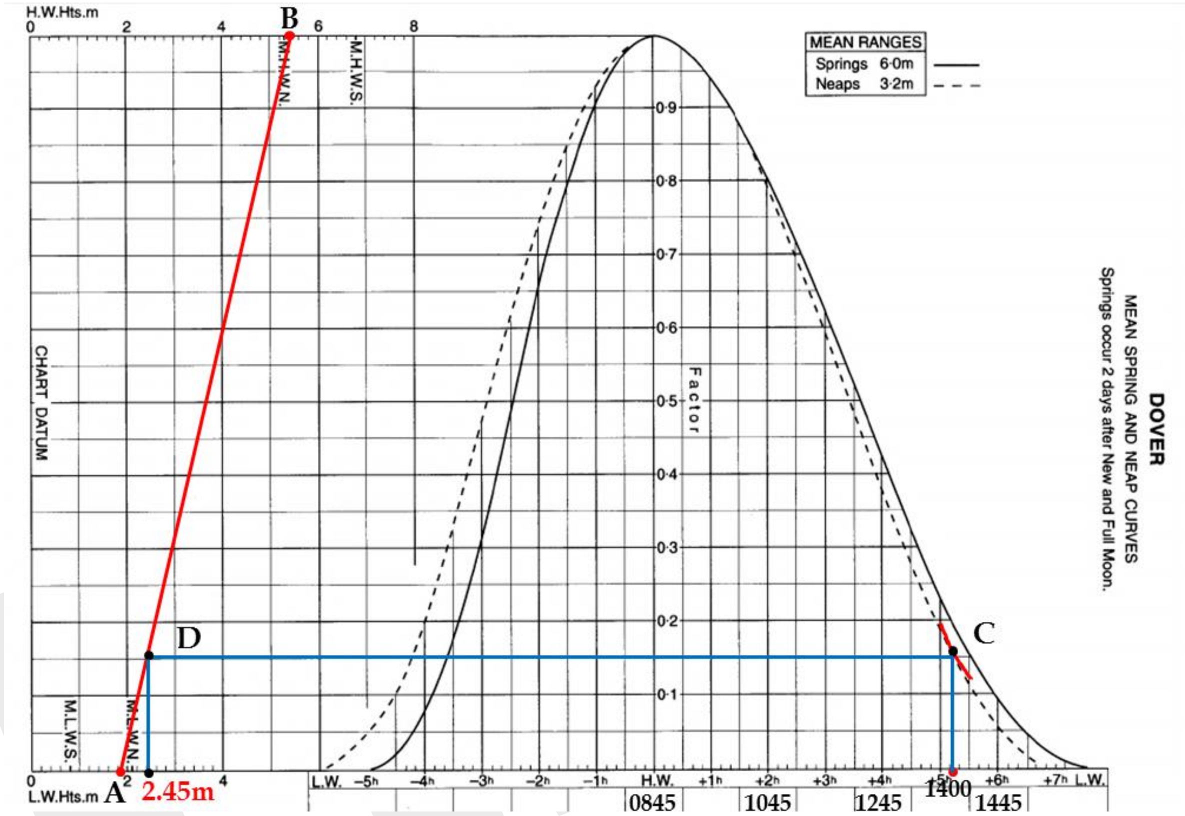
The range of tide is between 5.4m and 1.9m that is 3.5m.
Hence, a curve is drawn representing this tide range, between the two curves.

vii. The time of nearest high water is mentioned at the center of the graph on the time scale, below column H.W. timing. Further entries are made on the scale for before and after time of high water.

viii. Time 1400h being 5h 15min after high water, a vertical is drawn from the time scale. This vertical projects upwards till it touches the curve at point 'C'.

ix. A horizontal is then drawn, from this point C, till it intersects the line joining the tide range.

x. The point of intersection is marked 'D'.A vertical is drawn from point 'D' on the horizontal scale and the predicted height of tide is read from the scale below.




**Notes:**

- The two tidal curves are given for the spring tides and neap tides.
- When the tide range is in between the spring and neap values, a curve is drawn interpolated for the intermediate values, representing the tide range.
- In case the tide range exceeds the limits of spring or neap tides, the curve is NOT to be extrapolated and the extreme nearing curve only shall be used for calculations.
- The curve shall be selected for the rising or falling slope for rising or falling tides respectively.
- ATT Vol – I has individual curves for all standard ports, whereas in other volumes one tidal curve diagram is provided to be used for all ports.
- Same scales shall be used for marking the heights of high water and low water on the range scale.
- For secondary ports, the tidal curve graphs for the standard ports are to be used.

## 7) Calculation III – Time for desired height of tide on a given date (standard port)

Example – Calculate the time on 2nd Mar morning, falling tide, for height of tide 4.0m at Dover.

Solution –

i. Reference is drawn to the same pages of tide prediction as used in previous example.

ii. Tidal predictions for DOVER- England on 2nd Mar

| Time | Height of Tide (m) |
|---|---|
| 0312 | 2.1 |
| 0845 | 5.4 |
| 1539 | 1.9 |
| 2110 | 5.6 |

iii. Desired height of tide is lies between the times mentioned as follows:

| | |
|---|---|
| 0845h | 5.4m |
| 1539h | 1.9m |

iv. The height of low water is 1.9m. This is marked on the left hand side graph, lower range scale, marked as point 'A'. Height of high water is 5.4m marked on the upper range scale 5.4m as point 'B'. Points A and B are joined by a straight line.

v. At the tide is falling tide, the tidal curve is to be selected on the downward sloping side.

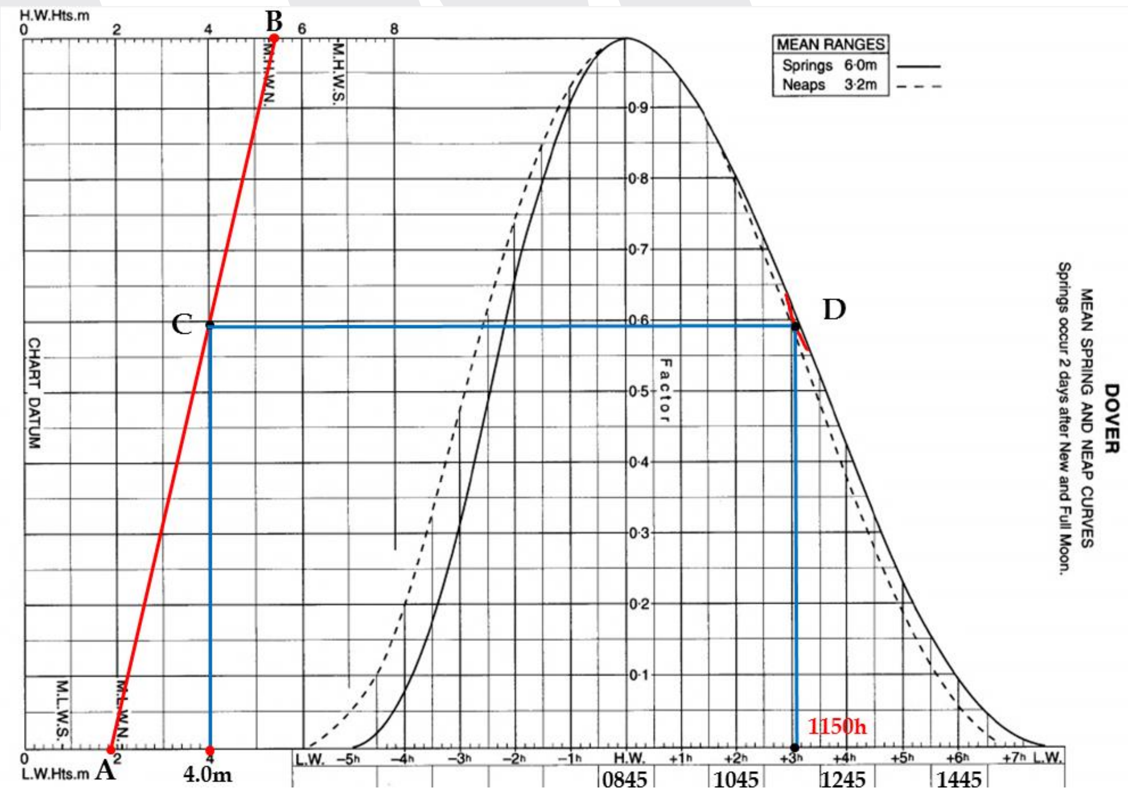
vi. The Ranges of tides at Dover are –
For Spring tide – 6.0m – shown by the continuous curve on the graph
For Neap tide – 3.2m – shown by the pecked curve on the graph
The range of tide is between 5.4m and 1.9m that is 3.5m.
Hence, a curve is drawn representing this tide range, between the two curves.

vii. The time of nearest high water is mentioned at the center of the graph on the time scale, below column H.W. timing. Further entries are made on the scale for before and after time of high water.

viii. For the desired height of tide 4.00m, a vertical is drawn from the range scale. This vertical projects upwards till it touches the tide range line at point 'C'.

ix. A horizontal is then drawn, from this point C, till it intersects the interpolated tide curve drawn for the current tide range.

x. The point of intersection is marked 'D'. A vertical is drawn from point 'D' on the horizontal scale and the predicted time is read from the scale below.



## 8) Calculation IV - Tidal predictions for secondary port

Example - Calculate tidal predictions on 2nd Mar for port Barry (standard port - Port of Bristol (Avonmouth) -England)

i. Name of the port and its serial number is given in the geographical index given at the end of the publication. For Barry – the serial number is 513.

ii. In the tide tables part II, the tables are entered searching for the serial number 513. The tables show standard port for Barry as Port of Bristol (Avonmouth).

iii. The predictions for Port of Bristol (Avonmouth) are as follows:

| Time | Height of Tide (m) |
|---|---|
| 0421 | 10.2 |
| 1036 | 3.2 |
| 1651 | 10.6 |
| 2313 | 3.0 |

iv. Difference tables for Barry are as follows:

v. The predictions for a secondary port are calculated using tidal prediction form given in the tide tables. The format is as follows:

**WALES; ENGLAND, WEST COAST**

| No. | PLACE | Lat. N. | Long. W. | TIME DIFFERENCES High Water Zone U.T.(G.M.T.) | | Low Water | | HEIGHT DIFFERENCES (IN METRES) MHWS | MHWN | MLWN | MLWS | M.L. $Z_0$ m. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 523 | **PORT OF BRISTOL (AVONMOUTH)** ..... | (see page 162) | | **0600 and 1800** | **1100 and 2300** | **0300 and 1500** | **0800 and 2000** | **13.2** | **9.8** | **3.8** | **1.0** | |
| 513 | Barry ............................ | 51 23 | 3 16 | –0030 | –0015 | –0125 | –0030 | –1.8 | –1.3 | +0.2 | 0.0 | 6.09 |

SEASONAL CHANGES IN MEAN LEVEL

| No. | Jan. 1 | Feb. 1 | Mar. 1 | Apr. 1 | May 1 | June 1 | July 1 | Aug. 1 | Sep. 1 | Oct. 1 | Nov. 1 | Dec. 1 | Jan. 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 476 – 482 | +0.1 | 0.0 | 0.0 | –0.1 | –0.1 | –0.1 | 0.0 | 0.0 | 0.0 | 0.0 | +0.1 | +0.1 | +0.1 |
| 482a – 512 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | –0.1 | 0.0 | 0.0 | 0.0 | +0.1 | +0.1 | 0.0 |
| 513 – 534 | 0.0 | 0.0 | 0.0 | –0.1 | –0.1 | –0.1 | 0.0 | 0.0 | +0.1 | +0.1 | +0.1 | 0.0 | 0.0 |
| 535 – 544a | +0.1 | 0.0 | 0.0 | –0.1 | –0.1 | –0.1 | 0.0 | 0.0 | 0.0 | 0.0 | +0.1 | +0.1 | +0.1 |

### Tidal Prediction Form

STANDARD PORT.................................... TIME/HEIGHT REQUIRED.........................

SECONDARY PORT.................................... DATE.................TIME ZONE...................

| | TIME | | HEIGHT | | |
|---|---|---|---|---|---|
| STANDARD PORT | HW | LW | HW | LW | RANGE |
| | 1 | 2 | 3 | 4 | 5 |
| Seasonal change | Standard Port | | 6 | 6 | |
| DIFFERENCES | 7* | 8* | 9* | 10* | |
| Seasonal change | Secondary Port | | 11 | 11 | |
| SECONDARY PORT | 12 | 13 | 14 | 15 | |
| Duration | 16 | | | | |

### <u>Tide calculations for port Barry</u>

| | | | |
|---|---|---|---|
| **Standard Port** | Port of Bristol (Avonmouth) | | |
| **Secondary Port** | Barry | | |
| **Date** | 2 Mar | **Sec Port Time zone** | GMT |
| | **Time** | | **Height** |

| | HW | HW | LW | LW | HW | HW | LW | LW |
|---|---|---|---|---|---|---|---|---|
| **Standard Port** | 0421 | 1651 | 1036 | 2313 | 10.2 | 10.6 | 3.2 | 3.0 |
| **Seasonal Change for Standard Port ( - )** | | | | | 0.0 | 0.0 | 0.0 | 0.0 |
| **Differences for Sec Port** | - 0026 | -0028 | -0050 | -0055 | -1.35 | -1.41 | +0.15 | +0.14 |
| **Seasonal Change for Secondary Port ( + )** | | | | | 0.0 | 0.0 | 0.0 | 0.0 |
| **Secondary Port** | 0355 | 1623 | 0946 | 2218 | 8.85 | 9.19 | 3.35 | 3.14 |

**Tidal predictions for Barry on 2nd Mar**

| **Time** | **Height of Tide (m)** |
|---|---|
| 0355 | 8.85 |
| 0946 | 3.35 |
| 1623 | 9.19 |
| 2218 | 3.14 |

**Notes**

- The times of high/low water as calculated above are in the time zone of the secondary ports. Any difference in the zone time of standard and secondary port has no significance and no correction is required for zone time.
- Tidal timing and heights for the secondary ports are calculated using the standard port predictions and applying the differences for correction.
- These differences are tabulated for mean spring and neap levels at the standard ports.
- The predictions for the standard ports include seasonal variations for the standard port. These shall always be SUBTRACTED algebraically from the predictions for the standard port.
- The next step is to apply time and height differences to the standard port predictions. The values are interpolated as follows:

**Interpolating differences for time –**

The time of the predicted high water is noted for the standard port.
The differences for time are mentioned in the below format (extract from above example)

| Time Differences | | | |
|---|---|---|---|
| High Water | | Low Water | |
| 0600<br>And<br>1800 | 1100<br>And<br>2300 | 0300<br>And<br>1500 | 0800<br>And<br>2000 |
| -0030 | -0015 | -0125 | -0030 |

Time of high water is 0421h.
This lie between the interval 2300h and 0600h
Corresponding differences -0015h -0030h
Hence for 0421hrs the differences can be interpolated as -0026h.

**Interpolating differences for height –**

Before calculating differences for height, the seasonal correction for the standard port shall be subtracted from the predictions.
The differences are then calculated for the corrected heights.
The differences for time are mentioned in the below format (extract from above example)

| Height differences in metres | | | |
|---|---|---|---|
| MHWS | MHWN | MLWN | MLWS |
| 13.2 | 9.8 | 3.8 | 1.0 |
| -1.8 | -1.3 | +0.2 | 0.0 |

Corrected height of high water is 10.2m.
The values for high water are 13.2m and 9.8m
Corresponding differences -1.8m -1.3m
Hence for height 10.2m the differences can be interpolated as -1.3m.

In cases where the standard port predicted height falls beyond the range as mentioned in correction tables, the values shall be extrapolated.

- The next step is to apply the seasonal changes for the secondary port. These are always ADDED algebraically.
- The above interpolation can be done graphically as well.
- The secondary ports are those ports on a stretch of coast where there is little change of shape between adjacent standard port curves and where the duration of rise and fall at the secondary port is not markedly different from that of the standard port.
- For calculating intermediate heights and times of tide for secondary ports, curves of the standard port are to be used.
- Tidal predictions for the stretches of coastline and offshore area shall be obtained using Co-Tidal charts.
- In the ATT Vol II, III& IV the values for secondary ports are given in a different format. The time differences re not mentioned for time range. These are mentioned in the same format as height correction. The differences are calculated in the same manner as height differences and applied.
- The tidal predictions for secondary ports can also be calculated by using harmonic constants and the simplified harmonic method of tidal prediction. Admiralty tidal handbook shall be referred or the same.

**9) Use of co-tidal / co-range charts**

Example - Find the time and height of high water at a position latitude 50º 24' N, Longitude 00º 48' W during the morning of 16th March 1995.
Standard Port: PORTSMOUTH

Extract from Tables
MARCH16

| | |
|---|---|
| 0402 | 0.9 |
| 1045 | 4.5 |
| 1621 | 0.7 |
| 2312 | 4.7 |

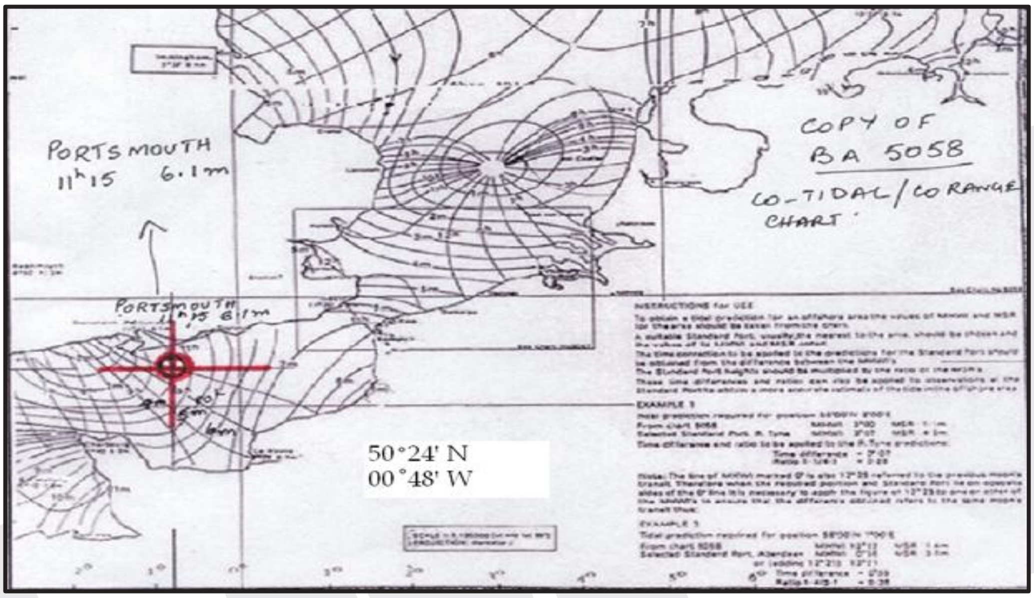
| | **MHW1** | **MSR** |
|---|---|---|
| Required Position | 10h 30 m | 4.0 |
| PORTSMOUTH | 11h 15m | 6.1 |
| Time difference | 0h 45m | Height Ratio 4.0/ 6.1 |

Height = 4.5 metres
Required height = 4.5 x 4.0/6.1 = 2.95metres
Here as the required position will have MHW1 earlier than the standard port,
HW Portsmouth: 10h 45m
Time difference: - 0h 45m
Required HW Time = 10h 00m
The time and height of tide of AM high water at position 50º24' N & 000º48' W on 16th March 95 is

Time = 1000hrs        Height = 2.95m

**Notes:**

- Co-tidal charts are provided for the purpose of obtaining the times and heights of high water in offshore areas and in places between secondary ports.
- Co-tidal lines are lines joining places which all have same Mean High Water Interval (M.H.W.I).
- Co-range lines are lines, which join places having the same Mean Spring Range (MSR).
- M. H. W. I. is the interval between the moon's meridian passage at Greenwich and the next high water time at a particular place.
- M. S. R. is the range between Mean High Water Springs and Mean Low Water Springs.

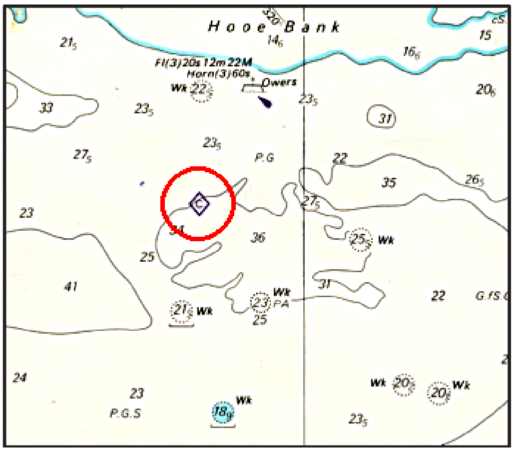



**10)** **Use of tidal diamonds and tidal stream tables on the chart**

The admiralty navigation charts have the coastal areas marked with alphabets in a diamond shape, called the tidal diamonds for the position. These tidal diamonds are to be used in conjunction with the tidal stream table provided on the chart.

The tidal stream table on the chart contains all the tidal diamonds mentioned on the chart with their geographical coordinates. Under these diamonds, the direction and rate of tidal stream is mentioned which will be prevailing at a given time at the location of diamond. The direction and rate of stream is mentioned against a scale of time, on the left hand side, at hourly intervals from the HW time at a standard port of reference. Further, the rate of tidal stream is mentioned under two headings, as during spring tides and during Neap tides at standard port.

The admiralty tide table shall be checked for the standard port and its tide, whether spring or neap for a given date. Then the tidal diamond shall be seen on the navigation chart, and from the tidal stream table on the chart, the rate and direction of tidal stream can be estimated, with reference to high water time at standard port. For intermediate tide ranges at standard ports, the values of rate of tidal stream shall be interpolated.




| Hours | A 50 42'.3N 0 26'.5E Dir | Sp | Np | B 50 53'.0N 1 00'.0E Dir | Sp | Np | C 51 01'.0N 1 10'.0E Dir | Sp | Np |
|---|---|---|---|---|---|---|---|---|---|
| Before HW 6 | 248 | 0.8 | 0.4 | 213 | 1.6 | 0.9 | 224 | 0.9 | 0.5 |
| 5 | 067 | 0.5 | 0.3 | 214 | 2.1 | 1.2 | 239 | 1.0 | 0.6 |
| 4 | 068 | 1.9 | 1.0 | 215 | 1.8 | 1.1 | 235 | 1.1 | 0.6 |
| 3 | 071 | 2.6 | 1.5 | 213 | 0.9 | 0.5 | 242 | 0.6 | 0.4 |
| 2 | 069 | 2.3 | 1.3 | Slack | | | Slack | | |
| 1 | 068 | 1.2 | 0.6 | 033 | 0.8 | 0.5 | 052 | 0.6 | 0.3 |
| HW | 067 | 0.1 | 0.1 | 032 | 1.5 | 0.8 | 049 | 1.2 | 0.7 |
| After HW 1 | 248 | 0.9 | 0.5 | 031 | 1.9 | 1.1 | 049 | 1.3 | 0.7 |
| 2 | 247 | 1.4 | 0.8 | 030 | 1.7 | 1.0 | 056 | 1.0 | 0.5 |
| 3 | 251 | 1.8 | 1.0 | 031 | 1.2 | 0.6 | 054 | 0.5 | 0.3 |
| 4 | 253 | 1.7 | 1.0 | 032 | 0.4 | 0.2 | Slack | | |
| 5 | 250 | 1.6 | 0.9 | 211 | 0.4 | 0.2 | 219 | 0.4 | 0.2 |
| 6 | 249 | 1.2 | 0.7 | 212 | 1.3 | 0.7 | 217 | 0.8 | 0.4 |

## 11) Use of admiralty tidal stream atlases

Admiralty tidal stream atlases display the major tidal streams for selected waters of north-western Europe, including direction and rate at hourly intervals, in diagrammatic form. Graded arrows illustrate mean, neap and spring tidal rates in tenths of a knot. Further, to calculate the tidal stream rate for a given date, a diagram is provided.

There are 20 admiralty tidal stream atlases.

The topic is covered in detail in task A1.3.4.8.

## 12) Admiralty tidal publications

- **Paper publications**
  - Admiralty tide tables (NP 201-204)
  - Admiralty tidal stream atlases
  - Admiralty co-tidal charts
  - Admiralty manual of tides (NP120)
    This is detailed description of tidal theory and its application to the analysis and prediction of tides and tidal streams.
  - Admiralty tidal handbooks (NP122 1-3)
    Outline the admiralty method of harmonic tidal analysis for long and short observation periods.

- **Digital publications**
  - Admiralty total tide (DP 550)
    It is a tidal prediction electronic program which uses the same prediction algorithms and harmonic constants as the admiralty tide tables. It has been designed to meet SOLAS requirements. It displays tidal heights for both standard and secondary ports are displayed in graphical and tabular form and tidal stream rates on a chart-based diagram.

    Using this, tidal heights for multiple ports for up to seven days can be calculated simultaneously. The system also includes periods of daylight and nautical twilight, moon phases and a springs and neaps indicator. Under-keel and overhead clearance can be displayed in a graphic form to aid passage planning. TotalTide is supplied in the form of a single CD which contains the calculation program and the seven geographic Area Data Sets (ADS) providing global coverage. Annual updates for TotalTide are available from admiralty chart agents, and are recommended.

  - EasyTide
    It is an on-line tidal prediction service provided by the UKHO and intended primarily for the leisure mariner.

**Apply Your Knowledge**

1. Calculate height of tide for a given time for any three standard ports from the tide table. Also, obtain time on a given date for a particular height of tide. Show the calculations.
2. Calculate height of tide for a given time for any three secondary ports from the tide table. Also, obtain time on a given date for a particular height of tide. Show the calculations.
3. Calculate the rate and direction of the tidal stream at locations marked on the chart by the tidal diamond (symbol ◊).

**Function:** Navigation

**Competence:** Plan and conduct a passage and determine position

**Task number:** A1.9

**Sub-task Reference number:** A1.9.15

**Topic:** Meteorology

**Task Heading**

- Demonstrate understanding of the application of Buys Ballot's law.

**Objectives**

- Understanding the formation of winds and weather disturbances such as depressions and tropical storms.

**Index**

1) Atmospheric pressure
2) Winds and their formation
3) Buys ballot's law
4) Frontal/ temperate latitude depressions
5) Tropical revolving storms

**Description**

**1) Atmospheric pressure**

Atmospheric pressure refers to the pressure exerted by the column of air on any point on the earth's surface. The common units of measurement are milli-bar or hecto-pascal.

**Isobars** are the lines joining the area of same atmospheric pressure. These are shown on surface weather charts. In upper air analysis, points of equal heights called iso-heights are used for analysis and prognosis.

Pressure is an important weather analysis and forecasting element. In forecasting, pressure is used to analyze the isobar patterns. Knowing the isobar patterns, centers of high and low pressure can be found and wind speeds and other critical weather information can be estimated with the same. By tracking the movement of high- and low-pressure centers the future movements of these centers and their associated weather patterns can be anticipated.

**2) Winds and their formation**

The air in motion relative to the earth's surface is termed Wind. Winds flow is affected by the following forces which are:
a) Pressure gradient
b) Coriolis force

Normally, Coriolis force is not greater than the pressure gradient force. In the absence of friction, the Coriolis force changes the direction of motion of wind until the Coriolis force and the pressure gradient force are in balance. When the two forces are equal and opposite, the wind blows parallel to the straight isobars and is named geostropic wind.

**3) Buys ballot's law**

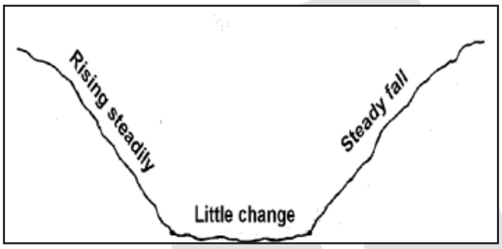
Published by Buys-ballot in 1857, Buys ballot's law provides a practical rule expressing the relation between wind and barometric pressure. It was first clearly enunciated and brought into prominence by the Dutch meteorologist Prof. Buys Ballot.

It is also known as the "baric wind law'.

It states that:
"When standing keeping back to the wind, in the northern hemisphere, the barometer will be lower on your left than on your right. The reverse is true in the southern hemisphere."

The law outlines general rules of conduct for masters, to assist them in steering the vessels away from the center of hurricanes at sea. Care shall be taken to observe the true wind direction as reference. As can be referred to the diagrams above, the law derives from the basics of geostrophic and cyclostrophic winds.

**4) Frontal/ temperate latitude depressions**




A frontal depression is a low pressure area formed at the boundary between two different air masses, often occurring at middle or high latitudes. The process of formation of a frontal depression is known as frontogenesis, whereas the decay or weakening is called frontolysis. These depressions are frequently seen at sea in middle latitudes and are responsible for most strong winds and unsettled weather. These depressions might be spread over a narrow area of 100 miles or at times these may spread to the extent of 2000 miles. A fall in barometric pressure indicates the approach of a depression. The barograph trace is a good method to observe the passage of a frontal depression. The trace is expected to be in a format as shown in the figure.

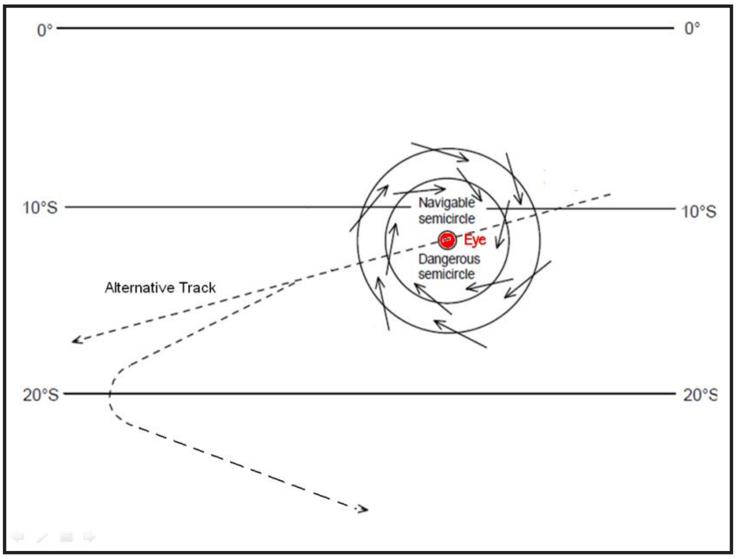
**5) Tropical revolving storms (TRS)**

Tropical revolving storms are intense depressions that develop in tropical latitudes between 5° to 20°. These are areas of very low pressures around which the winds blow spirally reaching speeds 130 to 150knots. These are known by different regional names such as Hurricane, Typhoon, Cyclone or Cordonazo in different area of the world. Tropical cyclones can be hundreds of kilometers wide and can bring destructive high winds, torrential rain and storm surge.

In the southern hemisphere the wind blows around a tropical revolving storm in a spiral flow inwards in a clockwise direction and anticlockwise in the northern hemisphere.

The general track of TRS in Northern Hemisphere is usually north-westerly, likely to change direction and re-curve to the north and thence follow a north-easterly path.

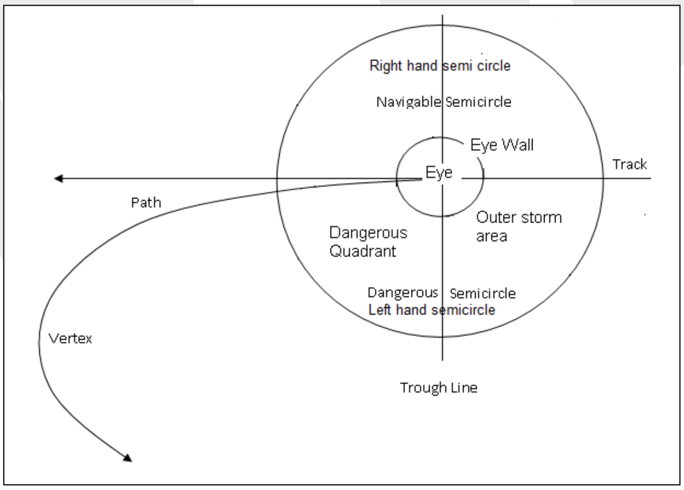
Vice versa is applicable in southern hemisphere. However, the storm may continue proceeding without re-curving and hit coastal areas.




Based on wind speed, storms are classified as follows:

| | Wind speed | Beaufort force |
|---|---|---|
| Tropical depression | <= 33 kts | <= 7 |
| Moderate tropical storm | 34 - 47 kts | 8 and 9 |
| Severe tropical storm | 48 - 63 kts | 10 and 11 |
| Hurricane or synonym | >64 kts | 12 |

The adjoining figure shows the structure of storm in southern hemisphere.




- **Eye** – The central area of low pressure, around 4- 30 NM in diameter, pressure as low as 60mbar below normal, (pressure drop of around 20mbar is observed often), low wind speed, poor visibility due to mist and fog, clear sky, mountainous and confused swell, no precipitation.

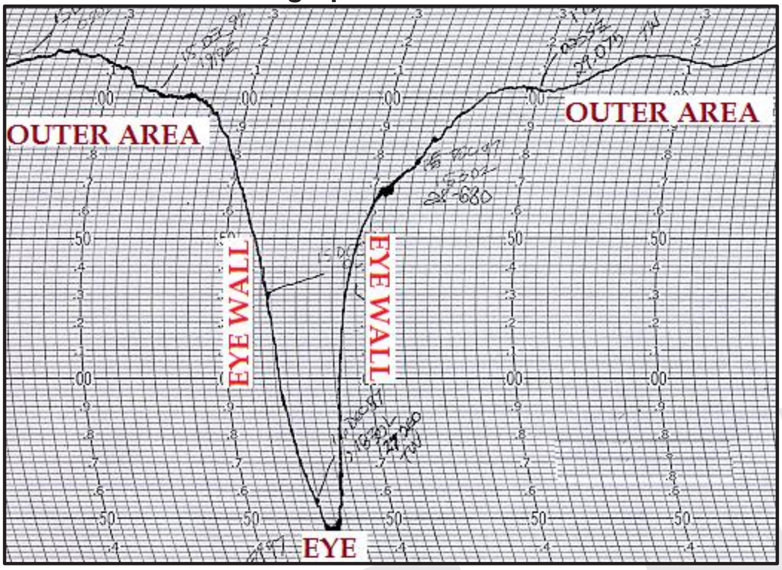
- **Eye wall**–The circular area of surrounding the eye, around 4- 30 NM in diameter, steep fall and rise of pressure ahead and aft of trough respectively, pressure gradient upto 11mbar in 15 miles, wind force 12 of range 130 to 150 knots, blowing in a circular direction, nimbostratus clouds and anvil shaped towering cumulonimbus, visibility poor in rain.

- **Outer storm area** – The area surrounding the eye wall, around 50- 800 NM in diameter slow fall and rise of pressure ahead and aft of trough respectively, the daily semi diurnal variation of pressure may be visible in the barograph trace, wind force 6 - 7gradually increasing as moving from outer area towards the eye wall, wind direction turning clockwise (veering) in the right hand semi-circle and anticlockwise (backing) in the left hand semicircle, cirrus clouds strands/ filament in outer fringes, followed by cirrostratus and altostratus, excellent visibility in outer area

Applying the Buys ballot's law, the direction of the storm center can be estimated.

The procedure of monitoring and avoiding the tropical storm is discussed under the task A1.9.11.

**Barograph trace in a TRS**




**Apply Your Knowledge**

1. Observe the semi diurnal change in atmospheric pressure using a barograph if available, or record the barometric readings from the log and observe the daily pattern of atmospheric pressure.
2. Check the current atmospheric pressure; apply applicable corrections to get the mean pressure at sea level. Check the nautical publications for expected mean atmospheric pressure in the area during the time of the year.

**Function:** Navigation

**Competence:** Maintain a safe navigational watch

**Task number:** A2.1

**Sub-task Reference number:** A2.1.7, A2.1.8, A2.1.9, A2.1.12

**Topic:** Watchkeeping

**Task Heading**

- Supervise ratings in watchkeeping duties.
- Understudy an officer on the bridge during coastal navigation and during navigation under pilotage, including berthing and un-berthing.
- Demonstrate understanding of procedures for navigating in restricted visibility.
- Observe a Master-Pilot information exchange.

**Objectives**

- To enhance watchkeeping skills in different conditions and situations which area part of navigational watchkeeping, along with controlling the bridge team being officer on watch

Please read this task in conjunction with tasks A2.1.1 to A2.1.6

**Index**

1) Bridge watchkeeping – responsibilities of OOW
2) Supervision of ratings in watchkeeping duties
3) Watchkeeping in coastal waters/ restricted waters
4) Watchkeeping duties during arrival in port/ berthing
5) Watchkeeping duties prior to departure/ un-berthing
6) Watchkeeping procedures for navigation in restricted visibility
7) Navigating with pilot on board
8) Master-pilot information exchange
9) Sample pilot card

**Description**

**1) Bridge watchkeeping– responsibilities of OOW**

- Officer in charge of the navigational watch is considered Master's representative on bridge. A continuous watch is maintained throughout. He shall not leave the bridge unattended at any time. Further he shall not leave the bridge unless properly relieved. Presence of another watchkeeping officer or master on bridge does not relieve him of his responsibilities until the watch has been properly taken over and is mutually agreed by both. Until then the OOW shall continue to be responsible for safe watchkeeping.

- Company specific checklists for various operations are provided for the safe procedures in order ensure none of the vital checks are left out. Same shall be followed as applicable.

**2) Supervision of ratings in watchkeeping duties**

- OOW leads the bridge team. When supervising the ratings on watch, it shall be ensured that

- ❖ The ratings are able to understand the orders given and the same are carried out efficiently. This becomes further more important when sailing with multilingual crew, whereby use of standard marine communication phrases is highly recommended.
- ❖ The ratings are suitably dressed and equipped for the job they need to perform with due consideration to prevailing weather.
- ❖ The ratings are physically fit and rested to carry out their duties effectively.

➢ While the ratings are assigned any of the support duties as discussed below, they shall
- ❖ be alert and attentive
- ❖ acknowledge the orders as understood and cross check if any of the orders are not clear
- ❖ give full attention to the duty assigned
- ❖ provide the duty at the station assigned until properly relieved or called off
- ❖ shall not engage themselves in insignificant conversations
- ❖ if on lookout or steering duty, should not be tasked with any other duties which could interfere with the main task of keeping lookout or steering

➢ The intention of having additional ratings on a navigational watch is to allow the watch-keeping officer put his complete attention to key issues of safe watchkeeping and not get distracted by any other assignment. Support staff and ratings on bridge are usually assigned the following responsibilities:
- ❖ Look-Out
- ❖ Steering
- ❖ Messenger

➢ While on lookout duty, the lookout man shall
- ❖ provide the OOW with the complete update on the surroundings for the 360° view around the vessel
- ❖ be performing a visual and hearing lookout
- ❖ be provided with binoculars especially in restricted visibility
- ❖ report every occurrence that he may see or hear however insignificant he may consider it to be. These include detecting ships and other marine crafts in vicinity, land marks, light houses, buoys, vessels or aircraft in distress, shipwrecked persons, wrecks, debris, traces of oil and other hazards to safe navigation.
- ❖ keep a look on operations in progress on open decks on board

➢ While on steering duty, the helmsman shall
- ❖ follow the standard steering procedures for steering the vessel
- ❖ steer the vessel, maintaining the ordered course to steer
- ❖ comply with the helm orders of OOW
- ❖ NOT be assigned duty of lookout or any other duty
- ❖ notify the OOW if he is unable to maintain course
- ❖ check with the OOW prior using large helm angles when the ship is proceeding at full speed at open sea

➢ While on a messenger duty, the rating shall be conveying messages to other personnel as desired. It shall be checked that the message to be conveyed is rightly understood by the messenger. **Written message** slips shall be preferred for the purpose instead of verbal message to avoid any ambiguity or mis-interpretation.

**3) Watchkeeping in coastal waters/ restricted waters**

➢ In addition to the watchkeeping procedures at open sea as discussed in task A2.1.5, additional procedures shall be followed while navigating in coastal waters are as follows:
- ❖ The largest scale charts updated to the latest notices to mariners and navigational warnings shall be used for navigation.

- ❖ The officer on watch should also be aware of the present status of the ship like the draft, freeboard and air draft.
- ❖ The echo sounder shall be frequently checked for under keel clearances. Company UKC policy shall be followed.
- ❖ Shallow water effects on the maneuvering characteristics of the vessel, such as increase in turning circle and squat shall be given due consideration.
- ❖ Careful check shall be kept on vessel's position while course alterations, keeping in mind the turning radius of the vessel and wheel over points.
- ❖ Due consideration shall be given to the available sea room when deciding on the action to avoid collision in coastal areas/ restricted waters.
- ❖ Hand steering shall be tried out during each watch and engaged in case of large alterations, frequent alterations, and restricted visibility and in areas where denser traffic is encountered.
- ❖ Vessel's positions shall be checked more frequently.
- ❖ Vessel's positions shall be cross checked using alternative means of position fixing other than satellite navigation systems. These include checking position by visual fixes and radar fixes. Buoys shall preferably NOT be used for position fixing as these are likely to drift from the charted position, particularly in areas where strong tidal changes are known to prevail.
- ❖ Compass error shall be checked particularly where transit bearings are available for reference.
- ❖ Radar shall be used for parallel indexing to monitor the progress along the planned track.
- ❖ The track shall be clearly monitored considering the expected tidal stream and resultant course made good.
- ❖ Vessel shall proceed giving wide berth to all hazards as advised by company procedures and Master.
- ❖ All navigational warning shall be received, noted, charted and complied with.
- ❖ Careful VHF watch shall be maintained for coastal radio Nav-warnings such as naval ships carrying out firing practices in specified areas.
- ❖ Vessel shall follow the local regulations when within the territorial waters of a state. Prohibited zones shall be carefully checked and marked on the chart.
- ❖ Vessel shall follow the coastal traffic separation schemes/ traffic services and shall participate in the reporting as required.
- ❖ Watch composition shall be strengthened if required considering the additional responsibilities such as additional lookout, steering, frequent position fixing and reporting.
- ❖ In certain areas it may be necessary to have anchors ready and a lookout man posted forward, especially if expecting heavy traffic or poor visibility.
- ❖ Vessel's operational readiness shall be cross checked before proceeding beyond areas marked as 'Abort Point' or 'Point of no return' on the passage plan.
- ❖ Expected time of passing of danger points shall be carefully estimated and any extra precautions to be taken in due time.
- ❖ Companies may have defined for certain types of ships to maintain a certain distance from the nearest coast which shall be maintained.
- ❖ Company specific SMS checklist shall be followed for coastal navigation.

**4) Watchkeeping duties during arrival in port/ berthing**

➢ In addition to the duties mentioned above for navigation in coastal waters, additional duties to be performed while arrival in ports are as follows:

- ❖ The passage plan shall be checked for port information and tides.
- ❖ Master shall be informed in accordance to his instructions. Master shall be immediately informed if land is sighted earlier than expected or any other unusual sighting.
- ❖ Sufficient notices shall be rendered to the engine room allowing them to ready the engines and other machinery for maneuvering.

- The port authorities and pilot shall be contacted on the VHF channels in use to check for the berthing program or suitable anchorages.
- If vessel is expected to berth on arrival, pilot boarding instructions such as pilot boarding time, position and the pilot ladder requirements shall be checked.
- Vessel's equipment, gear and machinery shall be tested as controls testing procedure specified in shipboard procedures manuals. The bridge and engine room clocks shall be synchronized for showing the same time.
- Engines shall be tried out for ahead and astern propulsion well before entering restricted approaches to the port.
- Steering gear shall be tried out. Some local regulations including that of USCG require emergency steering also to be tried out.
- Adequate notice shall be given to officers and crew to prepare for mooring or anchoring and to rig the pilot ladder and prepare gangway for lowering.
- Internal shipboard communication equipment such as walkie-talkies, PA system, and talkback system shall be tested.
- Signaling equipment, including flags / lights shall be checked.
- Deck and station lighting and Mooring machinery shall be tested.
- Cargo handling gear shall be in state of readiness.
- Pilot ladder shall be rigged as required by the pilots and the pilot boarding area shall be non-slippery and clear of any obstructions. Same shall be well lit at night. A responsible officer in communication with bridge shall be posted at the spot to receive the pilot.
- Hand steering shall be engaged in due time and additional watchkeeping personnel called.
- Echo sounder and course recorder shall be duly marked and checked to be running.
- Pilot card shall be kept ready for the master-pilot information exchange.
- The berthing plan including the approach, tugs to be used and mooring patterns shall be discussed with the pilot once pilot boards and the passage plan amended accordingly.
- All events and their timings shall be recorded in the Bridge Movement Book and Deck Logbook.

**5) Watchkeeping duties prior to departure/ un-berthing**

- Passage plan shall be ready prior departure, all the courses charted and the bridge team meeting held. Tides timing and heights shall be checked.
- Up to date weather information and navigational warnings shall be checked.
- Vessel shall be all secured for sailing. All hatch openings shall be closed, secured and cargo lashed & handling gear secured.
- Suitable notice shall be given to the engine room to ready engines and machinery for maneuvering.
- Officers and crew shall be notified well in time prior departure.
- Shore Leave Cessation notice shall be displayed near the gangway well before departure.
- Stowaway search shall be conducted prior departure.
- Controls including steering gear shall be tested trying out all equipment as detailed the company check list.
- Shipboard Internal communication equipment shall be tested.
- Signaling equipment, including flags / lights shall be checked.
- The pilot card must be completed and be ready for the pilot.
- The un-berthing plan including the departure route, cast off plan and tugs to be used shall be discussed with the pilot once pilot boards.
- All events and their timings shall be recorded in the Bridge Movement Book and Deck Logbook.

Sample SMS checklists for arrival/ departure have been included in task A2.1.1~A2.1.3.

## 6) Watchkeeping procedures for navigation in restricted visibility

OOW while navigating in or near area of restricted visibility shall take additional measures to ensure safety of navigation. Along with regular watchkeeping duties in deep sea or coastal waters (as applicable), the duties while navigating in restricted visibility are as follows:

- Master and engine room shall be informed regarding poor visibility. Engine room shall be advised that engines might be required at any time for immediate maneuver. The vessel shall be ensured to be proceeding at safe speed
- Extra lookouts shall be posted. Lookout shall be posted outside the wheelhouse to ensure the sound signals are heard. The lookout personnel shall be suitably dressed as required in the prevailing weather.
- Sound signals and navigation lights shall be switched on. If the ship is fitted with a Sound Reception System, same shall be monitored.
- Vessel shall comply with COLREGs, with specific regard to Rule 19. The ship shall navigate with extreme caution with due regard to prevailing conditions.
- Both radars shall be switched on. The radars shall be set to suitable ranges to ensure better detection of targets, preferably one on a short range and another on the long range.
- Vessel’s position shall be closely monitored particularly when navigating near coasts or hazardous areas. Limitations shall again be considered while using radar for checking the positions.
- If in anchoring depths, the anchors shall be kept ready for use. However same may be kept secured for avoiding accidental slipping, as in heavy weather conditions with visibility restricted by heavy rains.
- AIS shall be regularly monitored to detect and identify targets in the vicinity.
- VHF watch shall be maintained throughout to check on any warnings. However, VHF should NOT be used for collision prevention.
- All targets and navigational hazards shall be given wide berth.
- Company specific SMS checklist shall be followed for navigation in restricted visibility.

## 7) Navigating with pilot on board

- Having the detailed knowledge of the local area and being able to communicate effectively with local personnel (the tugs / mooring gangs and the terminal control), the pilot joins the bridge team of the vessel for a temporary duration. To utilize his services effectively, he shall be supported suitably.
- The presence of a pilot, however, does not relieve the master or the OOW of their duties

> Once the pilot is in control of navigation, the pilot’s instructions shall be closely monitored and followed. If the OOW becomes unsure of the pilot's actions or intentions, he shall seek his clarification and, if still in doubt, shall inform the Master immediately and take the necessary action before the Master arrives on the bridge.

and obligations for the safety of the ship.

- The pilot, on boarding, shall be provided with the essential information about the ship. This will include the draft, depth restrictions in port approaches and effects of squat. A duly filled pilot card and master – pilot information exchange serves the purpose.

- It shall be checked that the helmsman understands and executes the orders of pilot.

- Vessel's progress as per the berthing/ un-berthing plan shall be closely monitored by checking position of the vessel.

- Any dangers/ hazards or circumstance appearing unsafe shall be duly brought to the notice of pilot and master followed by prompt corrective action in consultation.

### 8) Master-pilot information exchange

- The pilot on board is a temporary member of the bridge team. The pilot has the detailed information regarding the port.

- As the pilot shall be handling the vessel during berthing/ un-berthing; he shall be apprised of the vessel's details prior handing over the con.

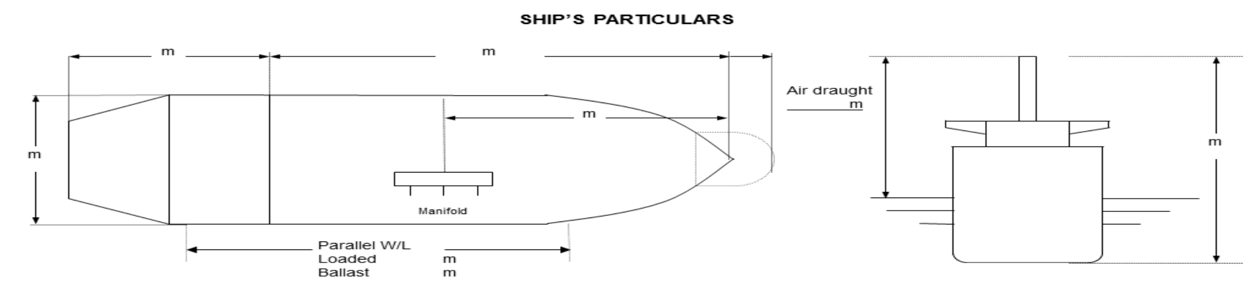
- This is best affected through master pilot information exchange and filling up the pilot card as provided in company specific manuals.

- The pilot must be requested for all necessary information for the intended passage and berthing. A list of information to be asked is generally provided in a company checklist.

- The pilot shall discuss the maneuver/ berthing plan with the Master/OOW. The passage plan shall be amended accordingly.

- The vessel's progress in accordance with the plan shall be monitored carefully throughout the maneuver till the vessel is safely made fast at the berth or during departure, out of approach channels and fairway leading to open waters, as applicable.

### 9) Sample pilot card




| Ship's Particulars | | | |
|---|---|---|---|
| Name | | | |
| Displacement | T | Deadweight | T |
| LOA | m | Breadth | m |
| Draught fwd | m | Draught aft | m |
| Draught amidships | m | | |
| **Engine Particulars** | | | |
| Type of engine | RPM | Maximum power | |
| Telegraph | | speed - loaded | speed - ballast |

| | | | |
|---|---|---|---|
| Full ahead | | (kts) | (kts) |
| Half ahead | | (kts) | (kts) |
| Slow ahead | | (kts) | (kts) |
| Dead slow ahead | | (kts) | (kts) |
| Full astern | | (% of full ahead power) | |
| Critical rpm | | Maximum number of consecutive starts | |
| Propellers | number | type | Right handed/ Left |
| Controllable pitch | | yes/no | |
| Thrusters | number | Bow power | Stern power |
| Steering Particulars | | | |
| Rudders | number | type | maximum angle |
| **Navigation Equipment Status** | | | |
| Anchors | | X-Band radar | |
| Whistle | | S-Band radar | |
| Flags | | Speed log | |
| Compass system | | Gyro error | |
| Engine telegraphs | | VHF | |
| Rudder/RPM/ROT indicators | | Echo sounder | |
| Steering gear | | Mooring winches and lines | |
| Number of power units in use | | Electronic position-fixing | |
| **Equipment Operational Defects** | | | |
| Master | | Pilot | |

**Apply Your Knowledge**

1. Compare your experience of driving a car in heavy rain or dense fog with navigation of ship in restricted visibility.
2. Observe the radar display when used during rain and in fog. Note the difference and evaluate the need of extra watchkeeping precautions such as use of sound signals.
3. Observe the pilot while maneuvering the ship.

**Function:** Navigation

**Competence:** Maintain a safe navigational watch

**Task number:** A2.1

**Sub-task Reference number:** A2.1.10, A2.1.11

**Topic:** Watch-keeping

**Task Heading**

- Demonstrate understanding of the instructions provided in the deck log book and procedures for making and correcting entries. Under supervision, make an entry in the deck log book for a navigational watch.
- Under supervision, make entries in the bridge movement book.

**Objectives**

- Understanding the importance of record keeping on navigation bridge and learning the procedure for the same.

**Index**

1) Introduction
2) General layout of the deck log book
3) Entries to be made in the daily pages of the log book
4) General instructions for making log book entries
5) Bridge note book/movement book/automatic logger system

**Description:**

**1) Introduction**

- SOLAS chapter V - regulation 28 requires that all ships engaged on international voyages shall keep on board a record of navigational activities and incidents which are of importance to safety of navigation and which must contain sufficient detail to restore a complete record of the voyage. When such information is not maintained in the ship's log book, it shall be maintained in another form approved by the administration.

- The deck log book is a continuous real time record of all the activities being carried out on board. It is an important document and serves as necessary evidence in the event of any accident and casualty. It contains factual entries with time. The deck log book is an official document and its contents are taken as reliable evidence during the course of any civil arbitration or litigation.

- It is required to maintain a clear and accurate record of the activities of the ship, as the log book forms one of the important evidences in case of any incidents. Deck log book must be retained on board and copies submitted with the shipping company for records.

**2) General layout of the deck log book**

The log book is usually divided in to two sections

- The **initial pages** contain the following. These entries are completed as and when the events occur.
  - Name of the ship
  - Month and year

- ❖ Details of the master, watch-keeping officers and ratings (lookouts and helmsmen)
- ❖ Tabulated format of the ship's freeboard and draft which shall be filled on for every arrival and departure port during that period
- ❖ Entries regarding internal and external inspections and surveys.
- ❖ Details regarding safety drills and training sessions

➢ The **daily pages** contain fixed tabulated columns for navigational details and other daily routines being carried out on board. These shall be completed at the end of each and every watch and signed by the responsible officer.

**3) Entries to be made in the daily pages of the log book**

✓ **While at sea**

- ❖ Date, zone time
- ❖ Voyage number, departure and destination port
- ❖ Drafts, and under keel clearance
- ❖ GPS position of the vessel and positions by alternative means such as range and bearing of shore objects
- ❖ Courses steered and observed speed, and engine RPM
- ❖ Gyro and magnetic compass errors, Magnetic variation and deviations of magnetic compass
- ❖ Meteorological data – wind direction and force, swell direction and height and corrected barometric pressure at sea level, visibility, rain, ice conditions
- ❖ If experiencing heavy weather and shipping seas, same shall be duly recorded.
- ❖ Navigational Watch keeping duties carried out, advancing/ retarding of clocks, VHF channels of watch, codes of the lookout and ratings and signatures of the OOW
- ❖ Any changes made to the voyage plan
- ❖ Entry regarding trying out Hand steering during each watch
- ❖ Operational status of navigational equipments and details of any malfunctions
- ❖ Details of compliance with routeing schemes or reporting systems.
- ❖ Any additional operations such as ballast exchange in progress on deck
- ❖ Details of any safety drills and safety committee meetings carried out
- ❖ Details regarding notifying engine room for readiness of engines, principal timings such as SBE, FWE, and RFA, etc.,
- ❖ Details regarding boarding/ dis-embarking of pilot
- ❖ Details of any damages / emergency experienced, details of any death and injuries among crew and passengers
- ❖ Timings for manning and unmanning engine room spaces on UMS class vessels should be recorded.
- ❖ Particulars of any unusual occurrences such as abnormal sightings, involvement in search and rescue operations, presence of stowaways etc., shall be logged.
- ❖ Details of SMS checklist followed for navigation

✓ **While in anchorages**

- ❖ Anchor position (range and bearing of the prominent landmarks),
- ❖ Anchor in use and shackles on deck
- ❖ Drafts, details of height and time of tides and under-keel clearance
- ❖ Distance from the closest vessel at anchor
- ❖ Meteorological data – wind direction and force, swell direction and height and corrected barometric pressure at sea level, visibility, rain, ice conditions
- ❖ Anchor watch keeping duties carried out, VHF channels of watch, codes of the lookout and ratings and signatures of the OOW
- ❖ Any additional operations such as repairs, surveys, bunkering and/ or lighterage in progress on deck
- ❖ Any safety drills carried out, lowering of lifeboats etc.
- ❖ Details regarding notifying engine room for readiness of engines, principal timings such as SBE etc., shall be logged.

- ❖ Details regarding boarding/ dis-embarking of pilot
- ❖ Details of any damages / emergency experienced, details of any death and injuries among crew and passengers
- ❖ Details of SMS checklist followed for anchor watch
- ❖ Details of anti-piracy watch maintained

✓ **While in port**

- ❖ Name of the port/ terminal (along with berth number)
- ❖ Mooring pattern while at berth and side alongside
- ❖ Timing of vessel all made fast, gangway ready, free pratique granted
- ❖ Details of height and time of tides
- ❖ Drafts, freeboard and under keel clearance
- ❖ Draft survey times, draft check times, draft surveyor's name, hold inspection times, hold passed times and the name of the inspector
- ❖ Meteorological data – wind direction and force, swell direction and height and corrected barometric pressure at sea level, visibility
- ❖ Port watch keeping duties carried out, VHF channels of watch, codes of the lookout and ratings and signatures of the OOW
- ❖ Cargo operations in progress, holds/ tanks being worked during the watch, name of the cargo, number of gangs working on board, details of lashing operations;
- ❖ Details/ timing of all important and critical cargo operations, change of tanks, topping off tanks, starting and stopping of pumps, COW operations, number of cranes in use, whether vessel's cranes or shore cranes number of grabs etc.
- ❖ The numbers of visitors, including the number of stevedore gangs (and securing gangs) in each hold and in total
- ❖ Cargo operation timings crane / loader wise, at each run including stoppages, with reasons for stoppage
- ❖ Ballast operations in progress
- ❖ Operations such as repairs, surveys, bunkering in progress on deck
- ❖ Any fumigation undertaken, with the names of operators and the type and quantity of fumigant used
- ❖ Details of any shifting / warping of vessel
- ❖ Any safety drills carried out, lowering of lifeboats etc.
- ❖ Details regarding notifying engine room for readiness of engines
- ❖ Details regarding boarding/ dis-embarking of pilot
- ❖ Details of any damages / emergency experienced, details of any death and injuries among crew and passengers
- ❖ Stowaway checks carried out
- ❖ Status of deck rounds and fire fighting/ anti-pollution gear
- ❖ Details of SMS checklist followed for port watch

**4) General instructions for making log book entries**

- ➢ The deck log book is an official document and its contents are legal evidence.
- ➢ All entries should be continuous irrespective of the voyage.
- ➢ All entries must be completed at the end of each watch, whether in port or at sea.
- ➢ The company may designate a navigating officer, usually the chief officer, responsible to ensure that the log is kept up to date at all times.
- ➢ Each completed page of the log book shall be signed by the chief officer and master.
- ➢ It is recommended to attach the latest crew list must be attached to the last page of the logbook.
- ➢ Other than above, in the log book, all applicable columns must be filled. Non-applicable columns should be crossed out. All noon data, arrival and departure information and ROB must be completed every day.
- ➢ Company specific instructions for making entries in deck log book shall be complied with.

- In addition to deck log book miscellaneous **special-purpose logs** are used on navigation bridges. These include:
  - GPS log
  - Radar log
  - Compass error log
  - Sight log
  - Echo-sounder log
  - Vhf/ communications log
  - GMDSS log
  - Tank sounding log
  - Anchor log
  - Port log
  - Cargo loading/ discharging log
  - Gangway log

**5) Bridge note book/movement book and automatic logger system**

➢ A movement book also called the “Bell book” is used to record significant information pertaining to the vessels movements. Automatic logger system is an electronic version of the movement book which facilitates automatic logging of the engine movements against time. The “Movement book” can be used as admissible legal evidence. Movement book entries shall provide complete record of all the events during the course of vessel leaving/entering port. Company specific instructions for making entries in bridge note book/movement book shall be complied with. Entries in respective movement books shall be initialed by the officer in-charge of the navigation watch and engineering watch.

➢ Chronological entries in movement book include
- Transit points with time of transit in a buoyed channel.
- Times of passing buoys, landmarks etc. and other position fixes
- RPM reductions along with the reasons
- Detailed entries regarding engine movements
- Times of testing controls,
- Time of SBE, FEW and RFA
- Engine telegraph orders given to the E/R
- Name of the pilot and his boarding/ disembarking time
- Names of tugs, location along the vessel, making fast / cast off times
- Times when mooring lines sent ashore, make fast and cast off
- All significant events such as entering fog bank etc.
- Any overriding of pilots advice by master
- Any pre-existing damage on quay side, brought to the pilots notice
- Any other operational details and malfunctions
- Letting go anchor, anchor brought-up time
- Damages if any caused to the port property or own vessel while berthing/casting of the vessel
- Oil spills observed/in the vicinity

**Apply Your Knowledge**

1. Check the data picked up from movement book, deck log book and cargo loading discharging log in preparing the cargo time sheet. Discuss the commercial aspect associated with the cargo time sheet.

**Function:** Navigation

**Competence:** Maintain a safe navigational watch

**Task number:** A2.1

**Sub-task Reference number:** A2.1.13, A2.1.14

**Topic:** Watch-keeping

**Task Heading**

- Give required notices to engine room for arrival and departure.
- Attend in the engine room when vessel is berthing and un-berthing (two periods each).

**Objectives**

- Learn the principles of engine room watch-keeping and procedure of navigation bridge notifying the engine room.

**Index**

1. Engine room watch-keeping
   a) Checks to be carried out while taking over/ handing over engine room watch at sea
   b) The principles to be observed while keeping an engine room watch at sea
   c) Procedures to be followed before/on arrival
   d) Procedures to be followed before/on departure
   e) Additional precautions while navigating in coastal and congested waters, heavy traffic or under conditions of restricted visibility and heavy weather
   f) Daily checks of machinery
   g) Checks for auxiliary diesel engines (generators) when kept on 'standby' mode
   h) Unmanned machinery spaces
   i) Reasons for notifying engine room and procedure

**Description**

**1) Engine room watch-keeping**

- Prior performing an engineering watch, the officer shall be familiar with their assigned watchkeeping duties. In addition, he shall have knowledge of:
  - Use of appropriate internal communication system;
  - Escape routes including emergency escape routes from machinery spaces;
  - Engine room alarm systems
  - Location and type of firefighting gear and other gear to be used in emergency situations

**a) Checks to be carried out while taking over/ handing over engine room watch at sea**

- The relieving officer shall be fit for carrying out engine room watch
- The standing orders and special instructions of the chief engineer officer relating to the operation of the ship's systems and machinery shall be read, understood and complied with.
- The nature of all work being performed on machinery and systems, the personnel involved and potential hazards shall be checked. Further, the maintenance works to be performed during the watch shall be noted.
- The condition and level of fuel in the reserve tanks, settling tank, day tank and other fuel storage facilities shall be checked.

- The level and the condition of water or residues in bilges, reserve tanks, fresh water tanks, sewage tanks and any special requirements for use or disposal of the contents thereof shall be checked. Any special requirements relating to sanitary system disposals shall also be checked.
- Condition and mode of operation of the various electrical power distribution systems shall be checked.
- The condition of monitoring and control console equipment, and the equipments being operated manually shall be checked.
- The condition and mode of operation of automatic boilers shall be checked.
- The area of navigation and prevailing weather and any adverse conditions resulting from bad weather, ice or contaminated or shallow water etc. shall be checked with navigation bridge.
- The location of engine-room ratings and the duties assigned shall be checked.
- The availability and readiness of fire-fighting appliances shall be checked.
- Details of operations relating to internal transfer of cargo, ballasting/de-ballasting and tank cleaning etc. shall be noted.

**b) The principles to be observed while keeping an engine room watch at sea are**

- The established watchkeeping procedures for engine room watchkeeping shall be followed.
- All bridge orders shall be promptly executed. Changes in direction or speed of the main propulsion units shall be recorded.
- The main propulsion unit controls, when in the manual mode of operation, shall be continuously attended under stand-by or maneuvering conditions.
- Due attention shall be paid to the ongoing maintenance and support of all machinery, including mechanical, electrical, electronic, hydraulic and pneumatic systems, their control apparatus and associated safety equipment, all accommodation service systems equipment and the recording of stores and spare gear usage.
- Any machinery not functioning properly, expected to malfunction or requiring special service shall be noted along with any action already taken.
- The preventive maintenance procedures, damage control, or repair operations to be performed during the watch shall be duly noted and performed.
- Any task interfering with the safe watch-keeping shall not be undertaken.
- Adequate rounds of the machinery and steering-gear spaces shall be made for the purpose of observing and reporting equipment malfunctions or breakdowns, performing or directing routine adjustments, required upkeep and any other necessary tasks.
- The watchkeeping ratings on rounds shall be directed to report any observations regarding hazardous conditions that may adversely affect the machinery or jeopardize the safety of life or of the ship.
- At any time, the machinery space shall not be left unsupervised in a manner that would prevent the manual operation of the engine room plant.
- Action shall be taken as necessary to control the effects of damage resulting from equipment breakdown, fire, flooding, rupture, collision, stranding, or other cause.
- The engineering watch shall be performed in coordination with the maintenance work in progress.
- Bridge shall be immediately informed in case of any occurrences that may cause reduction in the ship’s speed, imminent steering failure, stoppage of the ship’s propulsion system or any alteration in the generation of electric power causing threat to safety.
- In restricted waters and in port approaches, an additional generator and both steering motors must be kept on.

**c) Procedures to be followed before/on arrival**

- Standby auxiliary engines (generator) shall be put on parallel load.
- Second steering gear unit shall be started to run in parallel and both the steering systems tried out.

- Fresh water generator to be switched off.
- Sea suction shall be changed from low to high sea chest.
- Air bottles shall be pressed up and moisture drained.
- Control air and main air distributor valve to main engine shall be opened.
- Communication system with bridge along with telegraph shall be tried out.
- Boiler shall be fired on fuel and kept on standby.
- Throttle/bypass the coolers for lube oil and cooling water systems.
- Main engine shall be blown through and tried out in Ahead/Astern direction.
- The steam for fuel oil heating shall be switched off.
- Where the systems use diesel oil maneuvering, these shall be gradually changed over from fuel oil to diesel oil in due time allowing the complete flushing of lines by Diesel oil.
- Control shall be tested as per the company SMS checklist and clocks synchronized with bridge.
- Engine speed shall be gradually reduced and brought down to maneuvering speed after receiving the Standby engines from bridge.
- Power supply to the deck machinery and other deck systems shall be switched on.
- On tankers, the cargo/ballast pump turbine system shall be checked and kept ready for use.
- When experiencing long intervals between subsequent maneuvers, the engine shall be blown through on air.

**d) Procedures to be followed before/on departure**

- Standby auxiliary engines (generator) shall be put on parallel load.
- Air bottles shall be pressed up and any moisture from the system drained.
- Before departure from port, the turbocharger, scavenge spaces and air cooler shall be drained of any moisture.
- Start the warming process for main engine using auxiliary engine cooling water.
- Lube oil sump oil shall be purified for 24 hrs prior departure. Lube oil pump to be turned on 2 hrs prior departures.
- Main engine lube oil pump, fuel oil booster pump and main cooling sea water pump shall be started.
- All moving linkages shall be greased.
- Fuel oil/ diesel oil tank levels checked and the oils put on purification. The service tank levels shall be checked.
- The fuel oil pumps shall be switched on and the fuel valves primed.
- The main engine turning gear shall be engaged. Obtain propeller clearance from bridge and turn the engine on turning gear while simultaneously operating cylinder lubricators manually. Finally the turning gear shall be disengaged.
- The main engine shall be blown through and tried out on fuel in ahead/astern directions. The engine shall be tried from local control and bridge control.
- Steering gear shall be checked and tried out.
- Power supply to the deck machinery and other deck systems shall be checked on.
- Stern tube lube oil level shall be adjusted according to ballast/loaded passage (where such high/low header tanks are provided).
- Control shall be tested as per the company SMS checklist and clocks synchronized with bridge.
- Auxiliary boilers shall be kept on warm up prior departure from port.
- All the parameters, temperatures and pressures shall be closely monitored during maneuvering.
- After receiving the RFA from bridge, the systems shall be gradually changed over to heavy oil and the RPM slowly increased to full sea speed RPM or as advised by the navigation bridge.
- After receiving the RFA, systems shall be gradually changed over to auxiliary systems, such as auxiliary boiler, shaft generator etc. Fresh water generator shall be switched on when in clear deep waters.

**e) Additional precautions while navigating in coastal and congested waters, heavy traffic or under conditions of restricted visibility and heavy weather**

- ❖ All machinery involved with the maneuvering of the ship shall be kept ready to be immediately placed in the manual mode of operation when notified from bridge
- ❖ Emergency steering and other auxiliary equipment shall be ready for immediate operation.
- ❖ Adequate reserve of power shall be kept available for steering and other maneuvering requirements.
- ❖ Permanent air or steam pressure shall be kept available for sound signals
- ❖ While operating in heavy weather, the engine load shall be continuously monitored, and RPM may be reduced for avoiding excessive stressing of engines and gears.

**f) Daily checks of machinery**

- ❖ Correct parameters shall be maintained while operating at sea. Planned maintenance and overhaul routines shall be conducted.
- ❖ The pressures and temperatures of systems for lube oil, fuel oil and cooling water shall be checked and maintained.
- ❖ All warning alarms shall be acknowledged followed by due investigation and follow up.
- ❖ At sea only one air receiver is usually kept in service. The second receiver is kept pressed up and standby. Control air system shall be drained off moisture/oil daily.
- ❖ Turbochargers and operating parameters shall be checked. Turbocharger blower side is cleaned daily.
- ❖ Fresh water from engine cooling system and lube oil shall be tested.
- ❖ Log parameters shall be checked every watch.
- ❖ Fuel oil, lube oil and cylinder L.O. consumption shall be regularly monitored. The tank levels shall be checked regularly.
- ❖ The indicator cocks shall be blown through.
- ❖ Vibrations, any unusual noise or change of parameters shall be continuously monitored.
- ❖ FO/LO filters shall be cleaned as required.
- ❖ Shaft bearing and thrust bearing lubrication shall be checked.
- ❖ Level and condition of lubricating oil to miscellaneous machinery shall be checked and recorded.
- ❖ Feeds for jacket cooling and piston cooling water shall be checked and recorded.
- ❖ Stern tube header tank level shall be checked.
- ❖ Any water settled in fuel oil tanks shall be drained.
- ❖ The engine room bilge levels shall be regularly checked.

**g) Checks for auxiliary diesel engines (generators) when kept on 'standby' mode**

- ❖ Starting air pressure shall be checked normal, air receiver drained of water and starting air isolating valve is open.
- ❖ Lube oil pumps shall be primed and running on auto mode as programmed.
- ❖ Control switch in ECR shall be kept on standby mode and switch on local control panel on remote.
- ❖ Sump oil, rocker arm oil, turbocharger oil / governor oil and expansion tank levels shall be normal.
- ❖ Turn the standby engine few times manually once a day and blow through the engine. Before turning the engine, keep the control on manual mode.

**h) Unmanned machinery spaces**

- ❖ Some of the modern ships are operated with unmanned machinery spaces. On vessels provided with unmanned machinery spaces the engine controls are generally provided at navigation bridge console.

- The duty engineer performs routine rounds to engine room spaces. However a continuous watch is not maintained from engine control room. The items regularly checked include various process parameters such as temperature, pressure, revolution, flow rate, tank levels, vibration, noise, leakage and overheating monitoring system, alarm system, remote control system, automatic control system and electric system, fire protection/fire-fighting appliance and other equipment back-up systems, such as stand-by machinery.
- Various sensors, recorders and alarms are installed in navigation bridge, various other locations in the machinery spaces as well as in the crew spaces on these ships to monitor the safe operation of machinery.
- For vessel with unmanned machinery spaces, the duty engineering shall be immediately available and on call to attend the machinery spaces. Any personnel shall never enter unmanned machinery spaces unless checked and confirmed by the duty engineer. An engineer call alarm is provided for the purpose.
- Miscellaneous extended alarms from engine room are provided on the bridge, engineer's cabin, and crew spaces are provided on such systems. Additionally these ships are provided with a dead man alarm. Dead man alarm is used to notify the bridge when any personnel enter the unmanned machinery spaces. The person entering the machinery space shall activate this alarm while entering and shall at regular intervals update on the same by using the push buttons. If the alarm is not updated at the scheduled time interval, a buzzer rings up at navigation bridge warning the navigating officer that the person inside the machinery spaces needs immediate assistance.
- When machinery is under bridge control, the bridge should always be advised before changing over to control form engine room.

**i) Reasons for notifying engine room and procedure**

- When the engine room is put in a stand-by condition, all machinery and equipment, which may be used during maneuvering shall be in the state of immediate readiness and adequate reserve of power shall be made available for steering gear and other requirements. Sufficient personnel shall be available for various tasks. The systems require setting up well in time as discussed above. Also, when starting systems from cold condition, the systems need warming up. During vessel's port stay routine maintenance/ overhaul processes of systems might be in progress. To allow time to prepare all the machineries and systems as required, the engine room shall be notified well in time to prepare.
- Prior to arrival in ports, the positions are marked on the chart, depending upon the proximity of congested areas of ports. The reason being, in congested areas the engines may be required to be used at any time along with large helm angles.
- During arrival, considering the above, the standby position is marked on the chart where the navigating officer shall notify the engine room for putting engines on standby.
- Depending upon the expected steaming speed, the positions are marked along the track working backwards from the stand by position, for one hour notice and two hour notice to engine room. Transiting these positions the engine room shall be notified accordingly.
- While departure from port, close watch shall be maintained on expected completion time of cargo operations. Accordingly engine room shall be advised about the time of giving two hours and half hour notice to engine room. Stand by engines is generally given when the pilot is on board and prior starting to single up on moorings.
- While at anchorage engines are generally kept available at half an hour notice; prevailing conditions such as heavy weather, strong tidal streams or restricted visibility might require engines to be ready at a short notice. Navigation bridge shall keep the engine room informed regarding the same.
- Whenever any maintenance work or overhaul which requires immobilization of engines is planned in the engine room, same shall be duly checked with the navigation bridge. Additionally while carrying out immobilization of engines while the ship is at berth in port, prior permission has to be taken from the port authorities for the same.

**Apply Your Knowledge**

1. Discuss the functioning of fresh water generator, turbocharger, exhaust gas boiler and shaft generator with respect to the modern concept of saving energy and fuel.

**Function:** Navigation

**Competence:** Maintain a safe navigational watch

**Task number:** A2.1

**Sub-task Reference number:** A2.1.15

**Topic:** Watchkeeping

**Task Heading**

➢ Practice ETA calculations taking into account the time difference, distance and estimated speed, after allowing for expected weather and currents. Assist duty officer with noon calculations.

Please read this task in conjunction with task A1.2.4

**Objectives**

➢ Learn the different methods of calculating distances and practical application of this while doing voyage and ETA calculations.

**Index**

1) Introduction
2) Commercial aspect of ETA
3) Usual reporting of ETAs/ noon reports
4) Factors to be considered for ETA calculation
5) ETA calculation (principles)
   a) Distance calculations
   b) Speed calculations
   c) Advancing/ retarding clocks
6) ETA calculation in practice

**Description**

**1) Introduction**

Ships call ports for miscellaneous reasons. The first and foremost being cargo operations. Additional reasons include supply of bunkers, provisions, stores, change of crew, surveys and repairs etc. The ship's agents ashore at different ports handle the responsibility of organizing all above. Keeping track of the vessel Expected time of arrival (ETA) at their respective ports, they advise port authorities, shippers/ consignees, ship owners, charterers, managers and all others concerned regarding the vessel's arrival status, so that all the planned operations for the call can be completed on time and the vessel can be attended on arrival without any delays.

The governing factor here is the ETA that the agent receives from the vessel. The ships are required to keep the agents advised of the updated ETAs regularly.

**2) Commercial aspect of ETA**

Ships are hired by charterers for a certain voyage or a certain time period under voyage charter or time charter respectively. Once fixed, the ships have to present themselves at the port agreed at the agreed time also known as laycan. Ships failing to do so, the charterers have the option of cancelling the hiring of the ships.

While under charter, ships are expected to complete certain voyages in agreed time interval or they are required to maintain certain agreed speed. Again, ships failing to do so, may invite penalties unless there are justifiable reasons for the same which may include underperformance due to rough weather enroute.

Considering all above, from the ship's perspective, it becomes utmost important to run the ships as planned and keep all concerned updated about the correct ETA of the vessel regularly. Shall there be any changes in ETA, the same shall be advised in due time.

**3) Usual reporting of ETAs/ noon reports**

Considering the above aspects a vessel is required to regularly update the charterers, ship owners/ managers, the port authorities and the agents regarding the vessel's ETA. This is usually done on a routine basis at the noon time. Noon reports are drawn in a standard format as required by the respective parties and are sent to owners/ managers/ charterers for showing the break up in the last 24hrs duration. The noon reports generally include

- Vessel's name/ code/ voyage number/ last port/ next port
- The date, time and zone time
- The noon position of the vessel
- The durations of steaming, anchorage, alongside in last 24 hrs (including advancement/ retardation of clocks)
- Sea stoppages
- Distance steamed by log and made good
- Speed made good
- Distance by engine
- Engine slip
- Fuel consumption
- Fuel ROB
- Fresh water generated/consumed/balance
- Engine parameters
- Weather condition
- Distance to go
- ETA next port

**4) Factors to be considered for ETA calculation**

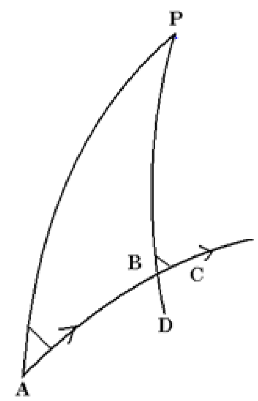
These are:

- Distance to steam
- Expected speed of the vessel in the prevailing circumstances
- Differences in time zones between the departure port and port of destination

**5) ETA calculation(principles)**

**a) Distance calculations**

The procedures of distance calculations for plane sailing, Mercator sailing have been discussed under task A1.2.4 which shall be referred to. The great circle sailing is explained in the section.



On a sphere the shortest distance between two points is the distance along the arc of a great circle. On the surface of earth, if two positions are known, the distance between them and the initial and final courses can be calculated using spherical trigonometry.

In solving great circle problems, Haversine formulae for spherical triangles and Napier's rules for right angle/quadrantal spherical triangles are used. These calculations can also be done using scientific calculator. ABC tables can also be used for the same purpose.

*Example - Find the great circle distance for the GC track from A: 24° 00′N 074° 15′W to B: 46° 00′N 053° 45′W.*

*Solution:*
*Since both the initial and the final positions are in the Northern hemisphere, so both A and B will be joined to North Pole. Now in spherical triangle PAB*
*Side PA = 90° – 24° 00′ = 66°*
*Side PB = 90° – 46° 00′ = 44°*
*Angle P = 074° 15′ W – 053° 45′W = 20° 30′*

*By Haversine Formula for spherical triangles,*

$$\text{Hav } AB = (\text{Hav } P.\ \text{Sin } PA.\ \text{Sin } PB + \text{Hav } PA \sim PB)$$
$$= \text{Hav } 20° 30'.\ \text{Sin } 66°.\ \text{Sin } 44° + \text{Hav } (66° \sim 44°)$$
$$AB = 27° 30.1'$$
$$AB = 1650.1'$$

*Hence the **great circle distance** between A and B is 1650.1′*

**b) Speed calculations:**

**i. Effect of wind on ship's course – leeway**

Leeway is the effect of wind in moving a vessel bodily to leeward at right angles to the course steered. Leeway depends on a number of factors:

- ✓ Own ship speed; higher the speed, less is the leeway.
- ✓ Wind speed; the higher the component of wind speed at right angles to the course, the greater the leeway.
- ✓ Longitudinal area; the greater the ratio of fore and aft area above the water line to that below, the greater the leeway.
- ✓ The depth of water; the shallower the depth of water in relation to the draught, the less the leeway.

Leeway is thus a complex relationship and, whilst attempts have been made to quantify it in mathematical terms, it is probably best for navigator to rely on his own experience and on data in the navigational data book.

In merchant ships, leeway is normally quantified in terms of leeway angle, i.e. the angular difference between the ship's course and her track through the water (water track).

When the wind is on the port side of the ship, the vessel will make good a course to the right of the course steered. Therefore, when the course is given in three figure notation, the leeway should be added to the course steered. If the wind is from starboard side the same is to be subtracted from the course steered. There will not be any leeway if the wind is from right ahead or right astern.

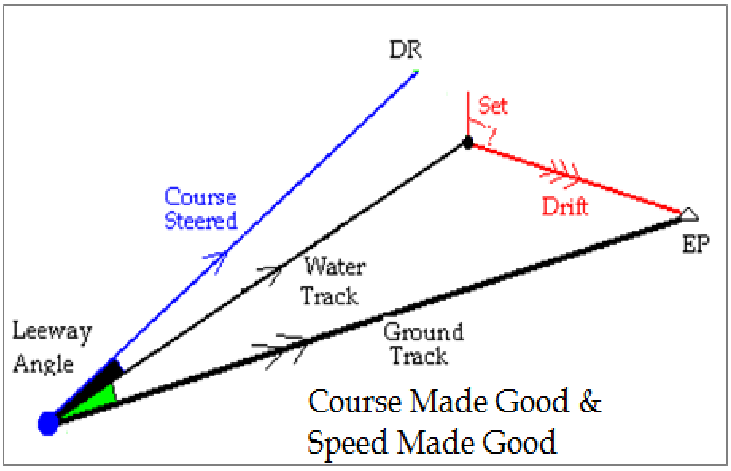
**ii. Tidal streams, currents and surface drift**

A tidal stream is the periodical horizontal movement of the sea surface caused by tide raising forces of sun and moon. Information concerning the tidal streams is given on admiralty charts, in admiralty sailing directions, in tidal stream publications and in special tidal stream atlases. Tidal stream data must be used with caution, particularly at springs and around the calculated time of change-over from ebb to flood and vice versa. It will often be found that the tidal stream experienced is different from that calculated.

A current is a non-tidal horizontal movement of the sea due mainly to meteorological, oceanographical or topographical causes. It may be nearly constant in some areas, and may vary seasonally. Information regarding currents is available in various admiralty publications.

Surface drift is the horizontal movement of surface water causes by the drag of wind. There is no recorded data available on it. The maximum rate of surface drift depends on the wind speed, the time for how long the wind has been blowing and the fetch of wind (fetch is the extent of open water over which the wind has been blowing before it reaches the observer).

All above can be summarized as shown in the diagram below




The compass course to steer is established by applying the set/drift, leeway and compass error to the true course as plotted on the chart. Vessel is steered on the calculated compass course and the progress along the intended track is checked by monitoring positions.

### iii. Day's work

When a vessel sails on several rhumb line courses for short distances, the irregular track that she follows is called a traverse. To find the direct course and distance between the departure and arrival positions, the several rhumb line distances that she sailed may be considered as the hypotenuse of the plane sailing triangles. Thus, the D'lat and Departure for each leg of the traverse can be calculated to obtain the final position arrived.

*Example:*
*A ship steaming at 15 knots steers the following courses*
*0000 – 1000 hrs 061° (C)*
*1000 – 1800 hrs 088° (C)*
*1800 – 2400 hrs 222° (C)*
*Throughout this period she experienced a current setting in direction 324° at 2.5 knots and a leeway of 2°, Wind Northerly. Calculate the estimated position at 2400 hrs if the ship started from position Lat 27° 12.0' N Long 178° 42' E.*

| Corrtd Comp. Co. | True Course | L'way | L'way Course | Speed Kts. | Time Hrs. | Dist | D'Lat | | Dep | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | N | S | E | W |
| 061° | N61°E | +2° | N63°E | 15 | 10 | 150' | 68.1' | - | 133.7' | - |
| 088° | N88°E | +2° | N90°E | 15 | 8 | 120' | 00 | - | 120' | - |
| 222° | S42°W | -2° | S40°W | 15 | 6 | 90' | - | 68.9' | - | 57.9' |
| **Current** 324° | N36°W | -- | N36°W | 2.5 | 24 | 60' | 48.5' | - | - | 35.3' |
| | | | | | | **Total** | 116.6' | 68.9' | 253.7' | 93.2' |
| | | | | | | | -68.9' | | -93.2' | |
| | | | | | **D'lat** | | 47.7' N | **Dep** | 160.5' E | |

Initial Position-

| | | | | | |
|---|---|---|---|---|---|
| Lat | 27° 12.0' N | Long | 178° 42' E | Dep | 160.5' |
| D' lat | 00° 47.7' N | D'Long | 003° 01.1' E | M'Lat | 27° 35.9' N |
| Arr'd Lat | 27° 59.7' N | Arr'd Long | 181° 43.1 | | |
| | | | = 178° 16.9' W | | |

D'long = Dep. Sec M'lat
= 181.1'

**Final Position: - lat 27° 59.7' N Long 178° 16.9' W**

## c) Advancing/ retarding clocks

Under the zone time system, earth is divided into 24 time zones, each zone being 15° of longitude in width. This is used by ships at sea. Ships in each zone keep time based on central meridian through that zone to ensure the Ship's Time maintained by them is near to the Local Mean Time of the area. Zone zero extends from 7 ½° E to 7 ½° W longitude. The central meridian of this zone being the Greenwich Meridian, ships within this time zone keep GMT. In the same manner zone +1 corresponds to next 15° longitude on west of Greenwich meridian and –1 to 15° on East. Developed in this manner, in addition to the zero zone, there are 12 zones with prefix + &12 zones with prefix -. The +12 zone is from 172 ½° W to 180° and -12 from 172 ½° E to 180°.

The time maintained in any zone corresponding to the central meridian of the zone is known as the zone time.
To find the zone time kept at any longitude, divide the longitude by 15. Convert the quotient to nearest whole number; this will be the time zone. Depending upon longitude East or West as appropriate, subtract or add the whole number of hours from GMT to get the zone time of that area.

As a ship passes from one time zone to the next, she would have to alter her clocks at a rate of one hour for every 15° of Longitude. Ships which pass from one time zone to the next in an easterly course need to advance their ship's clocks, whereas those on a westerly course have to retard their clocks so that their clocks indicate the correct LMT.

International Dateline has been introduced by international agreement. It corresponds to the 180th Meridian. Date line deviates from the actual180° meridian so that the islands in the same group and continuous land areas fall on the same side of the date line. Different dates are maintained on the two sides of the date line.

Ships crossing the date line on a westerly course advance their date by one day, for example, if they were having the date 3rd the next day will be 5th and not 4th. Similarly ships crossing the date line on an easterly course will need to retard their date by one day, for e.g. If the present day is 9th the next day will also be the 9th.

**6) ETA calculation in practice**

Some points to note:

- The voyage route is divided into parts, depending upon the expected speeds of transit.
- Distance of each route leg is calculated usually using GPS calculator. For long passages care shall be taken regarding whether following great circle or mercator sailing route. Short leg distances can be directly picked from the chart.
- Average steaming speed is estimated with reference to vessel's previous records.
- Steaming time is calculated on the basis of above for each part of the voyage.
- The time difference between various parts of voyage is checked.
- The total steaming time along with the time difference is applied to the departure time to calculate ETA.

Example- Vessel ABC departs Istanbul (Turkey) on 3rd May 2012, 1600 hrs for Port Kelang (Malaysia).Enroute she shall be transiting Dardanelles strait, Suez Canal and Piracy prone area in Arabian Sea. It is intended to calculate the ETA Port Kelang pilot boarding ground.

| From Port | To port | Time zone | Distance (NM) | Expected transit speed (kt) | Expected transit time (h) | ETA |
|---|---|---|---|---|---|---|
| Departure Istanbul | | | | | | 3 May 12 – 1600h |
| Istanbul | Dardanelles St. | - 2 | 135 | 15 | 9 | 4 May 12 – 0100h |
| Departure Dardanelles St. | | | | | 3 | 4 May 12 – 0400h |
| Dardanelles St. | Suez N | - 2 | 636 | 17 | 38 | 5 May 12 – 1800h |
| Suez anchorage for convoy | | | | | 1 | 5 May 12 – 1900h |
| Departure Suez Canal | | | | | 21 | 6 May 12 – 1600h |
| Suez S | Port Kelang | - 8 | 4810 | 19 | 253 | 17 May 12 – 0500h |
| Advancing of clocks | | | | | 6 | 17 May 12 – 1100h |
| Port Kelang | - | - 8 | | | | 17 May 12 – 1100h |

- Dardanelles strait transit time is taken as 3 hrs.
- Suez anchorage time has been added as 1 hr due to fixed convoy timing.
- Average speed from Suez to Port Kelang is taken as 19 kts on the basis of high speed transit through piracy prone area in Arabian Sea and expected weather during May.
- Time zone difference of 6 hrs will require clocks advancing by 6 hrs.

As calculated above the ETA port Kelang shall be 17 May 1100hrs.

**Apply Your Knowledge**

1. Assist the navigating officer in preparing the daily noon report.
2. Practice ETA calculations for various voyages undertaken by your vessel and compare your calculation results with actual timing.

**Function:** Navigation

**Competence:** Maintain a safe navigational watch

**Task number:** A 2.2

**Sub-task Reference number:** A2.2.5

**Topic:** Navigational equipment

**Task Heading**

- Locate the alarms units for Bridge Navigational Watch Alarm System (where fitted).

**Objective**

- To understand the bridge navigational watch alarm system and its function

**Index**

**1) Bridge navigational watch alarm system**

**Description**

**1) Bridge navigational watch alarm system**

- Bridge navigational watch alarm system (BNWAS) is designed to monitor bridge activity by a series of indications and alarms.

- It requires the OOW to regularly update the equipment at pre-set intervals (called dormant period) by resetting the system alarm. Where the alarms are not acknowledged by OOW, the same are relayed to alert the master or another qualified OOW.

- This further serves to detect OOW disability, if for any reason the OOW becomes incapable of performing the OOW's duties. Additionally, the BNWAS may provide the OOW with a means of calling master for immediate assistance if required. The BNWAS becomes operational whenever the ship's heading or track control system is engaged, unless inhibited by the master. The system may further be provided with motion sensors to detect physical movement in the bridge.

- The bridge navigational watch alarm system is to be kept operational whenever the ship is underway at sea. In operational mode the BNWAS can be kept in "manual" or "automatic" mode. The master decides regarding the operational mode and is guided by the company's safety management system.


- In "automatic" mode the BNWAS comes in operation automatically whenever the ship's heading or track control system is activated and is inhibited when this system is not activated. In "manual" mode the equipment remains "on" all the time.

- Once operational, the BNWAS alarm system remains dormant for a pre-set period of between 3 and 12 min. At the end of this dormant period, the alarm system initiates a visual indication (flashing indication) on the bridge. If not reset, the BNWAS additionally sounds a first stage audible alarm on the bridge 15 seconds after the visual indication is initiated. If not reset then, the BNWAS sounds a second stage remote audible alarm in the back-up officer's and/or Master's location 15 sec after the first stage audible alarm is initiated. If the alarm is still not reset, the BNWAS sounds a third stage remote audible alarm at the locations of further crew members capable of taking corrective actions 90 seconds after the second stage remote audible alarm is initiated. The alarms are sounded automatically.

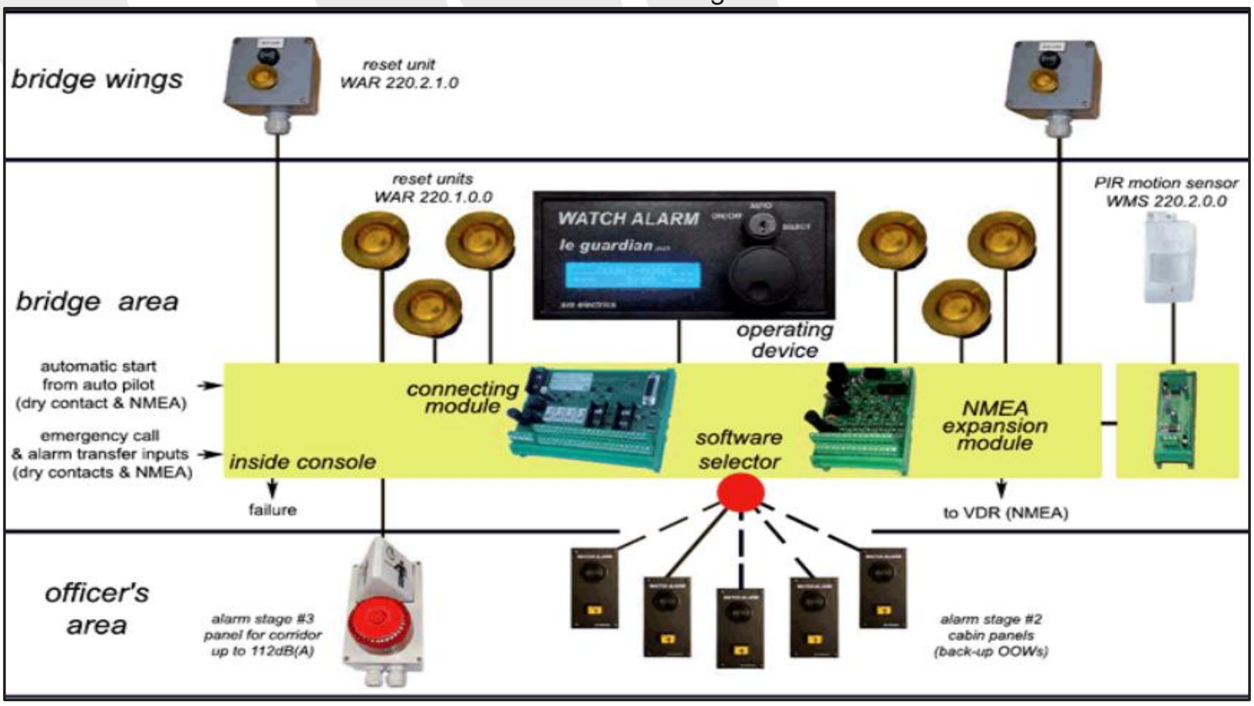
- In vessels other than passenger vessels, the second or third stage remote audible alarms may sound in all the above locations at the same time.

- The means of selecting the operational mode and the duration of the dormant period including switching "off" the equipment are security protected so that access to these controls should be restricted to the master only. This arrangement could be by "key" or "password" protection.

- In larger vessels, the delay between the second and third stage alarms may be set to a longer value on installation, up to a maximum of 3 min, to allow sufficient time for the back-up officer and/or Master to reach the bridge.

- The reset function, by a single operator action, cancels the visual indication and all audible alarms and initiates a further dormant period. To initiate the reset function, a unique, easily identifiable input button (illuminated at night) is provided requiring a single operator action by the OOW. This input may be generated by reset devices forming an integral part of the BNWAS or by external inputs from other equipment capable of registering physical activity and mental alertness of the OOW. It is not possible to initiate the reset function or cancel any audible alarm from any device, equipment or system not physically located in areas of the bridge providing proper look out. Additional reset arrangements may be incorporated in positions giving proper look out.

Schematic Diagram




Source: www.sm-electrics.de

- If the reset function is activated before the end of the dormant period, the period is re-initiated to run for its full duration from the time of the reset.

- Means may be provided on the bridge to immediately activate the second, and subsequently third, stage remote audible alarms by means of an emergency call push button on BNWAS.

- BNWAS is provided with any indication to warn in case of a malfunction or power supply failure.

- The BNWAS is powered from the ship's main power supply. The malfunction indication and other elements of the emergency call facility, if incorporated, are powered from a battery maintained supply.

**Apply Your Knowledge**

1. Locate the BNWAS system reset buttons on bridge and bridge wings (if fitted). Read the equipment manual and detect the input connected to the system.

**Function:** Navigation

**Competence:** Maintain a safe navigational watch

**Task number:** A 2.2

**Sub-task Reference number:** A 2.2.6

**Topic:** Navigational equipment

**Task Heading**

- Locate the sound reception system and external microphones (if fitted).

**Objective**

- To understand the use of sound reception system on navigation bridge

**Index**

1) Sound reception system

**Description**

**1) Sound reception system**

- Sound reception systems are acoustical electronic navigational aids to enable the officer on the watch to hear outside sound signals inside a totally enclosed bridge in order to perform the look-out function as required in the International Regulations for Preventing Collisions at Sea, 1972. On ships where the navigation bridge is totally enclosed, a sound reception system, is required to be fitted to enable the officer in charge of the navigational watch to hear sound signals and determine their direction.

- A sound reception system consists of one MASTER station, mounted on the bridge and 2 or 4 distributed microphones, located at the port and starboard, or port, starboard, fore and aft on the vessel.

- Sound reception systems features
  - These can receive sound signals from all directions in the audio band 70 Hz - 820 Hz.
  - These reproduce incoming sound signals acoustically inside the bridge.


  - These further indicate the approximate direction of incoming sound signals to determine at least whether the sound signal being detected is forward or abaft of the beam and from which side of the ship it is being detected (This may be accomplished by means of at least four microphones and separate reception channels.)
  - Further the system suppresses unwanted background noise and allowing reception of meaningful sounds.

- Output
  - Incoming sound signals available outside are reproduced by the system inside the bridge by means of loudspeaker. The volume of loud speaker is adjustable by

means of volume control. The volume control is capable of being set so that the sound pressure level of an incoming signal only is at least 10 dB (A) above the bridge noise level. Additionally the system has a display which gives a visual indication for at least 3 s of the incoming signals and their approximate direction.

- Installation
  - The microphones of the system are installed in such a way that they are as far from noise sources in the ship as is reasonably practicable. Wind induced noise and mechanical vibrations are reasonably reduced. The visual display is installed so that it is visible from the conning position. The loudspeaker(s) is installed so that incoming sound signals are audible at all positions inside the bridge.

**Apply Your Knowledge**

1. Check the minimum audible ranges of sound signaling appliances provided on board. Discuss the need for lookout by hearing.

**Function:** Navigation

**Competence:** Maintain a safe navigational watch

**Task number:** A 2.2

**Sub-task Reference number:** A2.2.7

**Topic:** Navigational equipment

**Task Heading**

- Demonstrate ability to set up and operate Automatic Identification System. Input the own vessel's voyage data in AIS and obtain static and dynamic information of other vessels. Recognize the limitations of AIS.

**Objective**

- To understand the functioning and operation of AIS system along with the benefits and limitations

**Index**

1) Automatic Identification System
2) Functioning of AIS
3) Information provided by the AIS
4) AIS modes of operation
5) Benefits of AIS for the officer of the watch
6) Limitations of AIS

**Description**

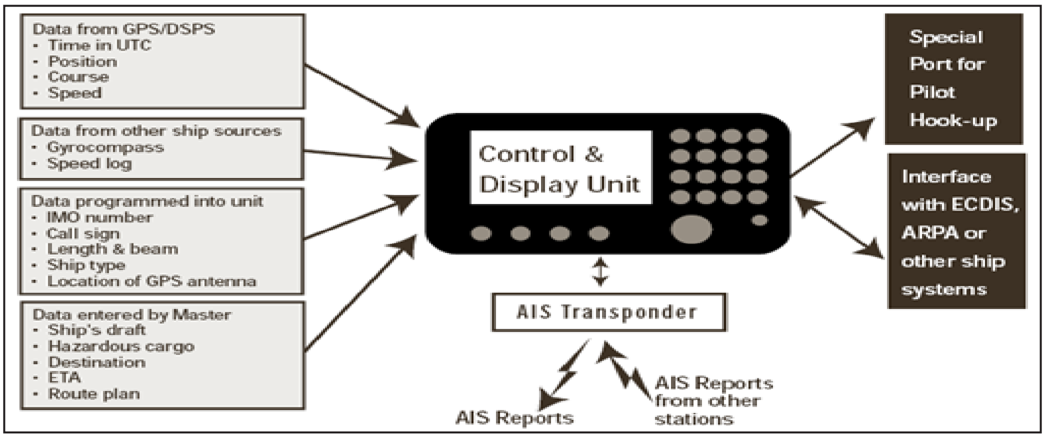
**1) Automatic Identification System**

- Automatic Identification Systems (AIS) facilitates positive identification of vessels by providing automatic means of data exchange between ships such as vessel id, position, course, speed and other vital data, with all other nearby ships and shore stations through a standardized transponder system. The result is OOW has improved situational awareness for collision avoidance.

- AIS continuously transmit ship's data on a common VHF radio channel. The radar coupled with AIS input facilitates given radar target to be identified while multiple contacts are being tracked; this being particularly useful when it is impossible to verify a ship's identity visually, as at night or in reduced visibility, thus removing the confusion aspect which may be introduced while using VHF for communication.

**2) Functioning of AIS**

- Position and other data are fed automatically into the AIS system from the ship's sensors, where the data is formatted and transmitted in a short data burst on a dedicated VHF channel.




- Updated AIS messages are transmitted every few seconds to keep the information up to date. The process is performed automatically without any action required by the OOW,

- When received on the other ships, the data is decoded and displayed for the officer of the watch, who can view AIS reports from all other AIS-equipped ships within VHF range in graphic and text format.

- AIS utilizes self-organizing time-division multiple access (STDMA) data communications scheme, which uses the precise timing data in the GPS signals to synchronize multiple data transmissions from many users on a single narrowband channel.

- AIS data transmissions utilize two dedicated VHF frequencies. These are 161.975 MHz (VHF channel 87B) and 162.025 MHz (channel 88B). In some parts of the world, such as the United States, where these frequencies may not be available for AIS, other channels may be designated.

- The ship's AIS station has two independent VHF receivers and one transmitter. The receivers are normally tuned to the two AIS frequencies; and the transmitter alternates its transmissions back and forth between the two.

- Each ship broadcasts its AIS messages and receives messages from all ships within VHF radio range. The area in which AIS messages can be received is called the ship's "cell". Each ship is in this way in the center of its own communication cell. The practical size of the cell can be varied according to the traffic density on the AIS channel. If the number of AIS messages begins to overload the network, the ship's AIS system can automatically shrink its cell by ignoring weaker stations further away in favor of those nearby.

- The AIS data is further fed to the ship's integrated navigation systems and radar plotting systems to provide AIS tags for radar targets.

- AIS is designed to work autonomously and continuously in a ship-to-ship mode, but the specifications provide for switchover to an "assigned mode" for operation in an area subject to a competent authority responsible for traffic monitoring, with the data transmission intervals and timeslots set remotely by the shore side authority. Alternatively, the AIS can work in a "polling mode" in which the data transfer occurs in response to interrogation from another ship or shore station.

**3) Information transmitted by the AIS**

- **Static data**(programmed into the unit while installing)
  - IMO number
  - Call sign and name

- ❖ Length and beam
- ❖ Type of ship
- ❖ Location of position-fixing antenna on the ship(Aft of bow and port or starboard of centerline)

- ➢ **Dynamic data**(automatically derived from interfaces with the ship's navigational equipment)
  - ❖ Ship's position with accuracy indication and integrity status
  - ❖ Time in UTC
  - ❖ Course and speed over ground
  - ❖ Heading
  - ❖ Navigational status (anchored, NUC, data manually entered)
  - ❖ Rate of turn (where available)

- ➢ **Voyage related data**(entered manually and is password-protected)
  - ❖ Ship's draft
  - ❖ Hazardous cargo (type)
  - ❖ Destination and ETA (at master's discretion)

- ➢ **Safety-related messages**(inserted at any time)
  - ❖ As needed

- ➢ The static and voyage-related data are transmitted every six minutes, when amended or on request when interrogated by a vessel traffic system operator. Safety messages are sent as needed. The update rates for dynamic information will depend on the ship's status and speed varying from 3 min while at anchor to every 2 sec when moving at 23 kts.

**4) AIS modes of operation**

- ➢ **Ship-to-ship data exchange**
  The primary operating mode for AIS is autonomous ship-to-ship reporting. In this mode, each ship transmits its data to all other AIS-equipped ships within VHF range.

- ➢ **Coastal surveillance**
  In coastal waters, shore side authorities may establish automated AIS stations to monitor the movement of vessels through the area. These stations may simply monitor AIS transmissions from passing ships, or may actively poll vessels via the AIS channels, requesting data such as identification, destination, ETA, type of cargo and other information.

- ➢ **Vessel traffic systems**
  AIS provide a tool to shore stations for monitoring and controlling the movement of vessels through restricted harbors and waterways. The AIS can augment traditional radar-based VTS installations, providing an AIS overlay on the radar picture, or can provide a cost-effective alternative in areas where it is not feasible to establish radar-based systems. When integrated with radar, the AIS can ensure continuous coverage, even when the radar picture is degraded by heavy precipitation or other interference.

**5) Benefits of AIS for the officer of the watch**

- ❖ Improved situational awareness by unambiguous automatic identification of radar targets
- ❖ Overcome problem of target swapping on the radar ARPA screen
- ❖ Ability to detect targets in rains, around bends or behind a landmass, in radar shadow sectors where the radar detection is obscured

- Detect a change in another ship's heading and other ship's movements almost in real time
- Reduce VHF voice traffic

**6) Limitations of AIS**

- Data received is only as good as the data entered into the AIS. To ensure that correct AIS information is broadcast current voyage related data such as draught, type of hazardous cargo, destination and ETA shall be updated regularly.
- The data automatically received from sensors shall be considered with equipment specific errors and limitations such as those affecting GPS, gyro etc.
- Not all ships, such as leisure craft, fishing boats and warships are equipped with AIS.
- AIS fitted on ships, under certain circumstances such as while transiting piracy prone area, may be switched off as per master's judgment.
- Information being broadcast by their own vessel, particularly position, heading (provided by the ships master gyro) and speed shall regularly be checked by OOW.
- AIS is subject to the limitations of VHF-FM propagation.
- The OOW shall be well familiar with the use and limitations of the AIS equipment.

**Apply Your Knowledge**

1. Read the AIS manual on board and learn the equipment operation. Discuss the limitations of AIS with reference to over reliance. Also discuss the errors / limitations of equipments providing input to AIS which may affect the reliability of AIS data.

**Function:** Navigation

**Competence:** Maintain a safe navigational watch

**Task number:** A 2.2

**Sub-task Reference number:** A2.2.8

**Topic:** Navigational equipment

**Task Heading**

- Demonstrate understanding of the backup procedures of the Voyage Data Recorder / Simplified Voyage Data Recorder. Locate the operation panel, main recording control unit and the protective capsule.

**Objective**

- To understand functioning and use of VDR/ S-VDR

**Index**

1) Voyage Data Recorders

**Description**

**1) Voyage Data Recorders**

- Voyage Data Recorder (VDR) is fitted on navigation bridge to continuously maintain sequential records of preselected data items relating to status and output of the ship's equipment and command and control of the ship. The data recorded includes navigation and miscellaneous data consisting of vessel's position, course, speed, depth sounding, radar picture, all radio communications including VHF, audio recording of all bridge activities, any activation of mandatory alarms, engine orders and response, rudder order and response, bow thruster data (if fitted), hull opening status such has bow and stern doors (if fitted), data from weather sensors and hull stress data.

- VDRs enable accident investigators to review procedures and instructions in the moments before an accident and help to identify the cause of accident. VDRs facilitate better casualty investigation analysis and improved loss prevention.

- VDR continuously records data for at least last 12 hours without requiring any manual involvement of shipboard personnel. Data stored for over 12 hours may be overwritten as the equipment continuously runs.

- To ensure that the recorded data is not damaged or lost as a result of an incident, the data recorded is stored in a protective capsule and is kept safe in a secure environment to be available for at least 2 years. It is designed to withstand extreme conditions such as low temperature fire of 260°C for 10 hours, sea water immersion down to 6000m and a penetration force equivalent to a weight of 250kgs dropped with a pin of 100 mm diameter from a height of 3m.

- The protective capsule is usually of bright fluorescent colour, fitted with Retro reflective tapes and mounted on an external deck close to the bridge like the “monkey island” to aid in the location of the VDR. It may be fitted on the deck with a float free arrangement. Additionally it is provided with a device to aid it to be located. This device is capable of transmitting an initial locating signal and further locating homing signal for at least 48 hours over a period of not less than 7 days/168 hours.

- Most VDRs have two duplicate disc writers, each containing a magneto - optical (MO) CD disk. One disc writer forms a removable, emergency “Breakaway” pack, designed to be hand carried in the lifeboat in the event of abandoning the vessel. In more normal circumstances, the removable magnetic disc can be sent to the ship owner for archiving purposes. A clean MO disk can then be inserted, ready for the next passage.

- The ship’s officers must know how to backup, store and retrieve VDR data.

- If the ship’s emergency source of electrical power supply fails, the VDR continues to record Bridge Audio from a dedicated reserve source of power for a period of at least 2 hours.

- The VDR system is tested annually for performance of the equipment along with all its sensors to verify the accuracy, duration and recoverability of the recorded data.

- The **Simplified VDR (S-VDR)** is not required to store the same level of detailed data as a standard VDR, but nonetheless maintains a record of date and time, ship’s position, speed, heading, bridge audio, communications audio, radar data, post-display selection, AIS Data and other items as available, over the period leading up to and following an incident.

**Apply Your Knowledge**

1. Read the installation manual of VDR/ S-VDR fitted on board your vessel and list the inputs connected to the unit. Check the float free system for the data capsule.

**Function:** Navigation

**Competence:** Maintain a safe navigational watch

**Task number:** A 2.2

**Sub-task Reference number:** A2.2.9

**Topic:** Navigational equipment

**Task Heading**

- Assist in checking steering gear and all other navigational equipment including internal communications, testing controls and synchronization of bridge and engine room clocks before arrival and departure as per pre-arrival and pre-departure checklist.

**Objective**

- To understand importance and procedure of control testing

**Index**

1) Controls testing
2) Control testing procedures
3) Sample checklist for arrival /departure
4) Sample checklist for testing steering gear

**Description**

**1) Controls testing**

- Controls testing provides an advanced check on operational status and readiness of the equipments and machinery, well before the actual operation so that any of the deficiencies and defects be rectified in time.

- It is prudent to check the functional condition and readiness of all necessary equipments, machinery and gear before vessel proceeds out to a location where these are likely to be used. Any malfunction or inoperability of the equipment, machinery or gear is likely to lead to last minute chaos, making the navigation unsafe and may result in serious casualties.

- Control testing shall be done by a certified navigational officer.

**2) Control testing procedures**

- Passage plan and publications - Ensure that the passage plan is ready prior departure from port. The plan shall be amended/ updated for arrival port information.

- Compasses - The gyro compass and the magnetic compass shall be checked and headings compared. The gyro and magnetic compass errors shall be checked. Azimuth mirror shall be placed ready for use on one of the gyro repeaters.

- Clocks - The bridge and the engine room clocks shall be checked and compared. Any differences shall be rectified by synchronizing.

- Communication systems (external and Internal) – VHF equipments for communication with outside authorities of port, and pilots shall be checked switched on and tuned to the port/ pilot working channel. The second VHF shall be kept on Ch16. Equipments to be used for communication on board as mentioned below, shall be checked and tried out. The portable walkie-talkie batteries shall be kept charged along with spare batteries.

- Engine telegraph and main engines – Bridge, bridge wing telegraph and engine telegraph shall be checked for synchronization. Main engines shall be tried out. This is usually done between half hour notice to engine room and stand by engines. Separate entry shall be made in the movement book for the time when engines are tried out.

- Steering gear – Both steering motors shall be switched on. The rudder movement shall be checked from hard over to one side to hard over on other side in both follow up and non-follow up modes. The rudder angle indicators shall be checked and compared with repeaters in bridge, bridge wings, engine room and steering gear room.

- Lights – All lights as mentioned below shall be checked and switched on as required. Lights to be checked include
  - Navigation lights
  - Christmas tree lights
  - Deck lights including pilot ladder light
  - Forward and aft station lights
  - Search light
  - Morse signaling light on christmas tree
  - Aldis lamp
  - Hand held torches

- Bridge equipments – Bridge equipments shall be switched on and checked as mentioned below.
  - Both RADARs switched on and tuned properly, heading aligned with gyro, all settings adjusted as required. Prior switching on radar, the scanners shall be checked clear of any obstructions. In tanker terminals, it may not be permitted to run the radar while alongside. Same shall be checked and RADARs kept in standby condition in that case.
  - Speed log switched on and checked
  - GPS/ other electronic position fixing aids operational and updated with route plan
  - ECDIS switched on, updated with route plan
  - Course recorder ready to be switched on preferably at the time of SBE or earlier. Sufficient paper roll shall be available. Course recorder shall be set to correct GMT, aligned with gyro and marked as appropriate
  - Engine movement logger operational with sufficient paper roll, set to correct GMT and marked as appropriate
  - Echo sounder operational with sufficient paper roll, (depth shall be checked and compared with reference to charted depth, height of tide and draft)
  - Binoculars kept near the lookout position
  - Navtex switched on and set to correct stations
  - AIS switched on and updated prior departure,
  - BNWAS shall be checked and ready for use.
  - Pneumatic whistle, fog horn, bell, gong and electric klaxon shall be checked, horn tried out by giving a short blast (if permitted by the port authorities). Ensure that the control air or electric power is kept on after testing.
  - Country flags, company flag, pilot flag, dangerous cargo flag, ensign flag etc. shall be checked and displayed.
  - GMDSS equipments on and in operation
  - Chart table lamp, instrument lights, dimmers on the rudder indicator and engine room RPM tachometer, standard compass, steering compass, gyro repeaters etc. shall be checked and adjusted as required
  - Bridge front window wipers/clear view screens shall be checked clear and operational.

- Deck machinery – Winches, windlass and gangway motor power supply shall be checked switched on. Anchors shall be checked clear of any lashings etc.

- Control panel for UMS ships engines shall be checked in consultation with the duty engineer on bridge. Control of bow/ stern thrusters if fitted shall be checked and ready.

- Pilot card shall be duly filled up and kept ready. Pilot boarding and disembarking arrangement shall be checked and the pilot ladder/ combination ladder rigged accordingly.

- Vessel's draft shall be checked and displayed on bridge.

- Engine room, bridge team, deck officers and crew shall be informed of the tentative plan for berthing/ anchoring/ casting off and preparations on deck carried out accordingly.

**3) Sample checklist for arrival /departure**

*PORT : ARR DATE : DEP. DATE :*

*[TICK OFF THE RELEVANT BOXES ONLY: A – ARR &D – DEP*
*USE SAME CHECKLIST FOR PRE-ARRIVAL AND PRE-DEPARTURE]*

*[To be carried out not more than 6 hours before arrival and 2 hours before departure.]*

| | | A | D | | | A | D |
|---|---|---|---|---|---|---|---|
| 01 | Steering gear tested as per checklist D/02 | | | 13* | Third radar operational and running. | | |
| 02 | Communication with engine room/ checked by main and secondary telephones. | | | 14 | First ARPA operational and running. | | |
| 03* | Talkback system bridge/ forward/aft/ E-room tested. | | | 15* | Second ARPA operational and running. | | |
| 04 | Bridge and Engine Room clocks synchronized. | | | 16* | Radar inter-switching operational /Test Performance Monitor for ARPA & Radars | | |
| 05 | Walkie-talkies fully charged and tested. Spare batteries charged and ready. | | | 17* | Gyro and magnetic compass errors checked. Gyro alarms tested. Magnetic off course alarm tested * | | |
| 06 | Telegraph tested from main console. | | | 18* | Voyage Data Recorder operational. | | |
| 07* | Telegraph tested from port and starboard wing consoles. | | | 19* | All repeaters synchronized with master gyro, including radars, auto-pilot, bearing repeaters, steering. Flat. | | |
| 08* | Telegraph data logger checked, clock synchronized. | | | 20* | Both VHF's tested. DSC operational. | | |
| 09 | Navigation, NUC, anchor and X'mas tree lights/alarms tested | | | 21 | Echo-sounder zero alignment checked, depth alarm set and tested on forward and aft sensors as fitted. | | |
| 10 | Whistles tested forward and after. | | | 22* | Speed/distance log operational, counter reset if reqd. | | |
| 11* | Manual operation of whistles tested. | | | 23 | Course recorder tested, heading synchronized, pens cleaned.* Time synchronized | | |

| | | A | D | | | A | D |
|---|---|---|---|---|---|---|---|
| | | | | | and set to UTC | | |
| 12 | *Clear-view screens & wipers tested. (Including Heating)** | | | 24* | *GPS No. 1, operational, (initialised before departure* | | |
| 25 | *Port radar operational and running.* | | | 39* | *ECDIS Operational set up, running.* | | |
| 26 | *Stbd. radar operational and running.* | | | 40 | *Nav Tex operational, running correct stations chosen.* | | |
| 27* | *AIS operational, running and voyage data updated* | | | 41 | *Arr./dep. draft & cargo figures posted on bridge notice board. Minimum U.K.C. expected written online board.* | | |
| 28 | *Magnetic compass binnacle light/dimmer tested.* | | | 42* | *Dangerous goods locations and class, available on bridge.* | | |
| 29 | *Passage plan prepared, read, discussed by Master and navigators. Briefing meeting to be held.* | | | 43* | *Stability / stress calcs. Made, GM and other necessary cargo information available to bridge.* | | |
| 30 | *Passage plan for Arrival port and berthing Discussed (Briefing meeting held.)* | | | 44 | *Courtesy flags hoisted / ready.* | | |
| 31 | *Check passage charts kept in order of use as per passage-plan* | | | 45 | *Pilot card filled ready for pilot.* | | |
| 32 | *Guide to port-entry, sailing directions, light lists, ALRS, pubs. As per Passage Plan, taken out ready on chart table, also Port Information File checked.* | | | 46 | *All bridge instrument illumination operational and tested, incl. All console lighting, rudder and rpm lighting, repeater's lighting, steering light.* | | |
| 33 | *Temporary and preliminary notices checked.* | | | 47 | *Aldis and Morse lamps tested on mains and battery.* | | |
| 34 | *Tides & tidal – streams calculated, written on chart, tidal stream atlas / tide tables out ready on chart table.* | | | 48* | *Megaphone, public address systems tested* | | |
| 35 | *Nav-warnings received and Navtex messages out and ready at navigation station.* | | | 49 | *Prior departure, binoculars, parallel rulers, pencils etc, out and ready for use.* | | |
| 36 | *Wx reports received (on EGC) and on Navtex/weather fax out and ready at navigation station.* | | | 50 | *Main engine tested Ahead and Astern. [Prior testing Propeller confirmed clear first.]* | | |
| 37 | *Security level as required by Flag State/Port State implemented.* | | | 51 | *Security level as required by Flag State/Port State implemented.* | | |
| 38 | *GPS No. 2, operational, (intialised before departure.)* | | | 52 | *Declaration of Security* | | |
| 53 | *Maritime Security search carried out.* | | | 62 | *Hatches battened down* | | |
| 54 | *Pilot / Combination ladder checked, cleaned and ready/rigged as per IMO/IMPA re-commendations.*<br>*a) Life buoy with light & heaving line available*<br>*b) Deck officer with at least one crewman available at* | | | 63 | *All cargo holds, hatch covers and coamings, and surrounding areas of cargo operations properly inspected for possible unobserved or hidden damage as and when cargo operations were completed. For any damage occurred/found, notice* | | |

| | | A | D | | | A | D |
|---|---|---|---|---|---|---|---|
| | embarkation point at time of boarding. c) Check walkie-talkies charged, operational & ready for use. | | | | served to the stevedores/ cargo terminal and charterers/sub charterers and others concerned notified, as appropriate | | |
| 55 | Bow Thruster checked and ready for use. | | | 64 | Windlass and mooring winches tried out. | | |
| 56 | All personnel informed of approx time of stations. | | | 65 | Deck lighting and pilot area lighting tested. | | |
| 57* | Wind direction / strength indicator operational (in case of dual display readouts, check and confirm scale setting m/s or Kts) | | | 66 | Correct Nav area set for safety net on Sat C prior departure. | | |
| 58* | Anchors unlashed/cement removed prior arr. | | | 67 | Drip Trays / Save-Alls Plugged prior arrival. | | |
| 59 | Deck cargo lashings checked. | | | 68* | Quay checked for any lashing material belonging to vessel prior departure (Containers). | | |
| 60 | Hatches Unbattened | | | 69 | Amver report prepared /sent. | | |
| 61 | Prior departure, EPIRB placed back in position (only when EPIRB has been removed, in case of ports with known threat of piracy) | | | 70 | Embarkation / Dis-embarkation of Pilot a) Time of E/D b) Agreed side of boarding Position for E/D Speed of V/L at time of E/D | | |
| 72 | LRIT operational and running | | | 71 | BNWAS operational and running | | |

*ARR-D/O: Name:________Sign:_________Time:__Master's Verification: __________*

*DEP-D/O: Name:________Sign:_________Time:__Master's Verification: __________*

*IF ANY EQUIPMENT IS NOT FUNCTIONING PROPERLY, INFORM MASTER IMMEDIATELY.*
** = AS MAY BE APPLICABLE TO VESSEL*

### 4) Sample checklist for testing steering gear

*PORT: DATE: ARR / DEP.*
*[Delete one. ]*
*[To be carried out between 12 to 2 hours before arrival / departure]*
*Ensure Duty Engineer is present in Steering gear compartment while conducting this test]*

| | | |
|---|---|---|
| 1 | In port - Duty Officer has checked that rudder is clear.[4] | |
| 2 | Test main and secondary communications, Bridge to Steering Flat. | |
| 3 | Test primary and secondary steering gear. The test procedure includes a visual inspection of the steering gear and its connecting linkage (confirmed OK by Duty Engineer), and, where applicable, the operation of the following: | |
| (i) | Each remote steering gear control system. (separately and then together) | |
| | [All combinations of pumps + motors must be tried out.] | |
| | a. Normal operation from bridge steering stand. | |
| | b. Non follow-up operation from bridge steering stand. | |
| (ii) | Each steering position located on the navigating bridge. | |
| (iii) | The main steering gear from the alternative power supply, if installed. This test is not required if the steering gear supplied from emergency power supply is at all times operated as such (e.g. – supply routed through emergency switchboard) | |
| (iv) | Each rudder angle indicator in relation to the actual position of the rudder + illumination. | |
| (v) | Each remote steering gear control system power failure alarm. (audible + visual) | |

| | | |
|---|---|---|
| *(vi)* | *The full movement of the rudder to the required capabilities of the steering gear. (as per SOLAS, the rudder should be able to be turned from 35 deg on one side to 30 deg on other side in not more than 28 secs)* | |
| *4* | *Check auto pilot fully operational.*[1&4] | |
| *5* | *Synchronize the gyro repeater in steering flat. (if applicable)* | |
| *6* | *Test Gyro off- course alarm*[2& 4] *(audible and visual )* | |
| *7* | *Time Log entry made: "Steering gear tested as per checklist No. D/02".* | |
| *8* | *Check automatic isolation arrangement and other automatic equipment are fully functional.* | |
| *9* | *Check that an Emergency Steering gear drill has been carried out in the last 3 months. If not, emergency drill to be carried out 48 hrs prior entry port and logged.*[3] | |

*NOTE: Any abnormality, deficiency or doubt must be immediately reported to Master and Chief Engineer.*

*NOTE 1: Align Auto-pilot heading indicator with ship's head and engage Auto-pilot. Now turn auto-pilot to port and stbd. The rudder must follow.*

*NOTE 2: With Auto-pilot still engaged, move the Auto-pilot heading marker about 10 degrees and off-course alarm must activate.*

*NOTE 3: For latest US Regulations, please refer to 33CFR. The above Checklist covers present Regs of 33CFR relating to Steering Gear.*

*NOTE 4: To be carried out before departure port only*

*Duty Officer: Name: Sign: Time:*

**Apply Your Knowledge**

1. Refer to the shipboard SMS manual and assist the navigating officer in control testing as per SMS checklists.

**Function:** Navigation

**Competence:** Maintain a safe navigational watch

**Task number:** A2.3

**Sub-task Reference number:** A2.3.3, A2.3.4

**Topic:** Ship reporting systems

**Task Heading**

- Identify Vessel Traffic Information System reporting points on the chart.
- Carry out necessary communication and reporting to the VTIS.

**Objectives**

- Understanding the VTS and reporting procedures

**Index**

1) VTS description
2) Services offered by VTS
3) Participation in VTS

**Description**

**1) VTS description**

- Vessel Traffic Service (VTS) is designed to improve the safety and efficiency of vessel traffic and to protect the environment. These are shore based systems engaged in management of traffic within a port or waterway and broadcast of simple information messages to ships, such as position of other traffic or meteorological hazard warnings.

- The local governments may make the use of VTS mandatory in sea areas within their territorial seas. Ships are required to follow the VTSs on their route. If not intending to use these services, ships are advised to pass at wide margins to avoid confusion amongst traffic. VTS, wherever possible, follow the guidelines developed by IMO. VTS are established in areas where, the volume of traffic or the degree of risk justifies such services.

- VTSs have declared service areas covered by the service and these may be further subdivided in sub-areas or sectors. VTS has a centre from which it is operated and is manned by VTS operators. Each VTS centre and sector is identified with a unique name. The boundaries are indicated in the nautical publications, admiralty list of radio signals and in the world VTS guide.

- The VTS authority holds the responsibility for the management, operations and co-ordination of the VTS, the interaction with participating vessels and the safe and effective provision of the service.

- A port VTS is mainly concerned with vessel traffic to and from a port or harbour or harbours, while a coastal VTS is mainly concerned with vessel traffic passing through the area.

**2) Services offered by VTS**

- VTS, also termed as "Vessel Traffic Management Service" (VTMS) offers the traffic organization service for management of traffic and the forward planning of vessel movements to prevent congestion and dangerous situations. This is particularly relevant in times of high traffic density or when the movement of special vessels may affect the flow of other traffic. The services establish and operate VTS sailing plans in relation to priority of movements, allocation of space, mandatory reporting of movements in the VTS area, routes to be followed, and speed limits to be observed or other appropriate measures as considered necessary.

- VTS, also termed as "Vessel Traffic Information Service" (VTIS), provide information service by broadcasting information at fixed times, when necessary, or at the request of a vessel. This includes reports on the position, identity and intentions of other traffic, waterway conditions, weather hazards or any other factors that may influence the vessel's transit.

- The navigational assistance service is available in cases where vessels have some defects or deficiencies. Assistance is also available in difficult navigational or meteorological circumstances.

**3) Participation in VTS**

- Ships entering a VTS area report to the authorities, usually by radio, and may be tracked by the VTS control centre. Ships must keep watch on a specific frequency for navigational or other warnings, while they may be contacted directly by the VTS operator with respect to transit through the VTS area.

- Generally VTSs have a sailing plan which is mutually agreed between a VTS authority and the master of a vessel concerning the movement of the vessel in a VTS area.

- Vessels navigating in an area where vessel traffic services are provided should make use of these services. Depending upon governing rules and regulations, participation in a VTS may be either voluntary or mandatory. Vessels should be allowed to use a VTS where mandatory participation is not required.

- Communication with the VTS and other vessels should be conducted on the assigned frequencies in accordance with established ITU and SOLAS chapter IV procedures; in particular where a communication concerns intended manoeuvres. Standard marine communication phrases shall be used to facilitate effective communication.

> Vessel transiting an area of a certain VTS on the way shall be clearly mentioned in the passage plan. Duly filled report formats shall be made readily available at the navigation bridge near the VHF radio well in advance providing data required for reporting.

- VTS procedures should stipulate what communications are required and which frequencies should be monitored. Details are available in respective nautical publications.

- The process of participating in a VTS begins when a vessel checks in to inform the VTS of its position, identity and intentions. The medium for communicating this information is usually VHF radio. In its initial report to the VTS, a vessel will provide the VTS with a sailing plan that will serve as the VTS's primary source of information to monitor the participating vessel and upon which it will base its traffic organization decisions. Upon completing its transit, vessels are required to make a final call to the VTS reporting all secure or to inform the VTS of its future plans.

- During their passage through the VTS area, vessels should adhere to governing rules and regulations; maintain a continuous listening watch on the assigned frequency and report deviations from the agreed sailing plan, if such a plan has been established in co-operation with the VTS authority.

  - In case of a complete failure of the vessel's appropriate communication equipment, the VTS centre and other vessels in the vicinity shall be informed by any other available means of communication.

- Automatic Identification System (AIS) offers a means to automate and simplify the verbal reporting system in VTS. AIS also deliver precise positioning and manoeuvring information to the VTS operator, enabling improved management of waterway space. A VTS fitted with AIS is capable of receiving the identities and the precise positions of vessels at the maximum reception range of the radio communications frequency in use.


**VTS Reporting point symbols**

- The reporting points in a VTS are marked by the symbol as described in chart 5011. The details regarding the contents of report and the procedure are available in the admiralty list of radio signals volume 6.

**Apply Your Knowledge**

1. Check the current passage plan and the next VTS vessel is scheduled to transit Prepare a report as required for reporting. Check the fields which will necessitate use of phonetics during reporting.
2. You are transiting a strait and passing a VTS reporting point. Write down the phrases that you will use to communicate the required information to the VTS. Use the IMO Standard Marine Communication Phrases (SMCP).

**Function:** Navigation

**Competence:** Maintain a safe navigational watch

**Task number:** A2.4

**Sub-task Reference number:** A2.4.2, A2.4.4, A2.4.5

**Topic:** Bridge resource management

**Task Heading**

- Recognize the role of the pilot in the bridge team.
- Demonstrate understanding of the concept of challenge and response during questionable decisions and/or actions on the bridge.
- Respond to master’s and pilot’s orders when using engine

**Objectives**

- To understand the role of pilot and the concept of challenge and response

Please read this task in conjunction with tasks under header A2.1

**Index**



**Description**

**1) Role of the pilot in the bridge team**

- The pilot on board is a temporary member of the bridge team. The pilot has the detailed information regarding the port.

- As the pilot shall be handling the vessel during berthing/ un-berthing; he shall be apprised of the vessel’s details prior handing over the con. This includes advising the pilot regarding the vessel’s specific maneuvering features which might have been observed earlier, its engines/propeller/rudder, availability of thrusters, vessel’s load condition, operational limitations of equipment or machinery and any other issues causing concern in vessel’s maneuver.

- The topic has further been covered in detail in Task A2.4.4, A2.1.8 and 2.1.12 under the headers
  - ❖ Bridge team meetings
  - ❖ Navigating with pilot on board
  - ❖ Master-pilot information exchange

**2) Responding to master’s and pilot’s orders when using engine**

- It shall be clearly understood that pilot on board is a temporary member of the bridge team. Master may delegate the conduct of the ship to the pilot, who in turn directs the navigation of the ship but the same is organized in close co-operation with the master and /or the OOW.

- During master-pilot information exchange, the pilot shall be apprised of the vessel's maneuvering characteristics and engine features, along with availability of thrusters. With respect to engines, he shall be specifically informed regarding the maximum ahead and astern power, response time, time required to run from full ahead to full astern, maximum number of consecutive kicks and the critical RPM. A duly filled pilot card serves the purpose.

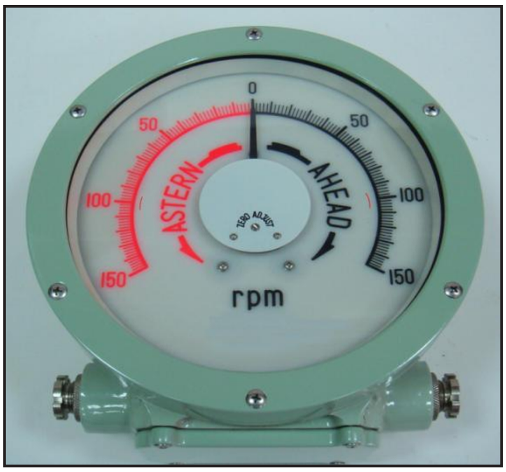
- Pilot card contains the details for engine specifying the above mentioned details along with engine order and the corresponding RPM in a tabular form. If the ships is fitted with more than one propeller and/ or thrusters at bow and astern, details of the same are also provided in the pilot card.

- The engine orders are narrated verbally by master and/ or pilot. As a recommended practice, the engine orders given by pilot are repeated by master.

- The officer serving the engine telegraph shall closely monitor for such orders. As heard, he shall repeat the order loudly before executing the command on telegraph. Once the order is relayed to engine room by telegraph, he shall monitor the tachometer. As soon as the RPM observed in tachometer is same as the specified RPM for the engine status, he shall repeat the order again, acknowledging that the engine movement has been carried out as required.


- The master/ pilot shall be immediately informed, if a delay is observed in compliance of the engine order, as may be apparent from the tachometer. A quick reference maneuvering table listing the engine order and RPM is usually provided close to the telegraph.
  The commonly used engine telegraph orders are as follows:
  - Full Ahead
  - Half Ahead
  - Slow Ahead
  - Dead Slow Ahead
  - Stop
  - Dead Slow Astern
  - Slow Astern
  - Half Astern
  - Full Astern

- All telegraph orders shall be duly recorded in Bridge movement book, unless recorded in automatic telegraph data logger.




- Telegraph repeaters are provided in bridge wings on ships with a large beam. These shall be synchronized with the bridge telegraph before switching on. The officer serving the Telegraph shall follow the master/ pilot to bridge wings in such cases or a messenger shall be appointed to relay the engine order.

- During maneuvering, tachometer shall be continuously monitored and Master and/ or pilot shall be kept informed on the engine status.

- The bridge telegraph relays the order to the engine control room telegraph where the duty engineer acknowledges the order. An audio buzzer sounds immediately whenever the telegraph is moved. Following the acknowledgement on telegraph, the engine rpm is increased, decreased, or reversed as required using the engine control. In UMS ships the engine is directly controlled from navigation bridge.

- The telegraphs are usually provided with locking lever, which prevents the accidental movement of the telegraph. In case a telegraph is accidentally moved, the engine order position of the telegraph shall be corrected immediately and the engine room shall be informed by telephone regarding the same. A record shall be maintained of such happenings.

- The telegraph is tested during control testing stage and while engines are being tried out.

**3) Concept of challenge and response**

- It shall be remembered that the ultimate intention of having a bridge team is to control the navigation of the vessel in a safe and efficient manner. Miscellaneous procedures are established providing various monitoring equipments and procedural checklists to prepare a decision support system for the watch keeping officer.

- The OOW shall consider all the prevailing parameters in relation to vessel's specific features including limitations, while deciding on the preventive action for the safeguard of the vessel. The presence of any other watch keeping officer or Master does not relieve the OOW to be relieved from their duties of safe watch keeping unless properly relieved and mutually agreed.

- The presence of a pilot does not relieve the master or the OOW of their duties and obligations for the safety of the ship.

- When the pilot is in control of navigation, the pilot's instructions shall be closely monitored and followed. If the OOW becomes unsure of the pilot's actions or intentions, he shall immediately seek his clarification and, if still in doubt, shall inform the master immediately and take the necessary action before the master arrives on the bridge.

> Pilots engaged on prolonged pilotage duties such as river/ canal pilotage may be affected by fatigue. It results in slower reactions, reduced ability to process information, memory lapses, absent mindedness, decreased awareness, lack of attention, underestimation of risk, reduced coordination etc.

- The OOW shall continuously apprise the master and pilot with the vessel's progress along the intended track providing all necessary information such as vessel's position, speed, rudder position, UKC and the factors such as proximity to navigational hazards and floating navigational aids as might have been noted by OOW causing concern towards safe navigation of the vessel.

- Any equipment malfunction or any unusual occurrences causing concern to safe navigation shall immediately be brought to the notice of the master and pilot.

- A tactful approach is always recommended while following the above procedures of cross checking with the pilot/ master.

- The master and OOW above all, are responsible for safe navigation of the vessel. If so justified they can supersede the orders of the pilot for the safety of the life, ship, cargo and environment.

- Due protest shall be lodged with the port authorities whenever the conduct of pilot and/ or tugs is observed to be non-cooperative with vessel's command exposing the navigation of the vessel to dangers.

- It shall be understood, that master is the owners' representative on board, appointed to ensure that the ship is run in a safe and efficient manner. OOW on bridge is further master's representative to comply with his orders.

**Apply Your Knowledge**

1. Monitor the vessel's transit during pilotage through rivers, canals or areas such as Great Barrier Reef. Observe the conduct of watch keeping officers during such pilotages.

**Function:** Navigation

**Competence:** Maintain a safe navigational watch

**Task number:** A2.4

**Sub-task Reference number:** A2.4.3

**Topic:** Bridge resource management

**Task Heading**

➢ Attend bridge team meetings

**Objectives**

➢ To understand the organizing watchkeeping procedures through team work in order to facilitate safe navigation.

**Index**

1) Introduction
2) Bridge resource management
3) Bridge team management
4) Bridge team meetings

**Description**

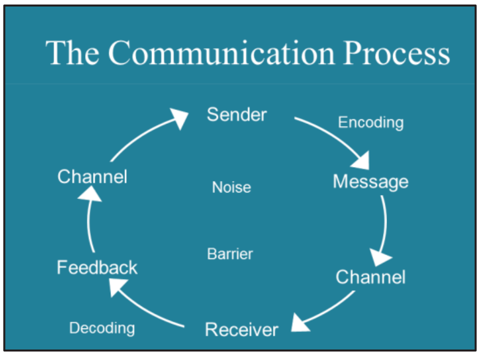
**1) Introduction**

Navigation bridge is the central control station for the navigation of the ship. It has extensive data coming in from various resources, pertaining to vessel's navigation, surrounding area and prevailing conditions. These sources include

➢ The real time data from bridge equipments
➢ Data from engine room
➢ Data regarding the load condition of the vessel and details of cargo
➢ Data from external broadcasting stations
➢ Data from the observations of the OOW and bridge team regarding the prevailing conditions and traffic

The data is said to turn into information only when it is available to the person in-charge in response to his query whenever required, allowing him to appraise the situation and to decide on the required follow up.

International regulations require the vessels to be fitted with sufficient bridge equipments and suitably manned. The broadcasting stations promulgate the safety information as per their schedules. Despite this, navigational accidents such as collisions and groundings take place in the absence of the data being utilized as information. The reasons being the available resources need to be so managed that these are organized in an effective usable manner.




**2) Bridge resource management**

Bridge resource management can be defined as managing safe navigation of ship by utilizing the available information from respective resources. It is the process of effectively using the bridge team and the creation of an environment where “one person error” is eliminated. BRM addresses the management of operational tasks, as well as stress, attitudes and risk. It shall begin before the voyage while planning the passage and continued/ updated as required along the passage concluding with a briefing at end of the voyage. Bridge resource management involves development of a detailed passage plan for anticipating and managing workload.

**3) Bridge team management**

Amongst the all available resources, managing the ship’s manpower to provide suitable configuration of watchkeeping personnel to the navigation bridge, as required in the prevailing conditions, is called the “Bridge Team Management”.

Bridge team management is based on the concept of having a team for navigation of the ship, comprising of ship’s master and watchkeeping officers as considered suitable in the prevailing circumstances. It facilitates pre-evaluating expected watch conditions in relation to workload and potential threat to the vessel. The aim of the process is to define the individual task and responsibilities of the various team members while developing a situational awareness to prevent individual errors.

**4) Bridge team meetings**

Bridge team meetings are conducted prior departure from port, prior entering into congested locations, port arrival, heavy weather etc. or whenever deemed necessary. The meeting includes all navigating officers and the chief engineer. In case any member is unable to attend it on time, he should be duly informed of the requirements concerning the passage.

Hazards to navigation as identified in the passage plan and their controls should be discussed during this meeting. This should include any follow up briefings when encountering or expecting to encounter any hazards during the voyage like heavy weather or restricted visibility etc.

Any restrictions on main/auxiliary engines including steering unit, imposed due to special circumstances of the situations should be discussed by the chief engineer. An entry shall be made in the deck log book regarding conduct of this meeting.

The primary goal of all watch officers is to function cohesively, and support each other so that errors of any one person do not create a hazardous situation and the same are brought to notice and rectified well in time. The bridge team shall achieve this by:

- Creation of a team environment
- Discussion of passage plan
- Considering the maneuvering characteristics of vessel
- Bridge team / pilot information exchange
- Recognition and handling of stress or distractions

**Conducting an Effective Bridge Team Meeting**

**Define Agenda**
An outline of all the points or topics that need to be discussed in the given amount of time, for example: transit through a congested TSS, shall be determined and the members informed well before the actual meeting so that the participant will be ready with their inputs/ comments. The meeting shall be focused on the agenda and kept free of other irrelevant discussions.

**Schedule the meeting**
The meeting shall be scheduled well before time so that the desired plan is ready before the actual executing. The schedule shall allow sufficient time for follow up on the issues discussed.

**Venue**
An area free of any distractions shall be selected as the venue for the meeting. These meetings shall not be conducted at navigation bridge or engine control room as will result in causing crowding at the place and is likely to interrupt the OOW/ Duty engineer during watchkeeping.

**Check on Time**
The meeting shall be commenced on time. Expected duration shall be estimated beforehand allowing discussing the relevant issues within the stipulated time. The head of the Bridge Team, the Master shall act as the convener and facilitator ensuring that discussions do not veer away.

**Take Notes**
To facilitate follow up on relevant issues, members shall take not of the topics being discussed and the salient features as being discussed in the meeting. Minutes of the meeting shall be sent for follow up after the meeting.

**Assigning the Tasks and Responsibilities**
Before a close of the meeting the follow up tasks and their timeline shall be duly discussed and the personnel responsible shall acknowledge his role to play.

**Listening attentively and Feedback**
A team meeting is a time to hear the thoughts and insights of the individual members relevant to the agenda.

**Apply Your Knowledge**

1. Attend bridge team meetings and listen attentively to various discussions.

**Function:** Navigation

**Competence:** Use of radar and ARPA to maintain safety of navigation

**Task number:** A3.1

**Sub-task Reference number:** A3.1.9, A3.1.10

**Topic:** Radar/ ARPA checks, set up procedures and operational use

**Task Heading**

- Perform the changeover of the display from sea stabilized to ground stabilized mode. Recognize the advantages and disadvantages of both.
- Check heading line marker alignment with fore and aft line of the vessel

**Objectives**

- Understand the stabilization modes of the RADAR /ARPA

**Index**

1) Stabilisation modes
2) Ground stabilised mode
3) Sea stabilised mode
4) Heading alignment in RADAR

**Description**

**1) Stabilisation modes**

RADARs are provided with ground and sea stabilization modes. The stabilization mode and stabilization source in use is indicated on the PPI.

**2) Ground stabilised mode**

A ground stabilised display indicates target's motion over the ground. Automatic ground-stabilization can be achieved by using the input from GPS or a twin axis Doppler log operating in ground track mode. Ground-stabilization can also be affected by feeding in the values of estimated set and drift. The same can be checked by referring to a stationary target on the radar display, which when operating in ground stabilised mode shall not show any trails in true motion.

In some sets, the ground-stabilized display provides the means for stopping the small movements of the echoes from stationary objects. For the changeover procedure from sea stabilised to ground stabilised, reference shall be made to the equipment operator's manual.

The sea-stabilized display indicates true courses and speeds through the water based on the assumption that own ship and target are affected by the same current.

**3) Sea stabilised mode**

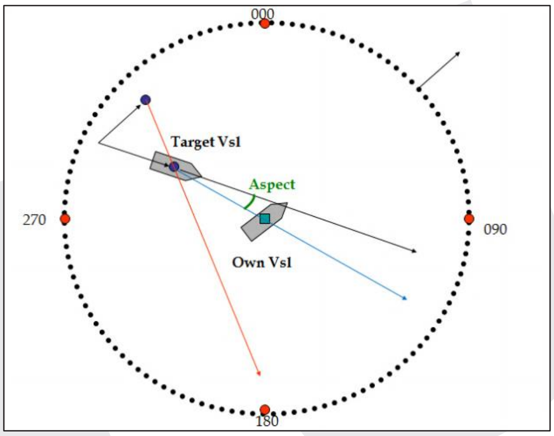
In sea stabilised mode, true motion, when the own ship motion is affected by current and leeway, the echoes of stationary objects will show trails, formed in a direction opposite to the leeway or set.

In coastal, estuarial and river waters where a significant set and drift may be experienced, a sea stabilised display will produce significant target trails from all stationary objects possibly producing an unacceptably high level of clutter on PPI.

In such circumstances a ground stabilised display may reduce its effect and enable the observer to detect clearly the trails of moving targets, thus enhancing the observer's situational awareness.

The observed and predicted relative motion of a target is unaffected by the choice of sea or ground stabilisation, allowing the same assessment of CPA and TCPA.

HOWEVER, IT IS VERY IMPORTANT THAT WHEN ARPA IS USED IN ANTI COLLISION MODE, THE UNIT SHALL BE IN THE SEA STABILIZED MODE BECAUSE FOR APPLICATION OF COLREGs THE ASPECT OF THE TARGET SHALL BE KNOWN CORRECTLY.




Ground stabilization display may be misleading about the aspect of the target/ship. For this reason, in spite of a vessel being equipped with a GPS receiver, it is required for the ARPA to have a feed from the speed log.

When switching between sea and ground stabilisation, the observer should be aware of the time required for the radar equipment to reprocess the stabilisation input data.

A sea stabilised target plot may be inaccurate when own ship and the target, are experiencing different rates of set, drift or leeway.

The calculation of its true track is dependent on the choice and accuracy of the own ship's course and speed input. A ground-stabilised target plot may accurately calculate the ground track of the target, but its heading may be significantly different from its track when experiencing set, drift or leeway. To understand better please refer to the below illustration.

In a normal plotting sheet aspect of a target can be depicted as shown in the adjoining picture.

**4) Heading alignment in RADAR**

As it is a general procedure to compare compasses and repeaters during a navigational watch, the watchkeeping officer shall be checking the heading shown in RADAR when in use with the actual compass heading.

The heading input set in RADAR might not be the same as shown in gyro compass. This could possibly follow after gyro switch off accidental or for maintenance or other similar reasons. The RADAR heading can be manually fed in by the key board provided for the purpose. Same shall be checked with reference to the lubber line in the centre repeater.

Even slight misalignment of the heading marker, can lead to dangerously misleading interpretation of potential collision situations, particularly in restricted visibility when targets are approaching from ahead or fine on own ship's bow.

It is therefore important that checks of the heading marker should be made periodically to ensure that correct alignment is maintained. If misalignment exists it should be corrected at the earliest opportunity. Procedure for the same is as follows:

- The heading marker shall be checked to be in line with the true compass heading of the ship.
- The heading marker line on the display shall be aligned with the fore-and-aft line of the ship. This is done by selecting a conspicuous but small object with a small and distinct echo which is clearly identifiable and lies as near as possible at the edge of the range scale in use. Measure simultaneously the relative visual bearing of this object and the relative bearing on the display. Any misalignment must be removed in accordance with the instructions in the equipment manual.

The adjustment of the heading marker should not be carried out when alongside a berth by using the berth's alignment or by using bearings of targets which are close to the vessel, not distinct or have not been identified with certainty both by radar and visually, in order to avoid introducing serious bearing errors.

**Apply Your Knowledge**

1. List the advantages and disadvantages of using sea stabilized and ground stabilized modes of display. Which mode will you use for the purpose of collision avoidance?

**Function:** Navigation

**Competence:** Use of radar and ARPA to maintain safety of navigation

**Task number:** A3.2

**Sub-task Reference number:** A3.2.6, A3.2.8, A3.2.10

**Topic:** Using radar/ ARPA for collision avoidance

**Task Heading**

- Demonstrate understanding of the use of true and relative trails.
- Demonstrate ability to detect course and speed changes of other ships.
- Identify advantages and disadvantages of using true and relative vectors.

**Objectives**

- To correctly interpret and understand the trails and vector function on RADAR/ ARPA

**Index**

1) Trails
2) Vectors

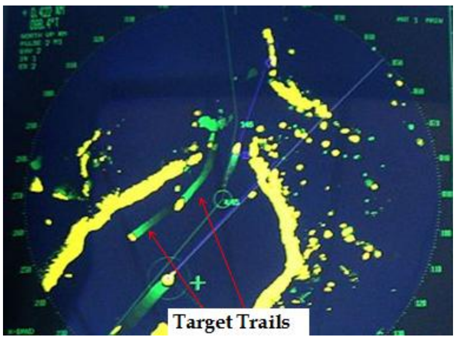
**Description**

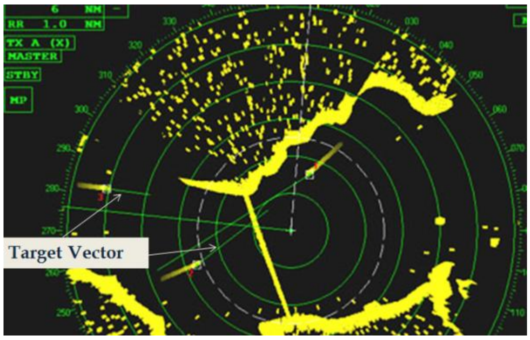
**1) Trails**

Trails are the afterglow of the targets on the radar display. These mark the target's past movement. Trails key is generally provided to start trails and choose trail time. The length of trails can be varied by changing the trail time. Too long a trail will lead to a congested and obscured radar display. The length and display colour of the target trails can be modified by selecting the desired option from radar menu. These are distinguishable from the target echo, usually in a fading pattern, fading with time.

Target trails are chosen either relative or true. Relative trails show the target's past track as is detected by the radar, as a resultant of own vessel and target vessel's movement, considering own vessel fixed at one point on display. True motion trails present true target movements in accordance with their over ground speeds and course, and require a gyrocompass and own ship speed input.

Seeing the past trails marks can help identify the targets past movement and if there are any changes made by the target in speed and course. Trails start to generate within two scans of the radar. Own ship trails are also seen with trails function in use and can be used to check any change in own vessel course/ speed.



**2) Vector**

On ARPA, vector is provided as a line extending from a tracked target which shows estimated speed and course of the target. The vector tip shows an estimated position of the target for the selected time interval for vector length.

True vector represents the predicted true motion of a target, showing course and speed with reference to the ground. These are helpful in distinguishing the stationary or moving targets. Relative vector shows the predicted movement of a target relative to own ship's motion. The same is a resultant of motion of own vessel and the target and show the relative line of approach of the target. The vector time can be adjusted to present predicted motion of any target. However time shall be allowed for the vector to stabilise to provide reliable data.

**Apply Your Knowledge**

1. Check the radar display settings in use, as to relative motion or true motion, head up/ north up, display centre / off center, vector true/relative, trail true/relative, bearing true/relative modes and discuss with the OOW regarding the preferred setting.
2. Identify some stationary shore target on the radar screen and check its trails. Compare the same with a RACON echo when possible.

**Function:** Navigation

**Competence:** Use of radar and ARPA to maintain safety of navigation

**Task number:** A3.2

**Sub-task Reference number:** A3.2.7

**Topic:** Using radar/ ARPA for collision avoidance

**Task Heading**

- Carry out manual radar plotting

**Objectives**

- Use of radar plotting to avoid close encounters or collisions with other vessels

**Index**



**Description**

## 1) Introduction

Any target acquired by radar when tracked gradually can be plotted on a radar plotting sheet. Then using the own vessel course/speed data, the target course and speed can be estimated by simple calculations. ARPA (Automatic Radar Plotting Aid) software is the electronic version of the manual radar plotting taking automatic inputs from compass, speed log and GPS and providing the navigator the calculated real time results.

International Regulations for Preventing Collisions at Sea, 1972- Rule 7(b) mentions the use of radar plotting for evaluating risk of collision. Rule 6 and 19(d) further specify the use of radar in relation to collision prevention.

## 2) Radar plotting requisites

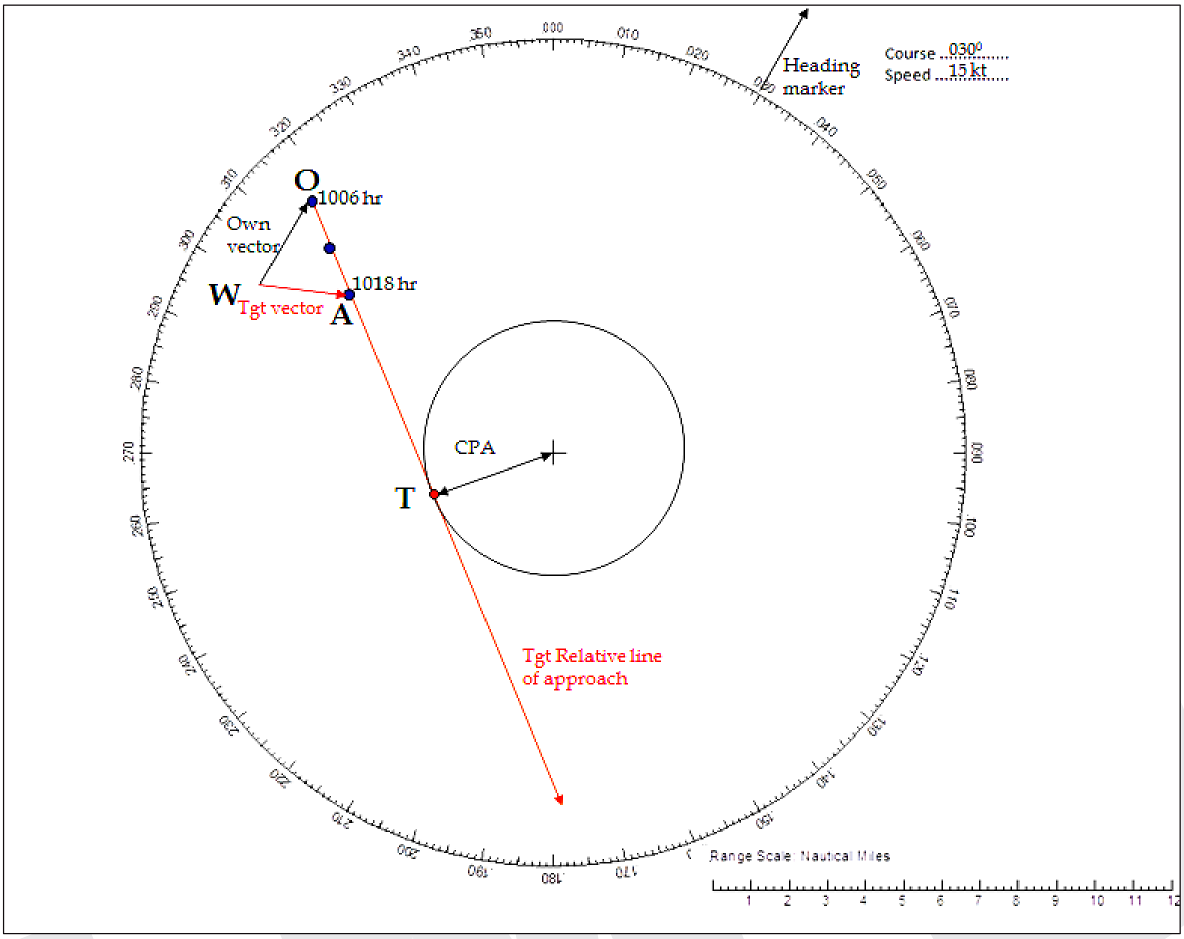
The requisites are:
- Radar plotting sheet
- Pencil& eraser
- Compass & divider
- Ruler
- Set square

## 3) Radar plotting procedure

Radar plotting is usually done with radar running in relative motion mode with true bearing in use. The procedure is:
- Check the own vessel compass heading, apply compass error and note the true heading. Compare this true heading with heading set in radar. Correct radar heading if required. Check the EBL (electronic bearing line) by comparing with the vessel heading. Note if there is any error. The same error shall be applied when

taking bearing of targets using EBL. Check the VRM (variable range marker) by comparing it with the range rings shown on screen. Note the error if any. The same error shall be applied when taking ranges of targets using VRM.

- Mark own vessel course arrow on the radar plotting sheet at the circle pointing away from the center in the direction of heading. Note the speed being shown by the speed log and mention on the plotting sheet corner along with true course.
- Observe the target to be plotted on the radar screen preferably when at a distance of around 11-12'. Note down the time, the TRUE bearing of the target using EBL and range using VRM.
- Using ruler and compass, plot the target's first location on the radar plotting sheet. Mark this point as 'O'. For measuring range use one of the scales provided on the plotting sheet. Put a tick mark on the range scale being used.
- After an interval of 6 minutes, again note the time, range and bearing of the target and plot on the plotting sheet. Repeat the above step again after another 6 minutes, to plot the target on the plotting sheet third time. Mark this point as 'A'.
- Join point 'O' to 'A', extending the line further towards the centre of the plotting sheet.
- Using the compass, from the center of the plotting sheet draw an arc to which the line drawn above becomes a tangent. Mark the point of contact as 'T'.
- Using the divider and the distance scale on the plotting sheet, measure distance from center to point 'T'. This is the CPA (distance at closest point of approach of the target).
- Measure distance TA and OA.
- {TA x(time interval from O to A) / OA} = TCPA (Time to closest point of approach for the target).
- From point 'O' draw own ship course and speed vector for 12 minutes termination at 'O'. Mark the tail of this vector as 'W'.
- Join 'W' to 'A'. This is the target ship course and speed vector using which the target course and speed can be calculated.
- In case the target is stationary, the vector WA shows the prevailing set and drift in area.
- The relative bearing of own vessel from the target vessel is known as the aspect generally reported as X° red or green.



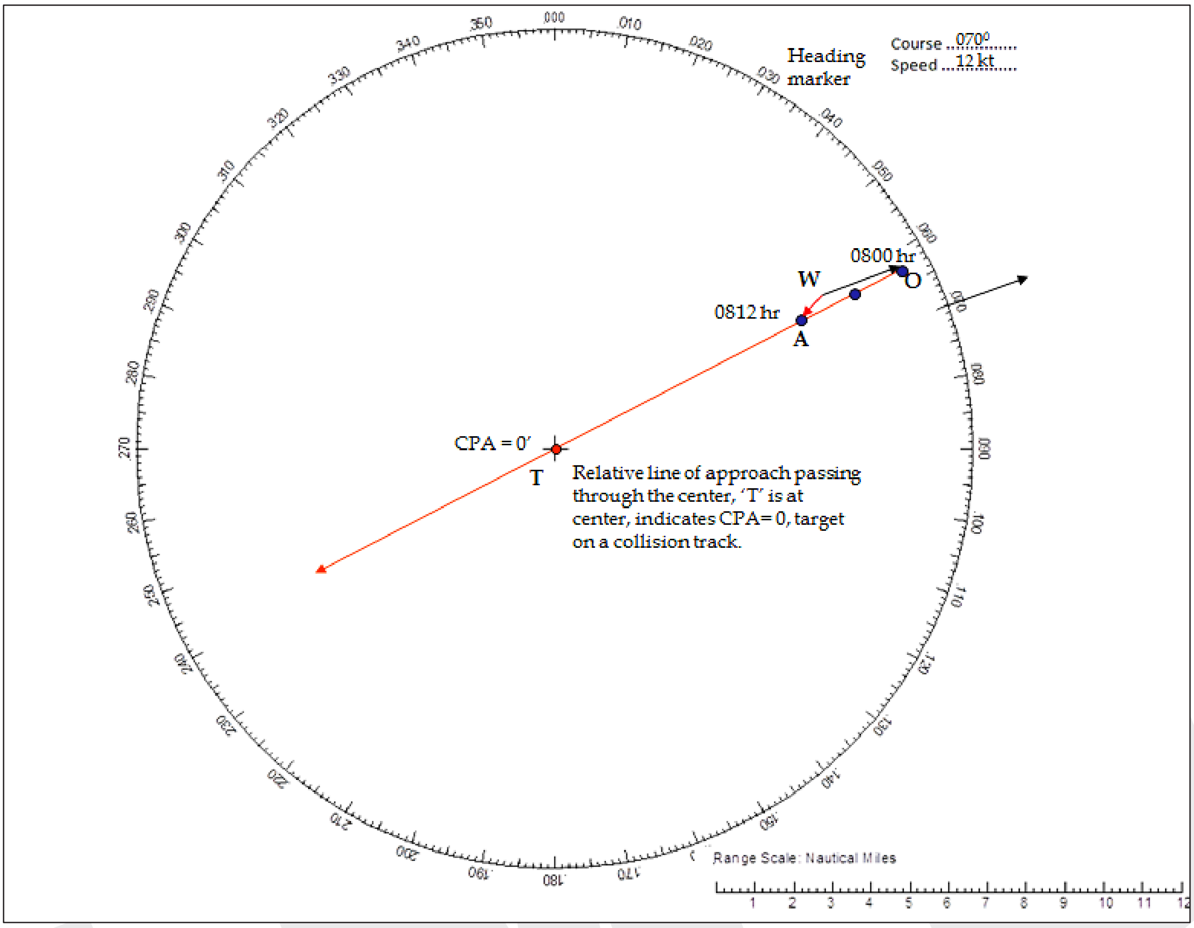

**4) Example**

Question: Own vessel steering 070º (T) @ 12 knots observes the following echoes in restricted visibility.

| Time (hrs) | Range (miles) | Bearing (T) |
|---|---|---|
| 0800 | 12.0 | 063º |
| 0806 | 10.2 | 063º |
| 0812 | 8.4 | 063º |

Calculate CPA, TCPA, Target's course and speed.

Answer: Target course 228 º
Speed 6 knot
CPA 0'
TCPA 28Min
Aspect 15 º green




## 5) Precautions in relation to manual radar plotting

The precautions to be taken are:

- Care shall be taken to ensure that the radar is operating in relative motion and true bearing mode. These settings resemble the plotting sheet, own vessel being located at the centre of the sheet. Settings in other mode, e.g. true motion or relative bearings can be used but the same shall be given due regard while plotting.
- Compass error, errors in EBL or VRM shall be carefully checked and applied to get the correct details regarding the targets. Targets shall be picked up when at large range in order to allow more time to track and access the situation.
- It is preferred to have at least three observations for plotting to get reliable results.
- Radar plotting shall be practiced only in open waters with lesser traffic density.
- Plotting can be done either or paper or on a reflection plotter if fitted on the radar screen.

## Apply Your Knowledge

1. Practice RADAR plotting under supervision of senior officers and compare the results with ARPA data.

**Function:** Navigation

**Competence:** Use of radar and ARPA to maintain safety of navigation

**Task number:** A3.2

**Sub-task Reference number:** A3.2.9

**Topic:** Using radar/ ARPA for collision avoidance

**Task Heading**

- Practice use of trial maneuvers

**Objectives**

- Understanding and practicing trial maneuvers on radar

**Index**

1) Introduction
2) How to use the function

**Description**

**1) Introduction**

- Trial maneuver is graphical simulation facility used to assist the operator to perform a proposed maneuver for navigation and collision avoidance purposes. It displays the predicted future status of all acquired targets as a result of own ship's simulated maneuvers. The function is available on all the IMO regulatory compliant equipment.
- It helps the navigator in decision making for collision avoidance. The feature becomes more useful when the traffic density is high whereby the navigator can check the effect of its maneuver on all acquired targets in vicinity, which in turn helps to identify the best avoiding action.
- It must be remembered that simulation is based on the assumption that targets will maintain course and speed

**2) How to use the function**

- The operating instructions for this feature are as per the equipment specific manual.
- Generally the feature can be activated by selecting the desired option from the radar ARPA Menu.
- A warning sign indication for example 'T' in bold capital letter or similar appears on the display to warn the user that the radar is operating in 'Trial Maneuver' mode.
- When the function is active, user can change the course and/or speed of own vessel ON THE RADAR SCREEN as desired and get the resulting CPA/ TCPA of acquired targets.
- During simulation, target tracking continues and the screen returns to previous status as soon as the function is disabled.
- A simulated time to maneuver is provided with a countdown.

**Apply Your Knowledge**

1. Practice trial maneuver under supervision of senior officers and compare the results.

**Function:** Navigation

**Competence:** Use of ECDIS to maintain the safety of navigation

**Task number:** A4.1

**Sub-task Reference number:** A4.1.8, A4.1.9, A 4.1.10

**Topic:** Use of ECDIS

**Task Heading**

- Demonstrate understanding of setting of safety depth/spot soundings.
- Identify the various inputs to the ECDIS. Select radar and AIS input to the ECDIS and use data provided.
- Confirm vessel position by alternative means.

**Objectives**

- Understand the concepts of safety depth, safety contour, spot soundings, watch-vector alarm on ECDIS, various inputs to ECDIS and the use of ECDIS in overlay with radar and ARPA.

Please read this task in conjunction with tasks A4.1.1 to A4.1.7

**Index**

1. ECDIS display – SCAMIN, over-scaling and under-scaling
2. Depth parameters
3. Safety contour
4. Safety depth
5. Spot soundings
6. Watch vector alarm
7. Inputs to ECDIS
8. Use of ECDIS with radar, ARPA and AIS

**Description**

**1) ECDIS display – SCAMIN, over-scaling and under-scaling**

The IMO has set standards for the information to be displayed on an ECDIS.

a) Base display
b) Standard display

The user further customizes the most appropriate chart display to suit their needs on ENCs. To avoid a cluttered screen, objects in ENCs are assigned a SCAMIN value. SCAMIN is the acronym for SCAle MINimum. The value determines at what chart scale, the ECDIS will show all the information required from the chart when in use for navigation.

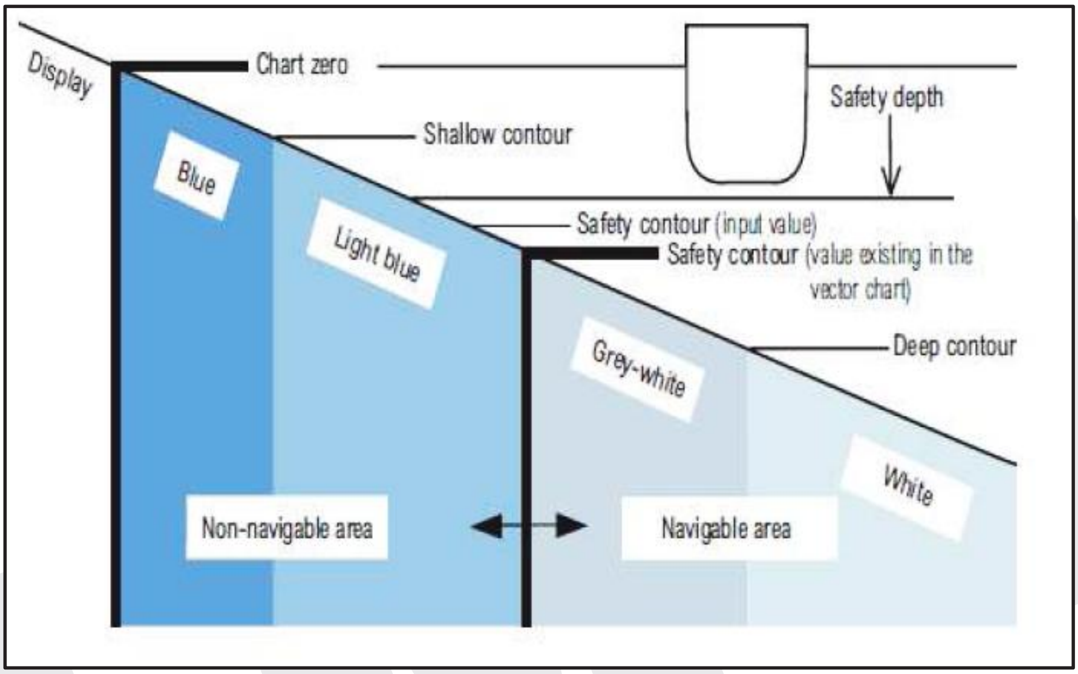
Many alarms including those for safety contour, safety depth and anti-grounding are not available on Raster charts.

ECDIS display is a flexible tool that the watchkeeping officer must regularly alter to suit the situation. The selection of the customized will be made by the watch-keeping officer to suit:

- The type of sea area
- Company procedures
- Master's standing orders
- Personal preference.

## 2) Depth parameters

Depths on ENCs are shown by numeric digits. Depth contours are drawn joining the areas of same depths. However, an important variation in the display of depth contours as compared to paper charts is the depth shades. There are two available colour schemes. First being the two shade colour code where the deep area, safe for navigation, is shown white in colour and the shallow unsafe area is colored deep blue. The four colour schemes give the watchkeeping officer a more detailed picture and it is useful in coastal passages. It shows the deep water as white, followed by grey white, light blue and blue as going towards shallows. The contours may have values such as 5m, 10m, 20m and so on.

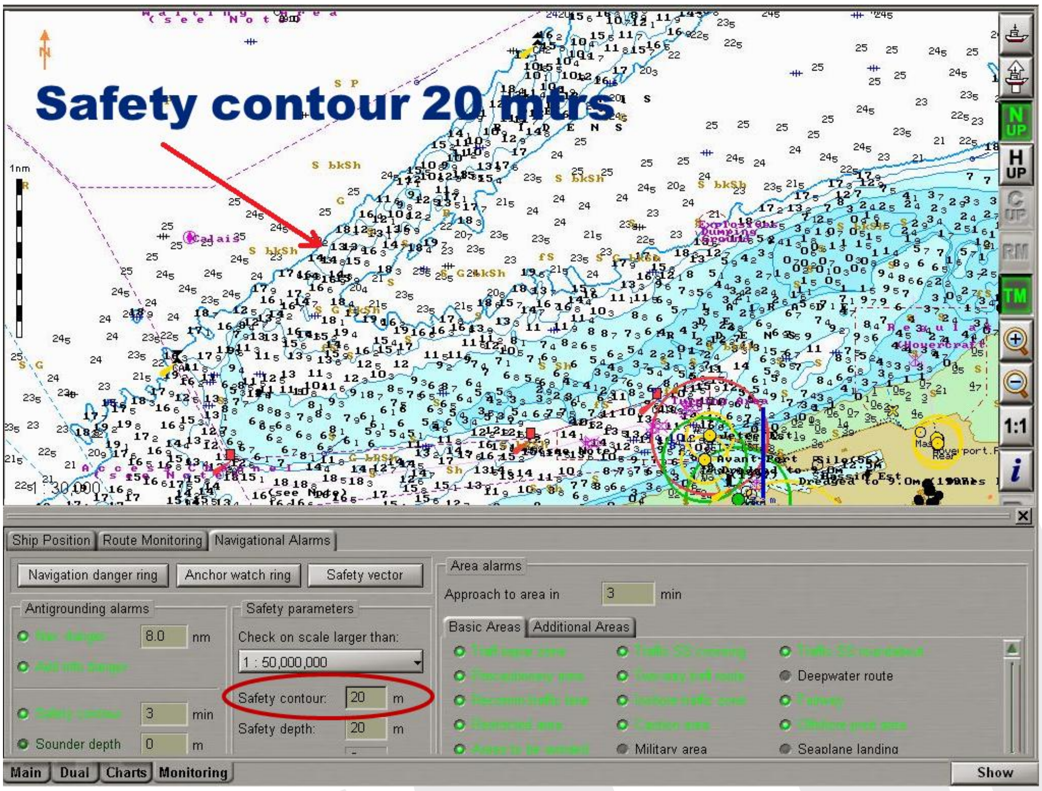



## 3) Safety contour

It highlights a particular depth contour (usually drawn at 5 or 10 m intervals). It is generally a solid dark line that separates the safe navigable waters from the non-navigable waters. The safety contour value is crucial to the anti-grounding alarms and capability of the ECDIS and determines the edge of the no-go areas. It is calculated by adding the maximum draft to additional safety factors.

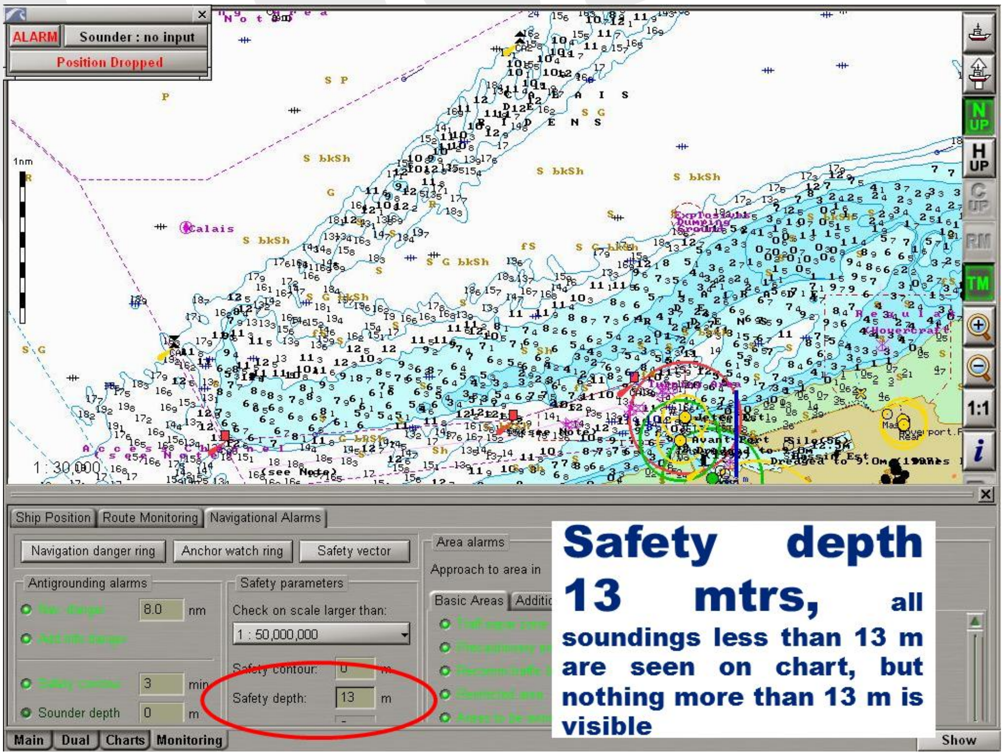
The value of the safety contour to set, is calculated considering

- ship's draft
- allowance for squat
- required under-keel clearance
- safety margin - adding depth for sea state, weather effects
- allowance may be made for chart accuracy and low zone of confidence of the charts



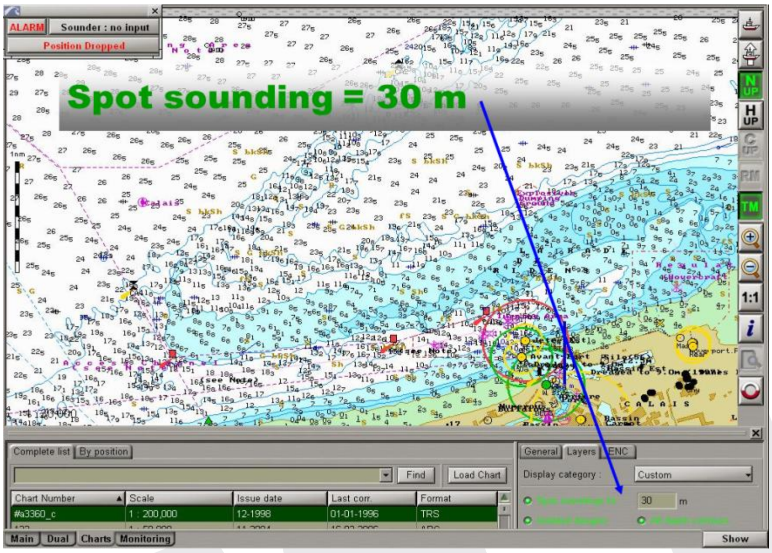

### 4) Safety depth

It highlights soundings less than the safety depth (by making them bold), and gives an alarm if own vessel is a certain miles / minutes away from it by setting of the watch vector/safety vector). This affects the way spot soundings are shown. For deep sea passages, it is a good practice to give the safety depth the same value as the safety contour.



### 5) Spot soundings

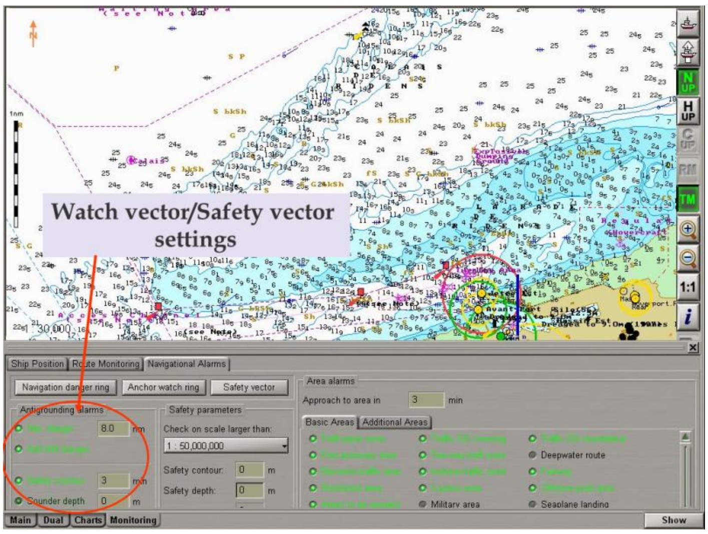
Spot soundings decide what soundings the operator prefers to see on the display. For example, choosing spot sounding 20 metres will show soundings less than 20 metres only. All soundings more than 20m will be shown in a very light shade on the display. It is related only to the display and unclutters the screen of unnecessary information. Spot soundings equal or less than the safety depth are displayed in black, those greater, in grey.

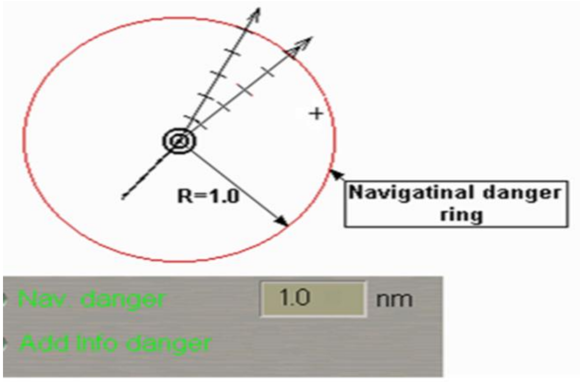


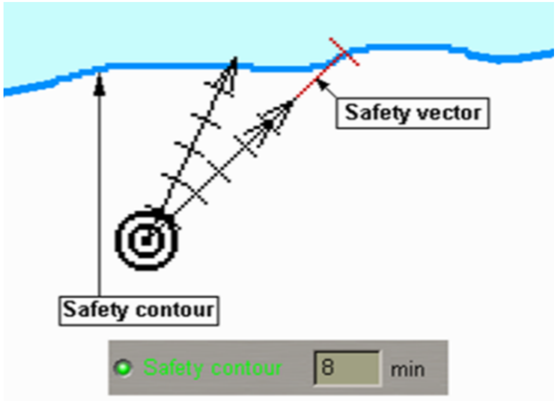

### 6) Watch vector alarm

The ECDIS provides a continuous safety watch by generating alarms and warnings. Along with datum shift from WGS 84 and malfunction of the ECDIS, IMO performance standards require these for certain specified conditions and areas with special conditions. Watch vector alarm gives an alarm if own vessel is a certain miles / minutes away from the above mentioned areas. There is also an alarm when the vector touches an isolated danger, less deep than the safe water area.

Watch vector alarm is set by setting the watch vector/safety vector. This vector is the vector for own ship's motion as per the vessel's course and speed for a specified time duration. The alarm settings are fed in accordance with the company's safety management system and the master's orders. Alarms must never be disabled and all ECDIS alarms must be investigated and appropriate action taken immediately.






## 7) Inputs to ECDIS

The real-time graphical display of the ship's current position with the course and speed vector has high informational value for the watchkeeping officer. To show own ship on the chart the ECDIS needs own ship information.

As a minimum requirement, ECDIS needs to be connected to
- electronic position fixing system, an EPFS,
- speed and distance measuring device
- gyro compass to give the ship's heading, (OR a marine heading transmitting device in case of unavailability of a gyro compass)

The sensors from these three equipments supply digital signals connected either directly or through a piece of computer hardware called a LAN adaptor.

Other than the above, ECDIS may be connected to a second set of sensors which might include
- differential GPS sensor
- second gyro
- echo sounder

ECDIS may also have AIS, radar and ARPA input as overlays.

In addition further possibilities include NAVTEX and autopilot inputs.
Other sensors such as engine rpm and wind speed measuring equipment may also be connected. As these are analogue signals they will be connected via a different type of connector.

If a second ECDIS is fitted to serve as back-up requirements, it will need to be connected to the primary EPFS, speed and distance measuring device and gyro sensor inputs, all connected directly or via a LAN adaptor. Further, it needs to be connected to the primary ECDIS so that all chart corrections, route plans and user charts are transferred from one ECDIS to the other. However, other than these sensors, ECDIS is not connected to any other computers on board or the internet.

> Watchkeeping officers need to compare and assess the input data to the ECDIS and never rely only on one system. The fact being the input equipments as GPS, Gyrocompass and Speed Logs have their inherent errors and limitations and the same need their data to be verified by alternative means.

## 8) Use of ECDIS with radar, ARPA and AIS

Many ECDIS systems have the capability to overlay both radar video and / or ARPA targets onto the ECDIS display. However, the full radar image when overlaid on ECDIS may obscure the charted information.

The superimposition of ARPA targets on the ECDIS display allows the rapid assessment of the possible actions of targets with respect to shoal water, traffic separation schemes etc. Availability of AIS data on display serves easy identification of target further enhancing the situational awareness of the watch keeper. Despite being used in conjunction with ECDIS, the radar shall remain the primary tool for collision avoidance. ECDIS shall be used only as an aid to possible target intentions.

Radar can be used as a check on vessel position. A charted radar conspicuous feature can be selected as ARPA target and its position shall be checked against its marked position on the ECDIS.


**Apply Your Knowledge**

1. Using the ARPA overlay on ECDIS, observe the traffic flow in a Traffic Separation Scheme. Monitor the difference in situational awareness in comparison to when navigating with paper charts. Monitor closely the movements the vessels movements in around the areas of crossing TSS.
2. Observe the difference in charted coastline of ECDIS and the observed coastline when Radar is used in overlay with ECDIS. Enumerate the cautions to be observed when plotting vessel’s position using Radar fixes using land target echoes.

**Function:** Navigation

**Competence:** Respond to Emergencies

**Task number:** A5.2

**Sub-task Reference number:** A5.2.6, A5.2.7

**Topic:** Emergencies in port

**Task Heading**

- Demonstrate understanding of the contents of vessel's Shipboard Oil Pollution Emergency Plan (SOPEP)
- Demonstrate understanding of the procedure for alerting port emergency services.

**Objectives**

- Understanding the contents of SOPEP/SMPEP and its use

Please read this task in conjunction with tasks C1.2.6 and C1.2.8

**Index**

1) Introduction
2) SOPEP - Shipboard oil pollution emergency plan
3) SMPEP - Shipboard marine pollution emergency plan
4) General guidelines
5) Recommended format and contents of SOPEP/ SMPEP
6) Oil pollution prevention team of the vessel
7) SOPEP gear

**Description**

**1) Introduction**

- An Oil spill shall be treated as an emergency.
- Immediate measures shall be taken to prevent the escape of oil into sea.
- Every crew member on board has a responsibility to prevent marine pollution.

With regards to marine pollution from oil and noxious liquid substances carried in bulk MARPOL requires the ships to have pre-established Shipboard Oil Pollution Emergency Plan (SOPEP)/ Shipboard Marine Pollution Emergency Plan (SMPEP). In an emergency situation, the ship's personnel are confronted with multiple tasks. In the heat of the moment, lack of planning is likely to result in confusion, mistakes, and failure to advise key people. Delays will be incurred resulting in waste of time further worsening the situation exposing the ship and its personnel to increasing hazards and greater environmental damage. A predetermined and properly structured plan will serve the purpose of combating such situations and minimizing risks.

**2) SOPEP - Shipboard oil pollution emergency plan**

SOPEP is an approved shipboard oil pollution emergency plan written in the working language of the master and officers of ship, describing
- the procedure to be followed to report an oil pollution incident
- the list of authority or persons to be contacted in an event of an oil pollution incident
- description of action to be taken by persons on board to control the discharge of oil

- the procedures and point of contact on the ship for coordinating shipboard action with national and local authorities

**3) SMPEP - Shipboard marine pollution emergency plan**

It is same as SOPEP applying to ships of 150 tons gross tonnage and above carrying noxious liquid substances in bulk covered under MARPOL Annex II. It is required to describe all the procedures and provide details of contacts as SOPEP with regards to pollution incident involving noxious liquid substances in bulk SMPEP should be combined with a SOPEP, in the above type of ships carrying noxious liquid substances in bulk, since most of the contents of the two plans are the same.

**4) General guidelines**

The plan is drawn to assist personnel in dealing with an unexpected discharge of oil or other noxious liquid substance. The primary aim is to initiate actions to stop or minimize the discharge overboard. Effective planning further ensures timely follow up in a structured, logical and safe manner. It provides follow up action in cases when the oil spill is occurring from cargo operations, bunkering/engine room operations or due to any accident such as collision or grounding causing rupture in an oil tank. It is drawn to be realistic, practical, and easy to use. It is written in a language understood by ship's master and officers to be easily understood by them and shall be reviewed and updated regularly.

The plan involves the shore based management of the ship owner/ manager to provide necessary coordination and support to the vessel in controlling the pollution and further arranging cleanup activities. A separate plan is drawn for the ship owners/managers in this respect in somewhat similar terms as SOPEP/SMPEP enlisting the procedures.

The plan includes review procedures for the regular updating of SOPEP/ SMPEP. The procedures followed may be through a periodic review by the owner or operator at least yearly and through event review following any incident having used the plan and checking its effectiveness.

The training drills to be conducted for training on SOPEP/SMPEP, their procedure and frequency are also mentioned in the plan. Procedures for training and exercise are also defined.

The SOPEP/ SMPEP also contains information crew's responsibilities are in a casualty where a vessel is partially or fully disabled. A decision process is outlined in the plan to decide on when salvage assistance is required for the vessel.

**5) Recommended format and contents of SOPEP/ SMPEP**

The format is as follows:

- Index
- Ship's name and particulars
- Approvals
- Record of updating
- Section 1: Preamble
- Section 2:Reporting requirements
  - ✓ When to report
  - ✓ What to report
  - ✓ Who to contact
- Section 3: Steps to control discharge
  - ✓ Operational spills
  - ✓ Spills resulting from casualties
- Section 4: National and local co-ordination

- Section 5: Additional information (non-mandatory)
- Appendices

Section 2 contains “Reporting Requirements”

- IMO has specified standard procedures to be followed by ships for reporting oil pollution incidents in MARPOL.
- Flag countries of the vessels have appropriate officer or agency appointed to receive and process all pollution reports from their registered vessels. The details of these agencies are also available with IMO for circulation to other countries.
- Any pollution incident from a vessel shall be sent to the respective agency of her country which shall relay the same to the local administration and the administration of the country affected by the pollution incident.

- ✓ **When to report -**A report shall be made in cases of actual discharge and/or probable discharge of oil/noxious liquid substances (NLS).
- ✓ **What to report –**SOPEP/ SMPEP requires Initial reports to be sent as soon as the pollution incident has taken place followed by supplementary reports. The SOPEP/SMPEP onboard includes a prepared message format to be used for reporting.

| INITIAL REPORT | |
|---|---|
| AA | SHIP NAME, CALL SIGN, FLAG |
| BB | DATE, AND TIME(UTC) OF INCIDENT (a 6 digit group giving day of month(first 2 digits) hours and minutes(last 4 digits)<br>/--/--/--/--/--/--/<br>D D H H M M |
| CC | SHIP'S POSITION, either LAT.(a 4 digit group)/LONG.(a 5 digit group);<br>/--/--/--/--/--/--/<br>d d m m N S<br>/--/--/--/--/--/--/--/<br>d d d m m E W or |
| DD | SHIP'S POSITION by Bearing(first 3 digits), DISTANCE(in nautical miles) FROM A CLEARLY IDENTIFIED LANDMARK<br>/--/--/--/ /------/ from ________<br>d d d N miles |
| EE | TRUE COURSE AT TIME OF INCIDENT (as a 3 digit group)<br>/--/--/--/<br>d d d |
| FF | SPEED AT TIME OF INCIDENT (in knots and tenths of knots as a 3 digit group)<br>/--/--/--/<br>kn kn 1/10 |
| LL | INTENDED TRACK(FROM - TO) |
| MM | FULL DETAIL OF RADIO STATION AND FREQUENCIES BEING GUARDED |
| NN | DATE AND TIME(UTC) OF NEXT REPORT<br>/--/--/--/--/--/--/<br>D D H H M M |
| OO | DRAUGHT(FORE AND AFT) AT TIME OF INCIDENT (4-digit group giving metres and centimetres)<br>/--/--/--/--/<br>m m c c |
| PP | TYPE AND QUANTITY OF CARGO/BUNKER<br>- Type of oil or the collect technical name of the noxious liquid substances on board<br>- Names of manufacturers of substances, if appropriate, when known, or consignee or consignor<br>- Quantity |
| QQ | BRIEF DETAILS OF DEFECTS/DEFICIENCIES/DAMAGE<br>- Damage area<br>- State of Damage<br>- Ability to Transfer Cargo/Ballast/Fuel. |

RR BRIEF DETAILS OF TYPE OF OIL POLLUTION
- Type of oil on board
  Loading port
  Specific gravity, either in terms of API gravity or grams per cc
  Viscosity at standard temperature, with the units and temperatures specified
  Pour point
  Wax and asphalt content
  Distillation characteristics
- An estimate of the quantity of the substances
- Whether lost substances floated or sank
- Whether loss is continuing
- Cause of loss
- Estimate of the movement of the discharge or lost substances, giving current conditions if known
- Estimate of the surface area of the spill if possible

SS BRIEF DETAILS OF WEATHER AND SEA CONDITIONS,
- Wind direction(a 3-digits) and force(Beau fort scale Including)
- Relevant current(direction, speed)
- Swell(direction, height)

TT CONTACT DETAILS OF SHIP'S OWNER/OPERATOR/AGENT,
- Name
- Address
- Telex and telephone

UU SHIP SIZE AND TYPE,
- Length
- Breadth
- Draft
- Tonnage
- Type

WW NUMBER OF PERSONS ON BOARD

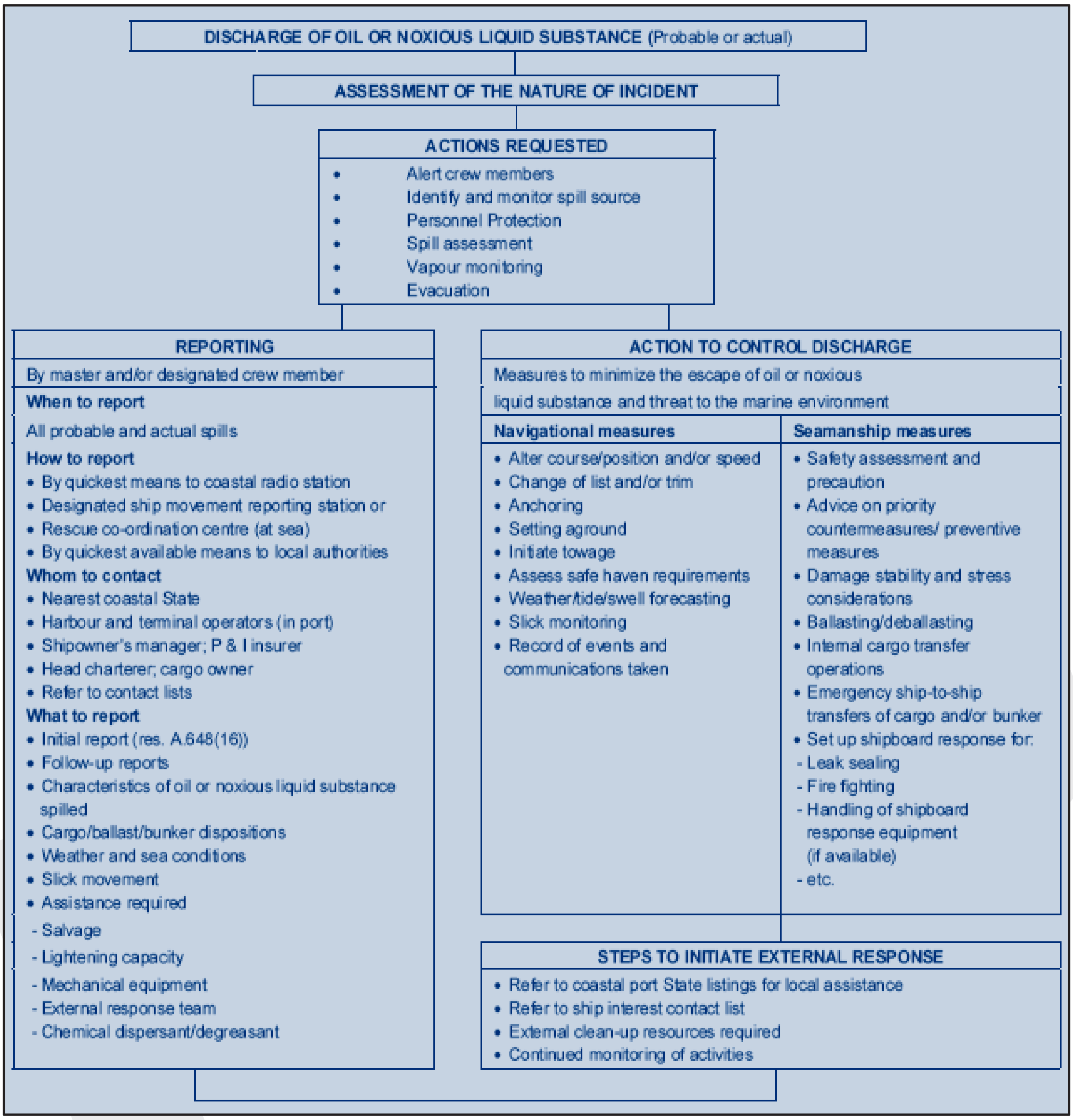
XX ADDITION INFORMATION, including
- Brief details of incident
- Type and quantity of equipment carried to assist in pollution response
- Need for outside assistance
- Actions being taken
- Action being taken with regard to the discharge and the movement of the ship
- Number of crew and details of any injuries
- Details of P & I Club and local correspondent
- Others

- ✓ **Whom to contact –** The details of the following are provided in the appendices. These shall be contacted as discussed above.
- ✓ Coastal state contacts
- ✓ Port contacts
- ✓ Ship interest contacts

Section 3 contains “Steps to control discharge”

- ✓ This section of SOPEP/ SMPEP mentions the procedures to be followed to minimize spill and control discharge. As discussed above the pollution is likely to occur during operations or due to accidents. Hence procedures are defined to facilitate control in different situations.

- ✓ The procedures specify preventive measures to avoid pollution such as the checks to be carried out prior loading/discharging bunkering etc. These further specify immediate and follow up actions to control pollution by restricting the overboard escape of Oil/ NLS from ship. It describes procedures for assessing extent of pollution and related hazards and dangers to crew, ship and environment. It also provides details regarding procedures to be followed to restrict the spread of oil/NLS slick in sea likely to be caused by currents and wind.




## 6) Oil pollution prevention team of the vessel

The ship's complement is organized in the form of an oil pollution prevention team for the vessel. This is mentioned in the ship specific SOPEP/SMPEP manual. The responsibilities and duties are assigned for each personnel and are mentioned in these plans.

## 7) SOPEP gear

The easily accessible SOPEP Locker on board has the following items, in order to contain any spill on board:

- absorbent roll
- absorbent pads
- absorbent granules
- absorbent materials
- shovels
- brooms

> No chemical agent such as OSD should be used for response to pollution on the sea without authorization of the appropriate coastal State.

- mops
- scoops
- empty receptacles (200 litres capacity)
- portable air driven pumps
- oil boom
- oil spill dispersants
- Portable pump usually a Wilden pump
- scupper plugs

**Apply Your Knowledge**

1. Check the precautions taken on board before starting cargo operations on oil tankers/ chemical tankers and or before starting bunkering with respect to pollution prevention.
2. Check the SOPEP gear provide on board and discuss the use of each of the items.
3. Discuss the action to be taken when you observe an oil slick near your vessel at anchorage.

**Function:** Navigation

**Competence:** Respond to a distress signal at sea

**Task number:** A6.1

**Sub-task Reference number:** A6.1.10

**Topic:** Distress signals

**Task Heading**

- Demonstrate understanding of procedures for cancelling a false distress alert.

**Objectives**

- To understand and learn procedures for cancelling a false distress alert

**Index**

1) General requirements
2) Cancelling a false distress alert
   a) Digital Selective Calling (DSC)
   b) Inmarsat C
   c) EPIRB

**Description**

**1) General requirements**

To prevent misuse of the system, international regulations requires that any false distress alert transmitted inadvertently shall be cancelled in due time. Persons failing to do so, or those deliberately and/ or repeatedly transmitting false distress alerts are liable to be prosecuted as required by international and national regulations.

It must be realized that if a false alert is not immediately cancelled, resources in form of man and material may be deployed and be wasted.

To avoid any false activation of equipments and alerts, personnel shall be duly trained and certified to use the equipments. They shall further be trained on follow up procedures in case of false distress alerts.

The GMDSS equipments are designed not to transmit a distress alert unintentionally. The key panels for emergency operation of equipments are different, separated from the key panel for routine operations and are usually protected by a cover, to prevent accidental activation. Further, the keys require to be kept depressed for a period of upto 4-6s for the distress alert to be actually transmitted. The equipments when activated for distress alert show visual and/or audible indications until manually deactivated.

If a distress alert has been accidentally transmitted, the ship shall make all reasonable attempts to communicate that the distress alert was a false alert, to crafts in vicinity, coast radio stations watching the distress frequencies and the nearest rescue coordination centre as applicable, by respective means to cancel the alert.

Whenever there is such an occurrence involving false distress alert and related cancellation communication, same shall be logged down in the GMDSS logbook. Company specific SMS procedures shall further be followed.

**2) Cancelling a false distress alert**

a) Digital Selective Calling (DSC)

I. Very High Frequency (VHF)

i. Switch off transmitter immediately
ii. Inform master and PIC responsible for GMDSS communications
iii. Switch equipment on and set to Channel 16
iv. Make broadcast to "All Stations" giving the ship's name, call sign and DSC number, and cancel the false distress alert

*Example:*
*All Stations, All Stations, All Stations*
*This is Vessel Name, Call Sign,*
*DSC Number, Position*
*Cancel my distress alert of*
*Date, Time UTC,*
*= Master Name, Call Sign,*
*DSC Number, Date, Time UTC.*

II. Medium Frequency (MF)

i. Switch off equipment immediately
ii. Inform master and PIC responsible for GMDSS communications
iii. Switch equipment on and tune for radiotelephony transmission on 2,182 kHz
iv. Make broadcast to "All Stations" giving the ship's name, call sign and DSC number, and cancel the false distress alert.

*Example:*
*All Stations, All Stations, All Stations*
*This is Vessel Name, Call Sign,*
*DSC Number, Position*
*Cancel my distress alert of*
*Date, Time UTC,*
*= Master Name, Call Sign,*
*DSC Number, Date, Time UTC.*

III. High Frequency (HF)

Same as that for MF, but the alert must be cancelled on all the frequency bands on which it was transmitted. Hence, the transmitter should be tuned consecutively to the radiotelephony distress frequencies in the 4, 6, 8, 12 and 16 MHz bands, as necessary.

| **Frequency Band** | **Digital Selective Calling (DSC)** | **Radiotelephone** | **Radio-telex** |
|---|---|---|---|
| VHF | Channel 70 | Channel 16 | |
| MF | 2187.5 kHz | 2182 kHz | 2174.5 kHz |
| HF (4MHz) | 4207.5 kHz | 4125 kHz | 4177.5 kHz |
| HF (6MHz) | 6312 kHz | 6215 kHz | 6268 kHz |
| HF (8MHz) | 8414.5 kHz | 8291 kHz | 8376.5 kHz |
| HF (12MHz) | 12577 kHz | 12290 kHz | 12520 kHz |
| HF (16MHz) | 16804.5 kHz | 16420 kHz | 16695 kHz |

b) Inmarsat-C

Inform master and PIC responsible for GMDSS communications. Notify the appropriate rescue coordination centre to cancel the alert by sending a distress priority message via the same coast earth station through which the false distress alert was sent.

*Example of message*
*Name, Call Sign, SAT- C Identity Number,*
*Position,*
*Cancel my Inmarsat-C distress alert of Date, Time UTC*
*= Master +*

c) EPIRBs

If for any reason an EPIRB is activated accidentally, the ship should contact the nearest coast station or an appropriate coast earth station or rescue coordination centre and cancel the distress alert.

**Apply Your Knowledge**

1. Check the various GMDSS equipment on board and mark the safety guards provided over emergency transmission keys. Discuss what information is carried in the emergency distress messages transmitted automatically.

**Function:** Navigation

**Competence:** Respond to a distress signal at sea

**Task number:** A6.1

**Sub-task Reference number:** A6.1.11, A6.1.12

**Topic:** Distress signals

**Task Heading**

- Make entries in the GMDSS log book under supervision.
- Record the communications, information and actions, including routine equipment checks, in the GMDSS log book.

**Objectives**

- To learn the procedure of making GMDSS log book entries.

**Index**

1) Radio records
2) GMDSS logbook
3) Sample page from GMDSS Log

**Description**

**1) Radio records**

SOLAS, STCW & International Telecommunication Union require a radio record of all incidents connected with the radio communication service which appear to be of importance to safety of life at sea, to be maintained. The maintenance of radio records is the responsibility of the radio operator designated as having primary responsibility for radio-communications during distress incidents.

GMDSS radio logbook is kept on the navigation bridge, near the radio installation and is routinely inspected by radio surveyors and other authorized personnel during audits, surveys and during port state control inspections. The master inspects and signs each day's entries in the GMDSS Radio Logbook.

**2) GMDSS logbook**

The GMDSS logbook usually comprises of four sections:

- **Section (A) - particulars of ship**
    - Ship's name
    - Call sign, official number and MMSI number
    - Port of registry
    - Gross tonnage
    - IMO number
    - Sea areas in which ship is authorized to sail
    - Date of expiration of current safety radio certificate
    - Date of expiration of current ship station radio license
    - Methods used to ensure availability of radio facilities
        - ✓ Duplication of equipment

    - ✓ Shore-based maintenance-giving details of name and address of service company
    - ✓ At-sea maintenance capabilities
  - ❖ Name and address of ship owner, manager or agent

- **Section (B) - details of radio personnel**
  - ❖ Names of certified operators
  - ❖ Dates of joining on board,
  - ❖ Certificate number and class
  - ❖ Name of person designated for radio communications during emergencies
  - ❖ Name of person nominated to carry out appropriate tests, checks and log entries

- **Section (C) - record of communications**

  The following are recorded in the GMDSS radio logbook in sequence of their occurrence with time:
    - ✓ Communications relating to distress, urgency and safety
    - ✓ A record of important incidents connected with the radio service
      - Any breakdown or malfunction of the equipment
      - Any breakdown of communications with a coast station, land earth station or satellite
      - Adverse radio propagation conditions, such as ionospheric static, atmospheric noise or other interference
      - Serious breach of radio procedures by other stations
      - Any significant incidents concerning the exchange of commercial traffic, such as disagreement over charges or non-receipt of messages
    - ✓ The position of the ship at least once a day

- **Section (D) - details and results of tests and checks carried out**
  - ❖ Details of daily tests
    - ✓ Test record of the proper functioning of the DSC equipment shall be tested at least once each day, without actual transmission
    - ✓ Test record of INMARSAT-C with EGC Self-test
    - ✓ Test record of batteries on-load and off- load and charging status

  - ❖ Details of weekly tests
    - ✓ Test record of DSC distress and safety radio equipment tested by a test call when within communication range of a coast station
    - ✓ Test record of batteries, voltage and density of fluid by hydrometer where applicable

  - ❖ Details of monthly tests
    - ✓ Test record of search and rescue radar transponder using the in-built test facility
    - ✓ Test record of each survival craft two-way VHF equipment
    - ✓ Test record of INMARSAT-C along with EGC by means of actual communication
    - ✓ Test record of batteries for the security and its connections

  - ❖ Half yearly and annual tests/ service records
    - ✓ In addition to above tests, annual tests such as that of EPIRB which are carried out in the shore based service centers and the servicing details of any other equipment ashore as and when carried out shall be duly recorded in the GMDSS Log.

Test record of NAVTEX messages shall be mentioned in the logbook. The print outs shall be kept filed separately.

GMDSS watchkeeping is part of responsibility of each deck officer on watch and all communication entries required to be made in the GMDSS log must be made by the OOW concerned.

Before departure, during the passage and upon arrival in port the vessel shall be participating in reporting systems such as AMVER. Appropriate entries shall be made in the GMDSS log as and when the sailing plan, the daily position report and the final closing arrival reports are sent to the respective stations.

All messages relating to distress, urgency and security shall be positively recorded in the log book.

Unauthorized transmissions and incidents of harmful interference should, if possible, be identified, recorded in the radio log and brought to the attention of the appropriate administration in compliance with the radio regulations, together with an appropriate extract from the radio log.

Any other entry as required by the company procedures as mentioned the ship's SMS manual shall be recorded in the GMDSS log.

### 3) Sample page from GMDSS Log

Sheet No.001

**GMDSS RADIO LOG BOOK**

Vessel name:............M/V **XYZ** ..................................................CALL SIGN:...... **ABCD** ...............MMSI. **1234567**

DATE:.........04 JULY 03.........................

MOVING: FROM ....................................**Port A** ...................TO..... **Port B** .............................

| Time (UTC) | Station From (Freq.,Ch.,Sat) | Station To (Freq.,Ch.,Sat) | Particulars of communication or remarks | Sign |
|---|---|---|---|---|
| 0935-0940 | 3EAA2 / No.1VHF | Yokohama, Sea | Reported ETA 11230500 LT etc. | C/O |
| | Ch.16 / 14 | Patrol Ch.16 / 14 | | |
| 1005-1010 | 3EAA2 / 8379.5Khz | JNA / 8419.5 khz | Sent jasrep "SP" | C/O |
| 1130-1140 | JMH 18220 khz | | Received Thyphoon warning (06Z) | C/O |
| 1310-1315 | Yamaguchi LES | 3EAA2 | Have been instructed medical treatment for crew from Tokio seamen´s hospital. | 3/O |
| 1325-1330 | JNA / Navtex | | Received urgent message "missing man". Copy attached. | 3/O |
| 1340-1349 | | | (daily) MF / HF DSC Radio Equipment: Checked by means provided routing: all sat´ry | 3/O |
| 1356-1402 | | | (daily) No.1 & No.2 Vhf Equipment with DSC: Checked by means provided routing: all sat´ry | 3/O |
| 1410-1420 | | | (daily) D.S.C. Watch Keeping Receiver: ---------- do-------------- | 3/O |
| 1425-1435 | | | (daily) Inmarsat- C with EGC: Checked by means provided Self Test: sat´ry | 3/O |
| 1440-1450 | | | (daily) ON-LOAD & OFF-LOAD radio batteries test carry-out: sat´ry | |
| 1805-1806 | 3EAA2 | Yamaguchi LES | Sent OBS 18 Z | 2/O |
| 1810-1815 | Navtex | | Checked paper supplies in good conditions. | 2/O |
| 1820-1825 | | | (weekly) No.1 & No.2 VHF Radio Equipment with DSC: Tested by only routing call: all sat´ry | 2/O |
| 1835-1840 | | | (weekly) MF / HF Radio equipment with DSC: tested by special calling (auto mode) with JNA | 2/O |
| | | | on 8Mhz: sat´ry | |
| 1843-1858 | | | (weekly) radio batteries tested using hydrometer: all sat´ry. | |
| 1500-1900 | No.1 VHF Ch.16 / 70 | | All nothing | 2/O |
| 1905-1908 | 3EAA2 | Yamaguchi LES | Sent Amver (SP) | C/O |
| 2005-2010 | | | (monthly)Two way VHF (No.1 , No2 & No.3): tested by ch. 17 (or ch.1) in good order | C/O |
| 2015-2022 | | | (monthly) Radar transponder (No.1 & No 2): checked by in-built test facility: ok | C/O |
| 2030-2035 | | | (monthly) Inmarsat-C with EGC: checked by mean of actual communication with Yamaguchi | C/O |
| | | | Land Earth Station (LES): sat´ry | |
| 2040-2058 | | | (monthly) radio batteries checked for the security of each battery and its connection: all sat´ry | C/O |
| 1900-2300 | No.2 VHF Ch. 16 / 70 | | All nothing and changed to No.1 VHF | C/O |

### Apply Your Knowledge

1. Check the GMDSS logbook onboard and discuss the format and related entries.
2. Check the filing system on board for keeping the records of various tests of GMDSS equipments.

**Function:** Navigation

**Competence:** Use the IMO Standard Marine Communication Phrases and use English in written and oral form

**Task number:** A7.2

**Sub-task Reference number:** A7.2.6

**Topic:** Use of English in written and oral form

**Task Heading**

- Supervise ratings and communicate with the bridge in English during anchoring, mooring and unmooring operations.

**Objectives**

- Understanding the right procedures for communicating during anchoring/ mooring stations.

Please read this task in conjunction with tasks under header A9.2

**Index**

1) The basis of good communications
2) Commonly used means of communication between navigation bridge and mooring stations
3) Alternative means to attract attention in case of a communication system failure
4) Standard marine terms and communication phrases

**Description**

**1) The basis of good communications**

- Good communication procedures provide safety benefit and shall be kept free from disturbing noises/ interruptions, maintaining professional standards. The unnecessary use of radio communications shall be avoided. Personnel not directly involved with an operation should not break into its working channel, apart in case of emergency situations.

- Conversations should be limited to operational matters only, keeping them precise, as brief as possible and expressed clearly.

- All personnel directly involved in an operation should be fully aware of the work to be undertaken. Clear comprehensive communication is extremely important which involves pre operational briefings.

- The conversations shall involve acknowledgement of instructions to ensure clear understanding and execution completing the communication cycle. Commands should be repeated by the recipient, not just by barely using the term “roger” or by using “click sounds” by using the transmitter button on the radio.

- Actions shall not be based on ambiguous order not clearly received. Due understanding shall be sought prior acting.

- Speaking quickly running words together or speaking too loud shall be avoided as the communication systems are often subject to interference, transmission breaks or other failures in clarity.

- Use of long dialogues shall be avoided.

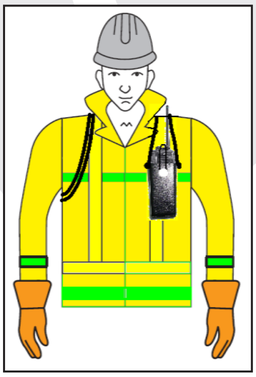
- Providing information to the central control station (navigation bridge during stations) is vital. The officer in-charge of the mooring/ anchoring station forward/ aft shall ensure that the navigation bridge is continuously kept informed of the current situation at and in the vicinity of the respective stations.

- Too much information is likely to result in overload which shall be closely monitored by bridge team. The officer in-charges of stations shall be clearly advised to update on information specifically required by bridge.

- Prior proceeding to stations, the means of communication shall be tested. The strength and clarity of communications shall be checked and operators familiarized with the sound and clarity of the personnel they are talking to.

- Working channels should be established on radio links and care taken that the channels selected do not interfere with other working channels of port operations and/or tugs.

- Each communicator shall be identified, to avoid confusion.

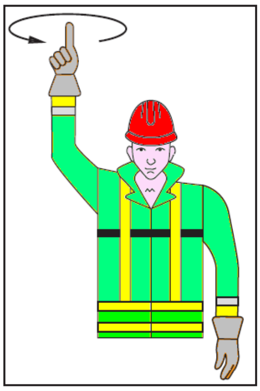


- With the multilingual crew, the recipients are likely to be not working in their native languages. English has been adopted as the official language for marine communications. English shall be used for communications making use of standard marine communication phrases.

- Use of ambiguous words, slangs or colloquial expressions shall be avoided. The use of offensive language on the radio is not permitted.

- For portable units, charged spare batteries shall be taken to the stations for use as and when required.

- Due regard shall be had to the prevailing weather and winds. The portable VHF units shall be used keeping the instrument in leeward side to avoid undue noise. During rains, these equipments shall be well protected from being affected by water.



- The VHF/UHF walkie– talkie shall be so carried by personnel so that the sound is clearly audible to them. Further the equipment shall preferably be carried in the designated carry pouch safeguarding it against accidental fall including fall overboard.

- The verbal orders shall be relayed to the operations crew loudly and clearly, preferably supplemented with standard hand symbols such as using hand for indicating to hoist/ slacken. However, use of signals such as whistles shall not be used. Careful watch must be kept on understanding of the orders by crew. Well known words from the native language of the crew may be used to best advantage ONLY when the respective meanings are well known.

**2) Commonly used means of communication between navigation bridge and mooring stations**

- VHF/UHF walkie-talkies
- Talk back systems
- Loud hailers

**3) Alternative means to attract attention in case of a communication system failure**

The alternative means are

- Public address system
- General alarm system
- Telephone system/ sound powered telephone if available
- Ship's bell forward
- Hand signals
- Other visual signals such as signal lights/ Aldis Lamp/ Hand Torch
- Word of mouth/ messenger

**4) Standard marine terms and communication phrases**

Standard communication phrases used during anchoring/ mooring stations are as mentioned below. These have been described in related task modules under header 9.2 in detail. The Officer in-charge of mooring/ anchoring station is required to be familiar with these terms.

- **Anchoring**
  - Stand by for letting go anchor
  - Let go anchor
  - Heave up anchor
  - Walk out the anchor
  - Anchor cable – x shackles in the water / in the pipe / on deck
  - Let go x shackles of port/starboard anchor and dredge it
  - Slack out the cable
  - Check the cable
  - Hold on the port/ starboard cable
  - Cable leading
    - ✓ ahead / astern
    - ✓ to port / starboard
    - ✓ round the bow
    - ✓ up and down
  - Checking the weight on the cable
  - Cable growing slack / tight / coming tight
  - Anchor holding the ground
  - Vessel brought up
  - Anchor light/ anchor ball
  - Putting windlass in gear/ on brake
  - Turn in cable
  - Anchor aweigh
  - Anchor fouled
  - Anchor clear of water
  - Anchor secured

- **Berthing and un-berthing**
  - Checking propeller clear
  - Fenders alongside the berth
  - Readying ship's fenders

- Berth port side / starboard side alongside
- Vessel mooring to buoys/ dolphins/ berth
- Headlines/ breast lines/ Spring lines/ stern lines
- Self-tension winches
- Heaving lines and messenger
- Fair-leads for moorings
    - ✓ the centre lead / panama lead
    - ✓ the bow lead
    - ✓ the port quarter / starboard quarter lead
- Heave on/ slacken/hold on/ check on the
    - ✓ head / stern line
    - ✓ breast line
    - ✓ forward / aft spring
- Heave away/ Slack away
- Heave in easy
- Heave alongside
- Vessel in position
- Finished with maneuvering stations
- Stand by for letting go
- Single up the xyz lines
- Make Fast/ Let go
    - ✓ the head / stern line
    - ✓ the breast line
    - ✓ the forward / aft spring
    - ✓ all (forward / aft)
- All Made Fast Forward/ Aft
- All Cast Off Forward/ Aft
- Towing Line
- Make fast/ let go the tug

**Apply Your Knowledge**

1. What do you understand by open loop and closed loop communication? Give an example of each.

**Function:** Navigation

**Competence:** Maneuver the ship

**Task number:** A9.1

**Sub-task Reference number:** A9.1.5

**Topic:** Maneuvering information

**Task Heading**

- Demonstrate understanding of squat, shallow water and similar effects. Calculate squat for a coastal passage at full speed (open and confined channel).

**Objectives**

- To correctly interpret and understand the maneuvering characteristics of the vessel in shallow waters

**Index**

1) Introduction
2) Shallow water
3) Shallow water effects
4) Squat
5) Squat calculations
6) Corrective action/ control measures

**Description**

**1) Introduction**

A ship proceeding through water pushes water ahead of her. This creates a void space immediately behind the vessel, which is gradually filled up with water from all around in vicinity, water rolling down underneath the bottom and that flowing along the sides of the vessel. The process continues as long as the ship is making way through the water.

In open seas the effect does not necessarily cause a great concern; however, in congested and shallow waters, the effect is predominant, the reason being unavailability of sufficient water near the aft extremity of the vessel, to fill up the void. And hence this requires due attention and control measures to avoid any damages or accidents.

**2) Shallow water**

Areas with depths less than 1.5 times the deepest draft of the vessel the waters may be termed as shallow where the shallow water effects will be prevailing.

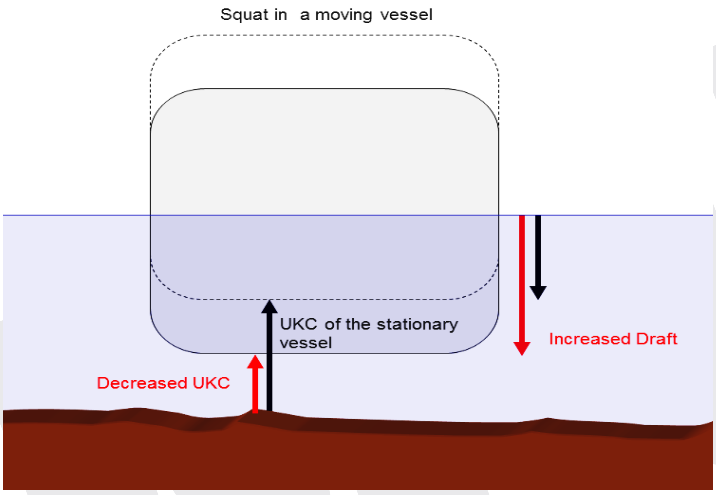
The extent in the transverse direction to which to the water is affected by the pressure field around the ship is termed as Width of Influence. The value is about 8 to 12 times the breadth of the ship. In the waters with width less than this a vessel will observe effects of shallow waters.

**3) Shallow water effects**

The effects are:

- Increased squat

- Change in trim - ships with a block co-efficient greater than 0.7 generally trim by the head and ships with block co-efficient less than 0.7 generally trim by the stern
- Reduced UKC seen in echo-sounders
- Wave making pattern changes with an increase in bow wave and a deep trough at the mid-ship region
- Sluggishness in maneuvering
- Drop in speed
- Vibration
- Reduction in rolling, pitching and heaving motions
- Appearance of mud on water surface
- Enlarged turning circle of the vessel
- Increase in stopping distances and stopping times
- Decreased effectiveness of the rudder helm
- Increased width of the wake




### 4) Squat

The occurrence of squat is based on Bernoulli's theorem. The water passing from forward towards aft underneath the vessel's bottom moves at relatively higher speed, causing a low pressure area underneath the vessel. This results in causing the vessel to sink downwards, causing a decrease in under-keel clearance of the vessel.

Squat prevails as long as there is relative motion between the ship's hull and surrounding water. This could be when the ship is making way or when the ship is anchored in a sea area with strong current. The effect of squat becomes a more pronounced in shallow waters and causes a greater concern. Excessive squat may result in causing damage to ship's underwater hull or machinery.

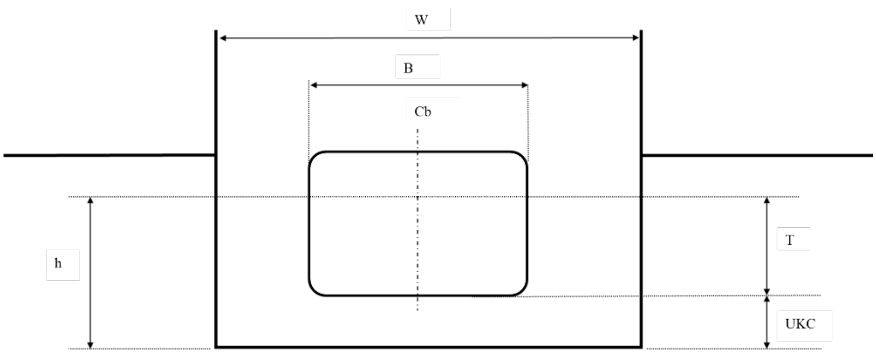
### 5) Squat calculation

Maximum squat can be calculated by the formula as mentioned below

Maximum Squat = $(C_b \times S^{0.81} \times V^{2.08}) / 20$

Where,
$C_b$ – Block Coefficient of the vessel
S – Blockage factor or the vessel
V – Speed of the ship in knots

Blockage factor S= $A_s$ / $A_c$
Where
$A_C$ = channel cross-section area = h x W (in square metres)
$A_S$= vessel submerged cross-section area (in square metres)




This is to say that for two channels of same depths, the effect of squat will be more pronounced in the channel which is less wide. Further to above, presence of another ship, in a river abreast own vessel, increases the squat on both vessels.

A more approximate calculation for squat can be done by the formulae
Squat in Open Waters = (Cb x V $^2$) / 100
Squat in shallow Waters = (Cb x V $^2$)/50

The vessel maneuvering booklet shall be referred for specific values of squat.

**6) Corrective action/ control measures**

The governing factor is the speed of the vessel which shall be adjusted accordingly depending upon the available depths and widths of navigable waters.

It is noteworthy that doubling the speed will be increasing the squat by four times whereas reducing the speed by half will be decreasing the squat to one fourth.

Due allowance shall be given to the squat effect while estimating the controlling depths for the passage and the anticipated UKC. Controlling depth of the passage are calculated based on tide and current conditions, sea state conditions (as applicable), depth at the port facility, anchorage of the transit area.

A company may have a minimum UKC policy, which must be followed, giving due regard to the effect of tides and squat, with respect to charted depth and vessel's draft.

It is preferred to have estimated squat values displayed on the bridge in tabular or graphical form for ballast/loaded and open/confined channels ready for use.

| Controlling depth and UKC | | |
|---|---|---|
| | **Approaches** | **Coastal** |
| Max upright draft | 12.00 | 12.00 |
| Minimum UKC (company policy) | 1.20 | 2.40 |
| Increase in draft (due to list) | 0.00 | 0.00 |
| Increase in draft (due to squat) | 1.61 | 1.30 |

**Sample squat chart (to be calculated for own vessel and displayed on bridge)**

| | | |
|---|---|---|
| Increase in draft (due to all other dynamic factors) | 0.00 | 0.00 |
| **Minimum Depth Required (MDR)** | **14.81** | **15.70** |

| Speed (kts) | Squat (Confined Waters) | Squat (Open Waters) |
|---|---|---|
| 1 | 0.01 | 0.01 |
| 2 | 0.03 | 0.03 |
| 3 | 0.08 | 0.06 |
| 4 | 0.14 | 0.11 |
| 5 | 0.22 | 0.18 |
| 6 | 0.32 | 0.26 |
| 7 | 0.44 | 0.36 |
| 8 | 0.59 | 0.48 |
| 9 | 0.75 | 0.61 |
| 10 | 0.93 | 0.76 |
| 11 | 1.14 | 0.92 |
| 12 | 1.36 | 1.10 |
| 13 | 1.61 | 1.30 |
| 14 | 1.88 | 1.52 |
| 15 | 2.17 | 1.76 |
| 16 | 2.48 | 2.01 |
| 17 | 2.81 | 2.28 |
| 18 | 3.17 | 2.57 |
| 19 | 3.55 | 2.87 |
| 20 | 3.94 | 3.20 |

**Apply Your Knowledge**

1. Check the areas on the current passage where the waters appear shallow.
2. Observe the speeds maintained during transiting such areas and under keel clearances.

**Function:** Navigation

**Competence:** Maneuver the ship

**Task number:** A9.2

**Sub-task Reference number:** A9.2.14

**Topic:** Anchoring and mooring procedures

**Task Heading**

- Assist inspection of chain locker.

**Objectives**

- To understand the structure of chain lockers and learn its inspection procedures.

**Index**

1) Chain lockers
2) Cleaning, maintenance and inspection of chain lockers at dry dock

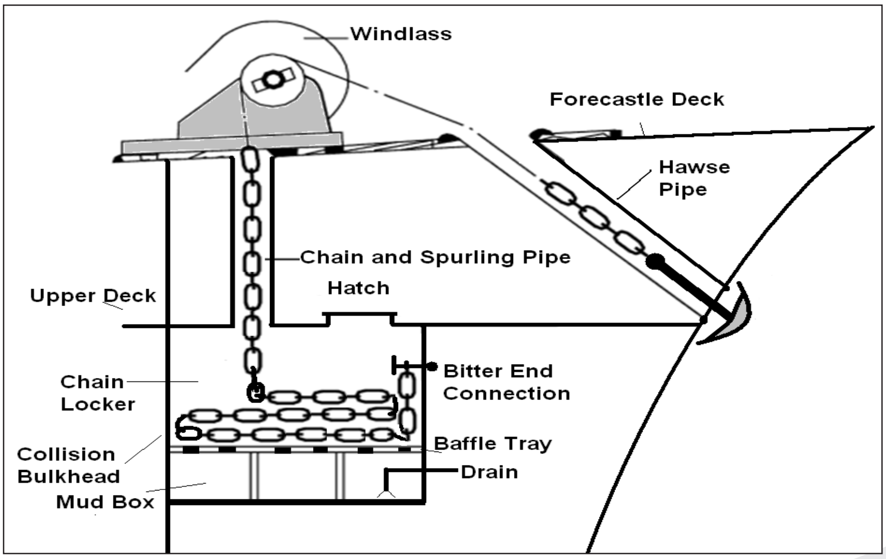
**Description**

**1) Chain lockers**

- Chain lockers are provided to stow the anchor chains below the windlass. The capacity of the chain locker is adequate to stow the full anchor cable providing an easy direct lead for the cable into the chain pipes, when the cable is fully stowed. The chain lockers are divided into two compartments or two separate chain lockers are provided for housing the full length port/ starboard anchor.

- The inboard ends of chain cables are secured to suitably reinforced attachments in the ship structure by means of end shackles, called the "Bitter End". These are usually arranged as capable of being released easily as and when required from an accessible position outside the chain locker. Generally, such attachments are designed to withstand a force equal 15 to 30% of the breaking load of the chain cable.

- The anchor chain is guided by from the chain locker to the windlass on forecastle deck through spurling pipe. From the windlass the chain passing through the bow stopper and hawse pipe, is finally connected to the anchor housed in the hawse pipe.




- Spurling pipes openings on deck are also provided with permanently attached closing appliances, to minimize water ingress such as steel plate covers with cutouts to accommodate chain links. These are further sealed by burlap and cement coating for sea passage of the ship.

**2) Cleaning, maintenance and inspection of chain lockers at dry dock**

- The chain locker is cleaned and inspected at the dry dock. With the anchor chains removed and ranged in the dry dock, all accumulated mud and debris is removed from the locker.

- The internals of locker are then cleaned with a high pressure water wash; bottom grates are lifted and cleaned underneath. All dirt and debris is removed and disposed of ashore.

**Points to look for during chain locker inspection**

- Corrosion of plating – caused by insufficient thickness of paint coating, incorrect paint coating specification or paint coating physically damaged by chain impact
- Dents or damage – caused by physical impact of chain due to malfunctioning of equipment/ incorrect operation

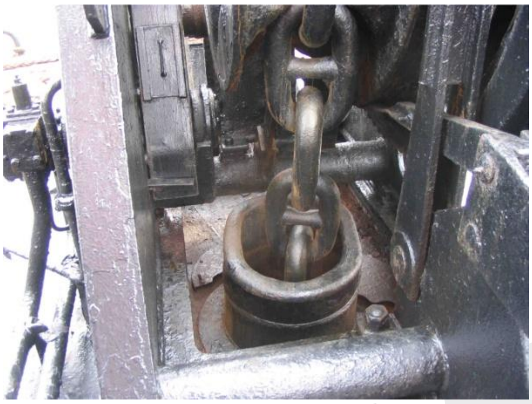
- Chain locker is then examined by surveyor for dents, damages and traces of corrosion. The corrosion spots are specifically checked are the joints and bulkheads separating the chain locker from ballast water tanks or water tight bulkheads. The thinned/ damaged parts are marked and gauzed and renewed as required.

- The drainage system is then tried out. The surface having been cleaned and prepared shall further be coated with inorganic zinc paints or bituminous paints.

- The anchor chain is simultaneously checked as required by classification rules, pained and marked (as discussed under task header 9.2.1-5). The bitter end connection and quick release arrangement is checked and lubricated followed by housing of the anchor cable.

- Chain locker is an enclosed space and is likely to run deficient in oxygen. Prior entering chain locker for inspection or any other reason, the enclosed space specific, permit to work procedures shall be followed, which include atmosphere checking, adequate ventilation, adequate lighting, preparing rescue equipment and continuous attendance etc. by personnel during the entry.

- Chain lockers are usually small in size (less than 0.1% of the ship's maximum displacement volume) and due to small volume the chain lockers are usually not fitted with the water level alarm systems. But if not maintained water tight, these are likely to lead to progressive flooding. Hence these shall be strictly maintained water tight. The spurling pipe openings on deck shall be regularly checked and sealed water tight prior long open sea voyages. Classification society for the vessel issues specific guidelines for the design of the spurling pipe opening on deck and arrangements for closing it water tight.



Spurling pipe capable of being closed watertight

Badly corroded spurling pipe

**Apply Your Knowledge**

1. Check the forepeak store for the quick release arrangement of bitter end. Check whether it is easily accessible. Learn the procedure for releasing the bitter end.
2. Discuss the circumstances when the bitter end of the anchor chain might require to be released from the bitter end.

**Function:** Navigation

**Competence:** Maneuver the ship

**Task number:** A9.2

**Sub-task Reference number:** A9.2.15

**Topic:** Anchoring and mooring procedures

**Task Heading**

- Assist stowage of ropes after mooring operations.

**Objectives**

- To learn procedures to stow and take care of mooring ropes

Please read this task in conjunction with tasks A9.2.2 and C2.4.6

**Index**

1) Stowage and care of ropes

**Description**

**1) Stowage and care of ropes**

- The mooring ropes when they are taken in on board after casting off are usually wet. It is not advisable to stow them under deck in wet condition. For short sea passages of a day or two, unless expecting heavy weather or extreme conditions such as icing enroute, the ropes are kept on coiled deck allowing them to dry in sun.

- When the mooring ropes are stowed on deck, these are stowed on wooden gratings tied to the deck. The ropes are neatly coiled, the coil starting with the end of the rope kept clear of the grating and then coiling from a tight small circle and then expanding to the edge of the grating. Once the edge is reached, the rope is coiled inwards towards the centre and then again as the inside coil is reached it is moved outwards. Finally the free end of the rope is put on the bitt. The coil as a whole is tied to the grating.

- When proceeding on long passages, the ropes shall be dried in sun for a day and cleaned for any salt, dust, rust particles or grease. The ropes shall be brushed clean of salt, dirt, grit, rust or ice particles, to avoid internal abrasion prior storage.

- Oily or greasy lines, stained with oil and grease, are difficult to handle. Dirt and grit further adhere to oil causing the internal abrasion of the rope. Heavy accumulations of oil and grease on a line should be scrubbed with a solvent such as mineral spirits and subsequently rinsed with a solution of soap and water.

- Prior stowing, ropes shall be checked for wear and tear and signs of weakening or damage. The ropes damaged beyond required specifications shall be discarded. Splices in both ropes and wires should be inspected regularly to check they are intact.

- The lines are kept coiled on gratings in dry ventilated spaces away from hot surfaces and bulkheads in the store. Care shall be taken not to stow the lines near bilges where the forepeak moisture is likely to get collected. The ropes shall further be kept clear of hydraulic system for machinery and the nearby oily surfaces.

- Prolonged exposure to sun's ultraviolet rays can cause polypropylene and polythene fibres to disintegrate. These ropes shall not be reeled on winches. However the high modulus fibre mooring lines made of high modulus polythene and aramid of diameters more than 24 mm are not significantly affected by UV rays.

- The ropes reeled on winches shall be allowed to drip dry and subsequently covered with canvas covers to protect from sunlight, sea spray and funnel soot. Winch/ windlass controls are also covered with canvas covers.

- The strength and life expectancy of a fibre rope is directly related to its bent radius that it is exposed to in its service. Sharp bends shall always be avoided. The minimum winch diameter shall be at least 16 times the rope diameter.

- The wire ropes are kept reeved on their winches. These shall be rinsed with fresh water and then allowed to drain. Once draining is complete the wire is covered by a canvas cover. Prior putting the canvas cover, the top layers are generally oiled with wire rope primer (WRP); this ensures that if the wire is not going to be greased during the voyage, the oil would seep down to the other layers.

- The wire ropes shall be maintained as per the planned maintenance schedule.

**Apply Your Knowledge**

1. Check the types of mooring ropes provided on your vessel along with the specifications provided by the manufacturer.

**Function:** Navigation

**Competence:** Maneuver the ship

**Task number:** A9.2

**Sub-task Reference number:** A9.2.16

**Topic:** Anchoring and mooring procedures

**Task Heading**

- Place rat guards on mooring ropes after berthing and understand importance of securing rat guards.

**Objectives**

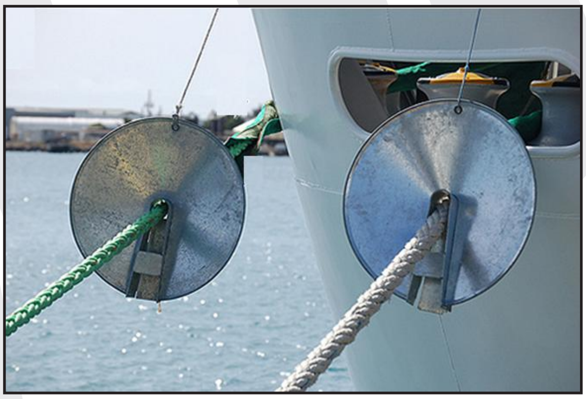
- To understand importance and use of rat guards.

**Index**

1) Rat guards

**Description**

**1) Rat guards**



- World health organization under international health regulations requires every ship trading internationally to have “Ship Sanitation Control Certificate” which was earlier known as de-ratting certificate.

- The de-ratting certificate earlier issued helped to reduce the international spread of rodent-borne diseases, especially plague, carried through infected rodents hiding on ships. The ship sanitation control certificate widens the scope for the prevention and control of public health risks on board ships on international voyages. Port health officers often inspect the ships for general sanitary conditions.

- If a source of infection or contamination is found on board, the necessary disinfection, de-contamination or de-ratting etc. are carried out as necessary to prevent the spread of the infection or contamination.

- Rat guards are placed on mooring lines after the vessel is made fast to the jetty and continue to be on the lines throughout the vessel’s stay in port.

- Rat guards are made of thin sheet of aluminium or galvanized steel, usually circular in shape, with diameter as wide as 1000mm.These once secured on ropes block the path of rodents boarding the vessel through mooring lines.

- The rat guards are lowered on to the mooring lines with the help of a small thin rope tail which are made fast on the ship’s bulwark. Precautions shall be taken against falling overboard while lowering rat guards.

- Very heavy fines could be imposed by authorities if they find the rat guards out of position.

**Apply Your Knowledge**

1. Locate the rat guards on board your vessel. List other measures taken on board for monitoring and improving sanitation.

**Function:** Navigation

**Competence:** Maneuver the ship

**Task number:** A9.2

**Sub-task Reference number:** A9.2.17

**Topic:** Anchoring and mooring procedures

**Task Heading**

- Demonstrate understanding of the precautions required for hydraulic mooring systems.

**Objectives**

- To learn procedures for operation of mooring winches

**Index**

1) Hydraulic mooring systems
2) Routine check of the hydraulic systems
3) Precautions to be observed while using hydraulic mooring systems

**Description**

**1) Hydraulic mooring systems**

- Hydraulic power systems consist of three basic elements:
  - A hydraulic pump attached to a prime mover, which can be electrically, diesel or air driven (usually electrically driven on board)
  - A hydraulic motor operating the equipment
  - A control circuit

- Pipes, hoses, fittings and hose assemblies connect the motor to the pump and resulting in flowing hydraulic fluids at high pressures. These high pressure fluids transfer energy and run the specific machinery such as mooring winches, windlass, hatch covers, cranes, gangway winches, steering gear and cargo pumps etc. to the do useful work.

**2) Routine check of the hydraulic systems**

- The components, bends and joints of the hydraulic system (the pipelines, hoses and assemblies) shall be closely checked for any leakages. The components used shall be as per manufacturer's specifications. Further, the manufacturer's instructions for installation which shall be followed. Routine maintenance, overhaul and inspections shall be carried out as per ship's planned maintenance schedule. The hydraulic fluid level shall be checked regularly and before starting the system. The hydraulic fluid shall be checked and changed as per manufacturer's instructions and replenished as required. Hydraulic line filters shall be cleaned as per manufacturer's instructions and company planned maintenance schedules (PMS). These shall be checked for metallic fines, which give the first indication in wear and tear in the hydraulic pumps and motors. The shipping company may require the lubricating oil sample to be sent ashore for infra-red spectroscopic analysis for "particle count test". The lube oil cooler must be periodically cleaned in accordance with the vessel's PMS.

### 3) Precautions to be observed while using hydraulic mooring systems

- Failure of hydraulic winches/ windlass is likely to result in serious accidents. Prior to use and as per PMS of company, windlass and winches shall be checked for signs of weakness such as dents, thinned plates and corrosion on the machinery, their base platforms and on the supporting hull structures.

- The cooling system for the hydraulic system of winches should be operational. It is important that the coolers are cleaned at regular intervals as stated in PMS.

- Effective lubrication of the mooring winch / windlass and other such equipment can be best achieved while the equipment is running (rotating). However working on any rotating machinery can be extremely hazardous thus a proper risk assessment is required. Loose fitting clothes and gloves should be avoided. Adequate amount of grease should be introduced into the bearings. All old / excess grease must be wiped off as otherwise this works as a dust catcher. Level and condition of oil in the gear case should be checked and replenished as per the lubrication schedule.

- In cold climates hydraulic systems will require to be warmed up prior use and shall be switched on usually 30 minutes before operations.

- Abnormal sounds or heating of the winches and hydraulic systems shall be duly checked.

- Oil, moisture or heavy rust on the brake linings or drum can seriously reduce the brake holding capacity. Moisture may be removed by running the winch with the brake applied lightly, but care must be taken not to cause excessive wear. Oil impregnation cannot be removed so contaminated brake linings will need to be renewed.

- The holding capacity of a winch brake is in inverse proportion to the number of layers of the mooring wire or rope on the drum. The designed holding capacity is usually calculated with reference to the first layer and there is a reduction in the holding capacity for each additional layer. This can be substantial – as much as an 11% reduction for the second layer. If the rated brake holding capacity of a split drum winch is not to be reduced; only one layer should be permitted on the working drum.

- Every ship's officer should be aware of the designed brake holding capacity of the self-stowing mooring winches installed on the ship. Kits are available for testing winch brake holding capacity and can be placed on board for use by the crew for conducting brake rendering test.

- Self-tensioning winches fitted with automatic rendering and hauling capability should not be used in the automatic mode while the vessel is moored. In automatic mode, such winches, by definition, will render under load and will allow the vessel to move out of position, with consequent risk to cargo arms or hoses.

- Once the winches have been used for making fast, the brakes shall be tightened and the winches shall be removed from gear. Under no circumstances shall the winches be left in gear while on load.

- The hydraulic system shall be switched off after use and checked for any leakages and overheating.

- While the winches are in operation, personnel shall take due precautions to safeguard against hazards from hydraulic fluid flowing at high pressure.

- The windlass and winches shall not be excessively stressed. The SWL of the machinery shall be carefully checked. Generally the SWL of the winches is equal or more than the breaking load of the mooring lines.

- Due regard shall be had to the additional load experienced by winches as a result of lead angles of ropes and friction of guiding equipment such as rollers and fairleads and rough chocks through which the lines pass.

- The system pressure should not be adjusted to overcome the excess force that may be encountered while heaving. Additional hydraulic pump may be used on the same line instead, by changing over the valve arrangement. All officers must be fully conversant in the flexibility of the hydraulic system to put a different pump or additional pump on a line.

- Excessive loads on mooring winches and anchor windlass shall be avoided. Engines and/ or tugs may be used to ease the load on anchor chain or moorings where applicable.

- Sufficient manpower shall be assigned for the operation. The winches shall not run unattended.

**Apply Your Knowledge**

1. Check the hydraulic system provided for windlass and winches on your vessel. Check if a placard is available near the system mentioning the operating procedure and checks before starting the system. If no such card is available prepare one with reference to the operations manual for the system.

**Function:** Navigation

**Competence:** Maneuver the ship

**Task number:** A9.2

**Sub-task Reference number:** A9.2.18

**Topic:** Anchoring and mooring procedures

**Task Heading**

- Identify the points where tugs usually make fast.

**Objectives**

- To understand the safety considerations when operating with tugs.

Please read this task in conjunction with tasks A9.2.2

**Index**

1) Use of tugs

**Description**

**1) Use of tugs**

- Tugs are used to assist in maneuvering the vessel in port basins, channels and while making fast and casting off from berths. As discussed in Task A9.2.2, the tugs operation shall be in close coordination with the vessel being assisted. Each and every maneuver shall be closely communicated between the tug and the vessel and the vessel's momentum shall be closely monitored.

- Tugs are usually made fast to the vessel either by tug's line or ship's line. The ship's mooring machinery and fittings such as winches, bitts, chocks, rollers, capstans and fairleads are fitted considering the vessel's size and required strength. The maximum breaking strength of the mooring lines used by the vessel is lesser or equal to the SWL of these mooring fittings. However, the tug's lines when used for making fast to the vessel need not necessarily be of the same breaking strength as the ship's lines and are likely to expose the ship's gear to additional stress.

- Lines of sound condition shall only be used for passing on to tug. Due check shall be kept on the line while the tug is pulling the vessel. Any early signs of damage or likely damage to the line or the mooring equipment shall be promptly informed to the bridge.

- The stress in the tow line and involved gear varies with the lead of the rope. Safe lead directions and angles for the ship's chocks and fairleads are mentioned in the towing and mooring arrangement plan of the vessel. The line for the tug shall be passed considering the recommended lead angles for vessel's lines avoiding sharp bends.

- The lines used by tugs shall preferably be passed through closed chocks of suitable strengths. The tow line passing though chocks not sufficiently strengthened impose serious threat to safety. The open roller fairleads and capstans rollers when used for tug line are likely to result in rollers uprooting and flying off.

- A powerful tug could easily cause deformation of the ship's hull and internals while pushing. The positions along the length of the vessel for tugs to push are usually marked on the ship side by large icons. It is further recommended to indicate the maximum push force safe for that area. It is a good practice to also mark the tug push points on the main deck abreast of the push point on the hull.

- The positions for tugs to push and the design safe pressure for the push points are identified by naval architects while designing the vessel, considering the longitudinal center of gravity and draft of the vessel in various load & ballast conditions, the maximum expected tug pushing force and the contact area. These positions for tug pushing are mentioned in the vessel's towing and mooring arrangement plan. The hull in these positions is specially strengthened to bear and distribute the tug's push impact.

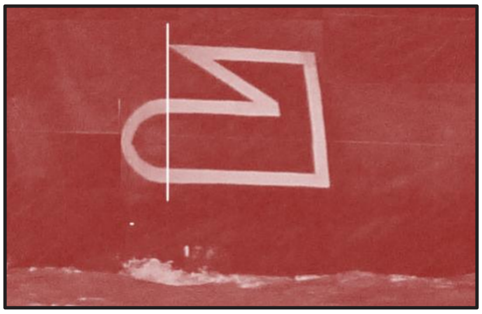

- With the advent of more powerful tugs, side shell reinforcement for the tug pushing shall be carefully considered on older ships. In addition to above, the areas specifically not to be touched by tugs, such as in way of side shell doors shall be clearly marked.

- Equipment used for towing should be adequately maintained and inspected before use, as during towing operations excessive loads may be applied to ropes, wires, chocks, bitts and connections. SWL of the bitts and other mooring fittings shall be clearly marked preferably in tonnes.

- While using the center line chocks, bitts used to make fast tow line shall preferably be those not directly in front of the chocks, rather slightly displaced form the chock line to avoid line chafing.

- Winches used to pick up messenger line from the tug shall be chosen closer to the chock, keeping in mind the length of the messenger rope and the distance between the chock and winch and the length of messenger rope required to take three turns on the warping drum.

- In all communications clear identification of the parties communicating should be used to prevent misunderstandings. The tug master should be kept informed of engine movements, proposed use of thrusts etc. Persons in charge of the mooring party should monitor the tow line to give warning to the crew if the tow line should become taut, for whatever reason.



- The tugs operate in and around the bow of the vessel and are affected by the varying pressure areas created by the bow wave and bulb. It is important for the tug to be informed how far the bulb protrudes. A marking at the bow as shown in the picture further provides a clear indication.

- While throwing heaving line on to the tug for connection due care shall be taken not to hit the tug crew. When unchecked it is likely to cause personnel injury and result in huge fines and claims.

**Apply Your Knowledge**

1. Identify the points where tugs usually make fast on board with reference to your vessel's Towing and Mooring arrangement plan.

**Function:** Navigation

**Competence:** Maneuver the ship

**Task number:** A9.3

**Sub-task Reference number:** A 9.3.1, A9.3.2

**Topic:** Man overboard

**Task Heading**

- Take part in a man overboard drill.
- Demonstrate understanding of the "Williamson" turn or other methods for positioning the vessel to recover a person overboard.

**Objectives**

- Understand emergency procedures and maneuvers for the rescue of person overboard

**Index**

1) Man over-board
2) Primary concerns in MOB situation
3) Factors effecting the recovery maneuver
4) Immediate action seeing a person falling overboard
5) Standard recovery maneuvers
6) General instructions
7) MOB facility in GPS and ECDIS

**Description**

**1) Man over-board**

Man overboard is an emergency situation posing of life of a person fallen overboard in danger.

**2) Primary concerns in MOB situation**

The primary concerns in case of a person falling overboard are

- Avoiding the person to be run into propeller
- Providing the person means to remain afloat
- Continuously keeping track of the person's location
- Fastest means of recovery of the person from water

**3) Factors effecting the recovery maneuver**

These are:

- Ship's maneuvering characteristics
- Wind direction and sea state
- Crew's experience and level of training
- Capability of the engine plant
- Location of the incident
- Visibility level
- Recovery technique
- Possibility of having other vessels assistance

## 4) Immediate action seeing a person falling overboard

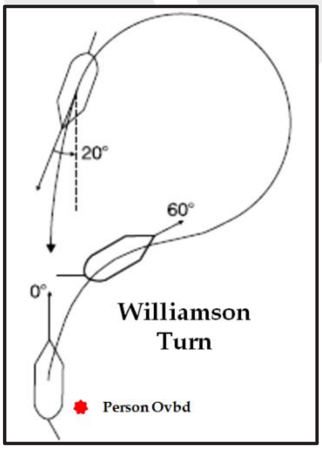
The actions are:

- Hail ‘‘Man Overboard’’
- Immediately wheel hard over to the side person has fallen, to turn propeller away from the person fallen overboard
- Throw a lifebuoy over the side as close to the person as possible, preferably one with the MOB marker. This serves the purpose of providing a floating aid to the person and the MOB marker help locate the person’s position
- Sound emergency alarm for follow up by ship’s teams as per the emergency plan
- Sound three prolonged blast of ship’s whistle
- Note position, wind speed & direction, time,
- MOB facility is available on electronic equipment such as GPS or ECDIS which shall be activated as the MOB command. This will assist in returning accurately to the same spot.
- Commence recovery maneuver as discussed below
- Post look-outs to keep the person in sight
- Stand by the engines
- Prepare lifeboat for possible launching
- Distribute portable VHF radios for communication between bridge, deck, and lifeboat
- Rig pilot ladder to assist in recovery
- Flag ‘O’ to be hoisted
- Broadcasting emergency alert ‘Mayday’ seeking assistance from ships in vicinity and coastguard

## 5) Standard recovery maneuvers

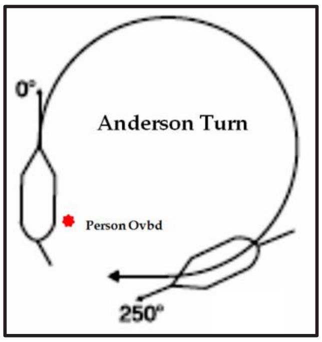
### a) Immediate actions

A person falling overboard has been seen from the wheel house, and action is taken immediately




#### i) Williamson turn

- Wheel hard over to the side person falling overboard
- Once heading 60° off the original track putting the wheel hard over to the other side
- When 20° lesser than the reciprocal heading, the wheel to be brought to amidships
- After completing the Williamson turn prepare to slow down the ship and maneuver as required to position the vessel upwind of the man overboard.



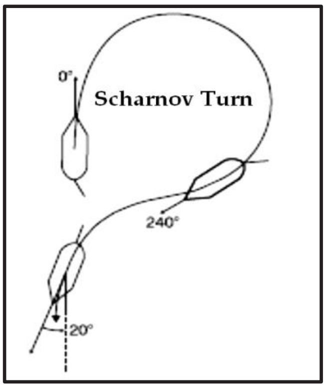

- Advantages
  - makes good original track line
  - good in reduced visibility
  - simple to execute

- Disadvantages
  - takes the ship farther away from the scene of the incident
  - slow procedure

#### ii) One turn (‘‘Single turn, Anderson turn’’)

- When put hard over to the side person has fallen over board
- Wheel brought to amidships as the person is nearly ahead

- Advantages




- ➢ fastest recovery method
- ➢ good for ships with tight turning characteristics
- ➢ used most by ships with considerable power

- Disadvantages
- ➢ very difficult for a single-screw vessel
- ➢ difficult because approach to person is not straight

**b) Delayed actions**

A person is reported missing and expected to be fallen overboard. The intention is to follow the steamed track.

**i) Scharnov turn**

- ➢ Put the vessel hard over to one side.
- ➢ When heading 60° more than the reciprocal heading the wheel put hard over to other side
- ➢ When heading 20° more than the reciprocal heading wheel brought to amidships, gradually steadying on the reciprocal course

- Advantages
- ➢ will take vessel back into her wake
- ➢ less distance is covered, saving time

- Disadvantages
- ➢ cannot be carried out effectively unless the time elapsed between occurrence of the incident and the commencement of the maneuver is known

**6) General instructions**

- The action to be taken will be similar whether a person has fallen overboard from own ship or is seen in water.
- In case unable to locate all the lifebuoy thrown overboard, a SECURITE warning reporting shall be made mentioning regarding the lifebuoy.
- Stop the vessel and ensure all way off, when in close vicinity of the man overboard
- In cold climate rescue boat crew must wear immersion suit otherwise lifejackets must be worn
- Rescue boat crew must take spare life jacket and blankets for the victim. Oxygen resuscitator should also be carried.
- Administer first aid to the casualty Seek radio medical advice as required. Person may be suffering from hypothermia. Take immediate actions in accordance with medical guide.

- In case of a MOB situation, emergency reporting shall be done as follows:
- ➢ Name, rank of person overboard
- ➢ Time reported
- ➢ Who all contacted [owners, charterers, coastal state, rescue coordinating centre]
- ➢ Name of providing assistance
- ➢ Name & position of other vessels assisting
- ➢ Has the man overboard recovered
- ➢ Condition of person rescued
- ➢ Name, age, nationality & other identification of person rescued
- ➢ Date / time engines on stand by
- ➢ Date / time rescue completed
- ➢ Time & position when vessel resumed voyage
- After the recovery of the person, the ‘Mayday’ warning shall be called off and all in vicinity shall be informed regarding the same.

- Following the recovery operation, evidences shall be collected as per company procedures.
- Emergency drills shall be practiced as per company specific SMS procedures whereby the ship's complement shall be following the procedures laid down in emergency procedures.

**7) MOB facility in GPS and ECDIS**


The MOB (man overboard) mark functions to mark man overboard position. The function is generally available with a dedicated key. As soon as the key is pressed, the current position is stored in memory and automatically turns as the next waypoint. The equipment then starts to show the course and distance from the MOB position.

On ECDIS, the man overboard (MOB) functions can be accessed by a dedicated key. An instant position entry is made in the electronic ship log. In some sets, the function can be accessed with the mouse. The scroll-wheel shall be brought to display Event/Info/MOB in the mouse functions area then push the mouse button to record MOB position to the logbook.

**Apply Your Knowledge**

1. List various methods for positioning the vessel to recover a person overboard. Describe briefly the advantages and disadvantages of "Williamson" turn.

## SEMESTER 5

## FUNCTION 2: CARGO HANDLING AND STOWAGE

**Function:** Cargo Handling and Stowage

**Competence:** Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

**Task number:** B1.2

**Sub-task Reference number:** B 1.2.6

**Topic:** Cargo gear

**Task Heading**

➢ Locate the chain register and state its contents.

**Objectives**

➢ Understand the purpose of maintaining chain register on board

**Index**

1. Chain register/ cargo gear register
2. Contents of chain register
3. General requirements regarding testing of lifting gear and entries in the chain register
4. Annual thorough examination of a lifting appliances
5. Four/ five yearly examination and testing of lifting gear
6. Annealing

**Description**

**1) Chain register/ cargo gear register**

**THE DOCK WORKERS (SAFETY, HEALTH & WELFARE) REGULATIONS, 1990**

**REGISTER OF LIFTING APPLIANCES AND LOOSE GEAR**

NAME OF THE SHIP :
OFFICIAL NUMBER :
CALL SIGN :
PORT OF REGISTRY :
NAME & ADDRESS OF OWNER :

Note : This Register is the standard International Form as recommended by the International Labour Organisation in accordance with ILO Convention No. 152

➢ The chain register is the register carrying the details concerning a ship's lifting gear. The lifting gear includes lifting gear used on deck and in the engine room such as derricks, cranes, lifting machineries, lashing equipments etc. including chains, rings, hooks, shackles etc. The ILO, dock labour regulations and factory act of maritime nations require regular testing and maintenance of lifting gear that will be used by stevedores. Records of the same are required to be maintained in chain register. Certification of a vessel's lifting appliances is

Dock Safety inspectors are likely to carry out spot checks aboard a ship to ensure that all the gear is safe, and also to verify that all items of gear are clearly marked and that the test certificates can be readily located. Failure to have the updated chain register is likely to result in stoppage of work and possible off hires.

enforced by the national authorities, i.e. port state and by the vessels' flag state. The certification has to comply with the ILO convention No.152 which covers safety in lifting operations. Dock safety inspector also may demand to inspect the chain register.

- Each country has its own requirements regarding frequency of inspections and these requirements differ one from another. The chain register of one country may not always be acceptable in another country and ship operators may provide their ships chain registers in an internationally accepted form from classification society or in formats provided by governments of other countries.

- Some flag states may require their ships need to have an additional dock labour certificate from these countries certifying that the lifting gear is in compliance with their dock labour regulations.

- Port state control officers may conduct concentrated inspection campaign for lifting gears in conjunction with PSC inspections. This again may not be sufficient to allow detention of vessel but is substantial enough for stopping cargo operations.

**2) Contents of chain register**

The chain register is usually divided into four parts as follows:

- Part 1: Entries of 4/5 yearly examination and annual examination of derricks/ cranes and permanent attachments.

- Part 2: Entries of annual inspection of winches and gears, the derricks/ cranes and its attachments

- Part 3: Entries of examination of gears exempted from annealing

- Part 4: Records of annealing

**3) General requirements regarding testing of lifting gear and entries in the chain register**

- Every item of cargo gear must be of a suitable design and sufficient safe working load (SWL). Every such item of cargo gear has a unique identifying number. An approval certificate, in an approved form, for each item of cargo gear, identified by its unique number shall be provided. These certificates shall be readily available.

- Every item of cargo gear must be maintained well in sound condition and Chain register shall always be kept updated.

- Thorough inspections of the cargo gear must be carried out at the required intervals (annually for most authorities, but three-monthly for Australia). Quadrennial (four yearly) or quintennial (five Yearly) examinations of lifting gear are carried out by competent persons such as surveyors from classification societies and representatives from marine engineering works or dry-docks. Entries shall be made in the chain register regarding such inspections which shall be duly signed by the surveyors. Load testing of derricks/ cranes and permanent attachments shall be conducted by competent person every time when a new derrick/ crane is installed or after a derrick/ crane has been repaired or modified.

**Initial and Periodical Load Test of Lifting Appliances and their Annual Thorough Examination**

(See Regulations 41 and 51)

**A. Initial and Periodical Load Test of Lifting Appliances**

| ...tion and Description of Lifting Appliances ...ed with distinguishing number of marks, if any | No. of certificate of test and Examination of Competent Person | I certify that on the date of which I have appended my signature, the lifting appliance shown in Col. (1) was tested and no defects affecting its safe working condition were found other than those shown Col. (4) (Date & Signature with Seal) | Remarks (To be signed and dated) |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| ...lro-hydraulic Deck Crane ...alled at Fr. Nos 65-69, centre ... upper deck. 30-0T SWL | | | |
| ...lro-hydraulic Deck Crane ...alled at Fr. Nos 104-108, ...line. Upper Deck - 30-0T SWL | YY171805-717880 -017 dated 10-8-2007 | Load testing of all the 4 deck cranes carried out at Balamban, Cebu and the test certificate issued by the Surveyor to ABS classification at Manila. | Details transferred from ... on board. ENGINEERING TESTING SERVICES K.T. PRAKASH ALVA COMPETENT PERSON APPROVED BY: DG, FASLI, GOVT. OF INDIA ALPHA MANGALORE |
| ...lro-hydraulic Deck Crane ...alled at Fr. Nos 143-147, ...line, Upper Deck 30-0T SWL | | | |
| ...lro-hydraulic Deck Crane ...alled at Fr. Nos 182-186 ...line, Upper Deck. 30-0T SWL | | | |

- ➢ The national and local regulations regarding testing of gear and maintaining chain registers are likely to vary from country to country. However a ship shall carefully maintain/ renew, properly mark and document details regarding all lifting gear in accordance with the requirements of the flag state, with which she will have done all that can reasonably be expected across the globe.

- ➢ All lifting gear shall in inspected and maintained in accordance with the vessel's planned maintenance schedule. Annual and four/ five yearly inspection and testing also shall be done in accordance with the PMS. Shipping company may prefer to have both these being carried out by the classification society surveyors.

**4) Annual thorough examination of a lifting appliance**

A thorough examination of a lifting appliance includes

- ❖ Check of the existing certificates for the appliances, the ropes, and the loose gear
- ❖ Check of the survey history of the appliance
- ❖ Any issues which are outstanding from the last examination
- ❖ Check of any recurring problems which will require particular attention in the examination
- ❖ Review of rocking test/grease sampling data, where applicable
- ❖ Inspection of maintenance and service records checking what has been serviced, which components have been replaced and what lubrication has been carried out.
- ❖ Inspection of items in their correct location with reference to general arrangement plans, reeving diagrams, block lists
- ❖ Examination of loose gear, ropes, protection and limitation devices, winches, brakes and drums, built-in sheave units, deck fittings, hydraulic cylinders and pins (ram luffed cranes), derrick booms, bridge structure , supporting crab, jib, mast fittings, long travel trolley saddles, jib heel pins, mast derrick posts, slewing columns and machinery decks, slew bearings and bolts, pedestal and foundations as applicable. Loose gear in this reference means hooks, shackles, swivel, chain, sling, lifting beam, container spreader, tray and any other such gear, by means of which the load can be attached to a lifting appliance and includes lifting device.
- ❖ Examination of safe access associated with the lifting gear
- ❖ Hammer testing of corroded points
- ❖ Non-destructive examination to investigate any cracks

**5) Four/ five yearly examination and testing of lifting gear**

- In addition to above annual procedures five yearly examination involves proof testing of the lifting gear. Measures shall be taken to ensure that the appliance can be controlled during the test and to avoid injury or damage which might occur in the event of failure under load.

- Proof load testing is a legal requirement and is needed for almost all lifting appliances and loose gear. It must be carried out before new equipment is taken into service, at set periods as required by national regulations typically every five years and after structural modification and repair.

- Proof load testing is carried out using test weights or testing machines. However some countries like Australia may not approve use of testing machines.

**6) Annealing**

- Annealing is also known as heat treating of gear whereby the gear is heated to high temperatures followed by gradual cooling. It helps remove the internal stress from the metal, which if untreated may cause cracks or fractures. The annealing of wrought iron gear is accomplished at a temperature between 1100° and 1200°F, with exposure of between 30 and 60 minutes duration. After being annealed, the gear is allowed to cool slowly and shall then be carefully inspected. All annealing is carried out in a closed furnace.

- All chains (other than bridle chains attached to derricks or masts), rings, hooks, shackles and swivels made of wrought iron which are used in hoisting or lowering shall be annealed at following intervals:

  - Half inch and smaller chains, rings, hooks, shackles and swivels in general use at least once every six months
  - All other chains, rings, hooks, shackles and swivels in general use at least once very twelve months
  - In the case of gear used solely on lifting machinery worked by hand, twelve months shall be substituted for six months and two years for twelve months as stated above
  - The period between annealing shall not exceed two years
  - Gear made of steel or gear which contains (as in ball bearing swivels) or is permanently attached to equipments made of materials which cannot be subjected to heat treatment shall be exempt from annealing. Such gear shall be thoroughly examined.

**Apply Your Knowledge**

1. List the contents of the chain register in bullet points.
2. Check the vessel's PMS for annual testing and maintenance of deck cranes/ derricks.

**Function:** Cargo Handling and Stowage

**Competence:** Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

**Task number:** B1.2

**Sub-task Reference number:** B 1.2.7

**Topic:** Cargo gear

**Task Heading**

- Identify and list the precautions to be taken during heavy lift operations with regards to cargo gear.

**Objectives**

- Understand the precautions to be observed during heavy lift operations.

Please read this task in conjunction with task B1.3.9

**Index**

1. Precautions to be taken during heavy lift operations with regards to cargo gear

**Description**

**1) Precautions to be taken during heavy lift operations with regards to cargo gear**

- First and foremost, the lifting appliance shall be fit/ certified/ inspected and appropriate for use.

- If derricks are being used the rigging plan should be studied and complied with.

- The forces or combination of forces to which the equipment will be subjected shall be identified prior lifting.

- The stress on various parts of cranes and derricks varies with the angles of operation. The limit switches shall be checked for proper functioning. The cranes and derricks shall never be operated beyond the cutoff limit angles.

- Any foreseeable failure modes likely to arise in service such as fracture, wear and fatigue, seizure shall be identified. Particular attention should be paid to the stress induced at mountings or fixing points. Other foreseeable failure modes may include exposure to temperature variations or acid or alkaline atmospheres such as some grades of alloy steel, which are susceptible to hydrogen embrittlement.

- It should be carefully checked and ensured that, where lifting equipment is anchored to other work equipment or structures, this equipment or structure will be able to withstand the forces that the lifting equipment and its use will impose on them.

- The lifting points on the load shall be of adequate strength and integrity. The weight of lifting accessories should be taken into account along with the load.

- A competent person should ensure that the strength and stability of the lifting equipment continues to be adequate for the tasks for which the equipment is intended to be used.

- A lift plan and risk assessment for the lifting operation cover the actual tasks to be undertaken shall be completed prior the lifting operation. The steps of the lift plan and individual responsibilities shall be clearly understood by all those affected and/or involved.

- The path the load will take shall be assessed and the set-down area shall be prepared. The tagline/ hold-back requirements shall also be checked and assessed.

- The loose gear such as wire slings, shackles and hooks etc. shall have appropriate certification. The SWL, wear, corrosion, abrasion and/or physical damage to the gear shall be checked. The rigging shall be correctly fitted in accordance with vessel's rigging plan. Fibre slings where used shall not be allowed to come into contact with sharp edges.

- During the heavy lift operation, the load shall not be left suspended on the hooks for prolonged periods. All planning needs to be done earlier and the cargo equipment should be kept under load for minimum time.

**Apply Your Knowledge**

1. List the precautions to be taken during heavy lift operations when using ship's cargo gear.

**Function:** Cargo Handling and Stowage

**Competence:** Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

**Task number:** B1.3

**Sub-task Reference number:** B 1.3.10

**Topic:** Cargo operations

**Task Heading**

➢ Identify the difference between zeal and load line hydrometers. Recognize the use of special hydrometers such as zeal for draft surveys.

**Objectives**

➢ Understand the difference between a load line hydrometer and a draft survey hydrometer.

**Index**



**Description**

**1) Hydrometers**

Hydrometer is equipment used for checking the density of liquids. Two types of hydrometers are commonly used in the maritime industry. Each shall be used only for the purpose it is designed for.

❖ Draught survey hydrometers
❖ Load line hydrometers

**a) Draught survey hydrometers**

❖ Draught survey glass hydrometers are used during draft surveys to determine the apparent weight (that is the weight in air) of the vessel to calculate the commercially accepted weight of the cargo on board. These are usually marked ‘for draught survey’ and ‘medium ST’ (medium surface tension) and are graduated in the range 0.990 / 1.040 kg/l.

❖ These hydrometers are also calibrated for a standard temperature. A small error is introduced if the hydrometer is not at its standard temperature, 15° Celsius (60° F). However for calculation purposes no temperature correction for density is required while using these. Because this error is compensated by the fact that being in the same water, the ship also experiences a proportional change in volume at the ambient temperature. The corrections due to the 'coefficients of cubical expansion' of glass and steel are approximately the same. These hydrometers should NOT be used for load line purposes.

**b) Load line hydrometers**

❖ Load line hydrometers are used to determine the displacement of a vessel at a given waterline. This is to check compliance with the requirements of the international convention on load lines. The loadline convention permits the applicable salt water loadline of the vessel to be submerged by the dock water allowance compensating for the relative density of the water in which the vessel is floating.

❖ The loadline hydrometer measures the relative density of the water in which a ship is floating. During manufacturing, load line hydrometers are graduated for measuring the relative density of a seawater sample at a standard temperature usually 15º (60ºF) against pure water at the same standard temperature. This relative density is measured against density of fresh water at 15°C that is 0.9991t/m$^3$. These hydrometers are usually marked 'RD' or 'Sp.Gr.', together with the standard temperatures.

> Hydrometers need to be calibrated at regular intervals. The calibration is done usually at a shore based unit.

❖ When the temperatures of the sea water have a huge variation from the calibration temperature, the temperature correction must be applied to allow for the expansion of the hydrometer.

**c) Relationship between hydrometers**

❖ The density of water varies with temperature; maximum density of fresh water is 999.972 kg/m$^3$ which occur at a temperature of +4° C. The density of fresh water at 100° C is 958.4 kg/m$^3$.

❖ The displacement and apparent weight of the vessel can be related to each other in the same manner as are the relative and apparent densities of the water the vessel is floating in.

❖ If a load line hydrometer and a draught survey hydrometer are placed in the same water sample the load line hydrometer will read 0.002 higher on its scale. The difference 0.002 is comprises of two corrections
- ✓ The air buoyancy correction that is required to convert apparent density to relative density accounts for 0.001
- ✓ The correction needed to convert density in kg./l to specific gravity amounting for the remaining 0.001.

The .002 difference will be the same over the full range of densities from 0.990 to 1.040 kg./l.

*A sample of seawater checked by a load line hydrometer reading relative density 1.025, a draught survey hydrometer would read an actual density of 1.023 kg/l in air. If a draught survey hydrometer is used to calculate a fresh water allowance when a ship is loading to its marks, the ship is likely to be overload by .002/025 x FWA x TPC tonnes. For a panamax size vessel this would be approximately 180 tonnes.*

**Apply Your Knowledge**

1. List the differences between zeal and load line hydrometer. Can the load line hydrometer be used for the purpose of draft survey calculations?

**Function:** Cargo Handling and Stowage

**Competence:** Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

**Task number:** B1.3

**Sub-task Reference number:** B1.3.11

**Topic:** Cargo operations

**Task Heading**

- Identify the markings on various types of containers and container stowage positions.

**Objectives**

- Understand marking system of containers and stowage locations on ship

**Index**

1. Various types of containers
2. Markings on containers
3. Bay plan of a container vessel
4. Container stowage positions

**Description**

**1) Various types of containers**

| Container Type | Image | Size | |
|---|---|---|---|
| | | Size<br>20' x 8'<br>(Height) | Size<br>40' x 8'<br>(Height) |
| General Purpose Standard Container |  | 8' 6'' | 8'6'' |
| High Cube |  | - | 9'6'' |

| | | | |
|---|---|---|---|
| Reefer Container |  | 8’6’’ | 8’6’’ |
| Reefer High Cube |  | - | 9’6’’ |
| Open Top |  | 8’6’’ | 8’6’’ |
| Flat Rack |  | 8’6’’ | 8’6’’ |
| Bulk Container |  | 8’6’’ | 8’6’’ |
| Tank Container |  | 8’6’’ | 8’6’’ |
| Platform |  | - | - |

| | | | |
|---|---|---|---|
| Half-height open-top container |  | 4' 3" | - |

**2) Markings on containers**

➢ **Container number**

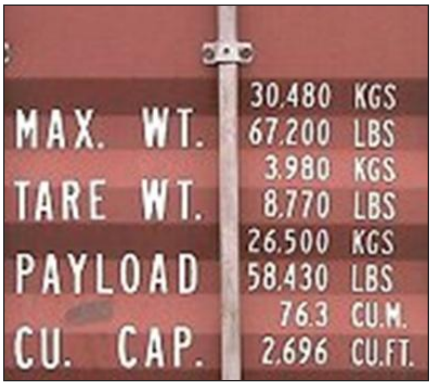
Each container has a unique identification code called the container number. It is a combination of four alphabets followed by seven numeric digits. Container number is the main identification number used in all documentation including B/L for registering and tracking the shipment. The container number is marked on the outer four sides, top surface and inner side walls. The characters are at least 100 mm in height.

- ❖ The first three alphabets indicate the owner or operator of the container. Such code needs to be registered at the 'Bureau International des Conteneurs' in Paris to ensure uniqueness worldwide.

- ❖ The next alphabet is the equipment category identifier. The equipment category identifier could be one of the following:
  U - for all freight containers
  J - for detachable freight container-related equipment
  Z - for trailers and chassis

- ❖ A serial number of 6 Arabic numerals

- ❖ A seventh digit is the check digit providing a means of validating the recording and/or transmission accuracy of the data. A check digit shall validate owner code, equipment category identifier and the serial number of the container. The software to calculate/ check the check digit is provided on the BIS website.




- **Container size and type code**

  This code comprises of three main parts:
  - 1st character, represents the container length
  - 2nd character, represents the container's width and height
  - 3rd and 4th characters indicate the container type

- **Weight and capacity markings**
  These characters are at least 50mm high.

  - **Maximum weight/ gross weight** – It is the maximum weight that the container can have when fully loaded safe and fit for handling and sea carriage.

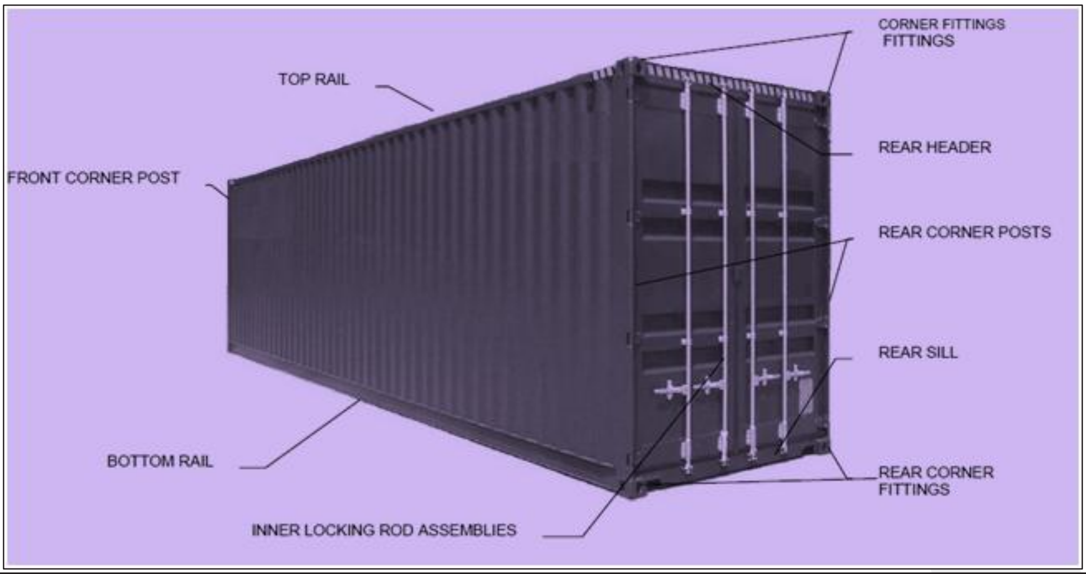
  - **Tare weight** – It is the weight of the empty container.

  - **Net weight/ maximum cargo weight/ payload** – It is the maximum weight of cargo that can be loaded in the container, upto which the container, when loaded, will be safe and fit for handling and sea carriage. It includes the weight of dunnage and cargo securing arrangements that are not associated with the container in its normal operating condition.

  - **Cubic capacity** – The volumetric capacity of the container in cubic metres and cubic feet


- **CSC safety approval plate**

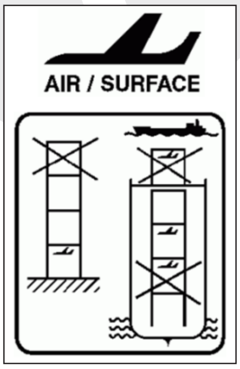
  - CSC safety approval plates are a part of Approved Continuous Examination Program (ACEP). The containers are constructed and maintained in accordance with ISO and CSC (Convention on Safe Containers). Containers used in sea transport are required to be fit for carriage through sea. A CSC safety approval plate is attached to a container only when it is checked for its fitness in accordance with the applicable regulations. The next inspection date is marked on the CSC plate. The owner of the container is responsible for maintaining it in safe condition. Containers with serious structural deficiencies to structurally sensitive components are also deemed to place a person in danger. In between the due dates the container is usually checked for the valid CSC plate unless there are reasons for detailed inspection. Control officers are appointed at various ports who, when spot a container that is in a condition that creates an obvious risk to safety, are authorized to stop the container until it can be ensured that it is in a safe condition to continue in service. However the safety approval plate can be withdrawn only by the country which issued it.




All containers with serious structural deficiencies in structurally sensitive components are considered to be in a condition that creates an obvious risk to safety. The structurally sensitive components of a container that are examined for serious deficiencies are the

| | |
|---|---|
| Top rail | Bottom rail |
| Header | Sill |
| Corner posts | Corner and intermediate fittings |
| Understructure | Locking rods |

- **Additional markings on the containers**




- **Air surface container symbol**
  To indicate that the containers have limited stackability, the symbols should be affixed where possible in the upper left-hand corner of the end and side walls and the roof. The symbol is in black. If the color of the container makes it difficult to see the symbol clearly, it should be applied to a different background of a more suitable color, preferably white. Dimensions of the symbol are aircraft 130 mm, stackability symbols 280 mm high and 260 mm high. The alphabets should be at least 80 mm high.

- **Warning sign of overhead electrical danger**
  All containers equipped with ladders must be provided with a warning symbol, which indicates the danger posed by overhead power cables. The height of the lightning in the warning symbol must be at least 175 mm. The size of the warning symbol, measured between the outer edges of the black border, must be no less than 230 mm. The symbol must be affixed in the vicinity of the ladder.

- **Height marks for containers higher than 8'6"**
  All containers higher than 2.6 m (8'6") shall have the following compulsory markings:
  - ✓ a height marking on each side; the height

marking must be at least 155 mm high and 115 mm wide

- ✓ yellow and black stripes, visible at the top and side, which must be affixed in the upper part of each side and end. These must start at the corner castings and extend at least 300 mm.

❖ **IMDG cargo marks**

The containers carrying dangerous cargoes mentioned in IMDG code shall carry suitable placards for the respective dangerous goods class. This becomes utmost important for the reasons of safety. Containers carrying IMDG cargo without having suitable markings/ placards on the container are likely to result in heavy fines from the port customs.

Placards minimum size 250 mm x 250 mm should be affixed to the exterior surfaces of the container to provide a warning that the contents of the unit are dangerous cargoes and present risks. These shall be so affixed as to be visible clearly.

➢ **Safety warnings and markings**



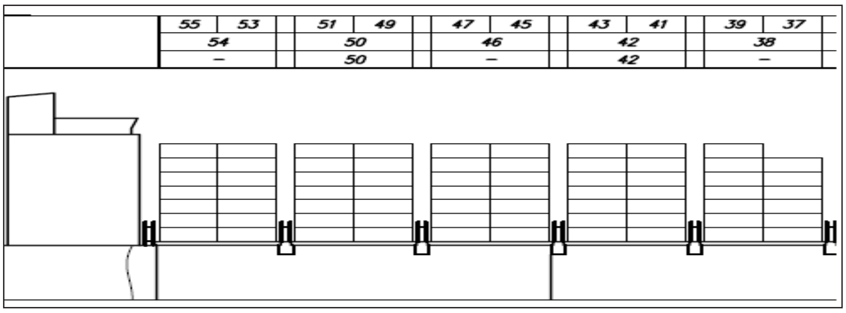


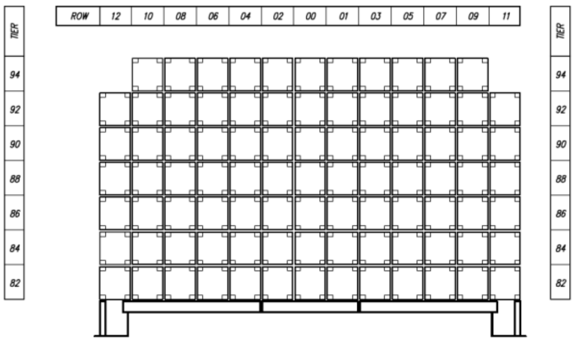

**3) Bay plan of a container vessel**

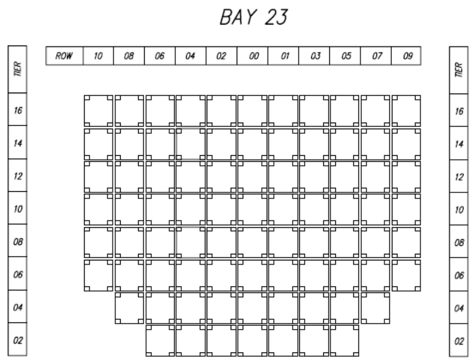
➢ On cellular container vessels the stowage locations for containers are defined in the form of a bay plan. Bays are numbered from forward to aft with odd numbers 01, 03, 05 and so on. Even numbers as 02, 04, 06 and so on are used to indicate 40 feet container slots.

- Athwartships each bay is numbered starting from centerline, the centre row being '00', odd numbers as 01, 03, 05 and so on, to starboard and 02, 04, 06 and so on to port.

- Tiers are numbered from hold bottom to top as 02, 04, 06 and so on. On the deck and hatch cover these are numbered as 82, 84, 86 and so on.




## 4) Container stowage positions

- Containers are stowed in dedicated slots in the cargo holds and hatch covers. Cellular container vessels have holds divided into dedicated bays for container stowage. These bays are fitted with cell guides to provide container securing. On deck and on hatch covers these ships sometimes have lashing bridges.

- The container bays numbers are marked in the respective bays in bold letters, so that the gantry operator and the stevedore personnel can easily identify the stow locations for containers. Maximum safe working load may sometimes be marked on the hatch covers.


- The protruding on deck/ hatch covers such as container shoes are painted with bright colours to get highlighted in order to be prominently visible to the workers working in the area in the area.

**Apply Your Knowledge**

1. Check the bay plan of your vessel if applicable and identify the bays where 45' containers can be loaded.
2. Check how many high cube containers can be loaded in each bay in hold under deck without slot loss.

**Competence:** Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

**Task number:** B1.3

**Sub-task Reference number:** B1.3.12, B1.3.13

**Topic:** Cargo operations

**Task Heading**

- Assist connection of refrigerated containers to ship's support system upon loading and ensure compliance with manifest requirements.
- Make a record of daily readings of the parameters of refrigerated containers on board.

**Objectives**

- Understand procedures related to carriage stowage and care of reefer containers

**Index**

1. Reefer containers
2. Reefer manifest
3. Reefer temperature log
4. Reefer repair kit

**Description**

**1) Reefer containers**

- Reefer containers are available in standard 20 feet or 40 feet high cube sizes. Reefer containers are capable of maintaining the temperature of frozen, chilled or warm cargo. These have in built refrigeration onto the end of the container for which the power is provided by the ship when laden on board.

- Air at the desired temperature is supplied to the inside of a container through an air duct system running through the container from the bottom. Air circulates through the load before it returns to the refrigeration unit. This circulation process is continuous while the unit is in operation. Advanced reefer containers have computerized systems which enable highly precise temperature control.

- In addition the units are provided with adjustable ventilation holes near the refrigeration unit. These vents allow fresh air exchanges to avoid a build up of carbon dioxide inside the container which is required by all fresh fruits and vegetables to avoid spoilage.

**2) Reefer manifest**

- A reefer container showing any visual signs of damage shall NEVER be loaded. Reefer damage claims are one amongst the heaviest claims in container shipping.

> Failure to plug in a reefer unit is likely to cause cargo damage which results in huge losses against the vessel.

- For all the reefer containers planned to be loaded on board, the vessel planner from container operator discusses the stowage plan with the master. Once the vessel berths a detailed reefer manifest is submitted by the agents. The reefer manifest mentions the name of vessel, voyage number container number, the B/L number, load port, discharge port, date of stuffing/change, the commodity in general, the temperature range settings for the unit and humidity controls percentage.

- After the refrigerated container is loaded to the vessel, the ship electrician or shore representative plugs in the refrigerated containers to vessel power as they are stowed onboard ship. As soon as the refrigerated container is plugged in, the supply and return air temperatures and any alarms shall be checked and the same recorded in the reefer log book. All set point temperatures and fresh air exchange (vent settings) should be checked against those listed on the refrigerated cargo manifest. Incorrect settings should be corrected as appropriate and recorded.

**REEFER MANIFEST**

M.V.: VOY.NO.: DATE:

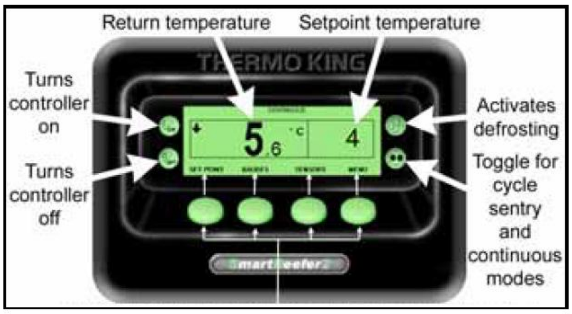
LOADING PORT:

| Container No. | Equipment Type | | | Commodity | Shipper | Cnee | Stowage Position | Temperature | Ventilation | Gross Weight | Place of Delivery | Remark (B/L No.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20' | 40' | Other | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

Prepared By: Signature:_______________

### 3) Reefer temperature log

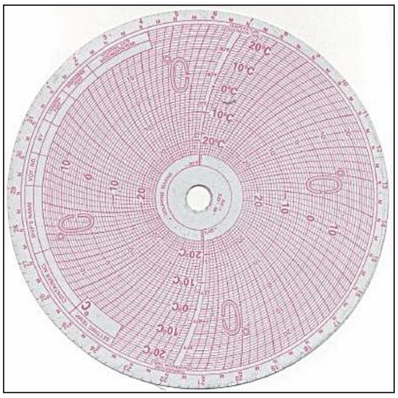
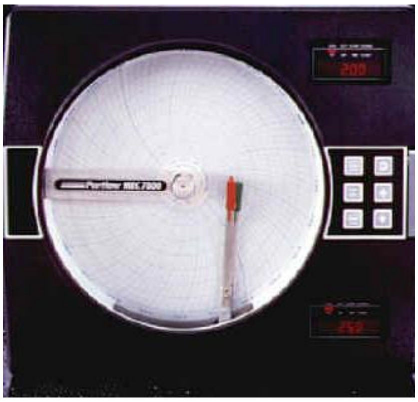
- During sea passage, the reefer container temperatures and vent settings should be monitored and recorded usually every 8 hours. Any reefer unit found not working should be reported to the Chief Officer. Partlow charts and/or the microprocessor printouts may be available with the reefer unit to provide a continuous temperature record of the unit.




- In addition to temperature and vent settings the reefer shall be checked for coolant levels, any leakages or if the unit has tripped. Manual defrosting may sometimes be required. The reefer plug shall be checked to be securely plugged in. Any alarms shall be checked with reference to operator's manual.

- While any such malfunction shall be immediately reported to the charterers/ container operator, efforts shall be made to repair the fault on board till shore based assistance is not available. If the reefer container cannot be repaired onboard the vessel, it should be offloaded at the nearest port for repairs to determine if there has been damage to the cargo.

Partlow chart – named after the manufacturer, is installed on some reefer units to automatically record the reefer temperature. The unit has a paper chart, marker pens and temperature sensors which continually sense the reefer temperature and provide input to marker pens which plot a trace against the time scale.

**4) Reefer repair kit**

- Usually a reefer repair kit is provided on board by the charterers for attending to minor repairs of the reefers carried on board. The kit shall be checked when received for all the items in the inventory. Along with the kit, different reefer manuals for all the various types and manufacturers of reefer containers laden onboard the vessel shall be provided for quick reference. Used up spare parts of the kit shall be replenished as required.

**Apply Your Knowledge**

1. If applicable check the temperature recording system of reefer containers on board your vessel.

**Function:** Cargo Handling and Stowage

**Competence:** Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

**Task number:** B1.4

**Sub-task Reference number:** B1.4.1, B1.4.2, B1.4.3, B1.4.4, B1.4.5

**Topic:** Securing of cargoes

**Task Heading**

- Locate the Cargo Securing Manual on board if applicable and discuss the lashing requirements with a senior officer.
- Assist in securing cargo stowed on deck and below deck.
- Assist in securing containers and the checking of container lashings and fittings, if applicable.
- Assist in checking the lashings on break-bulk cargo stowed on open flats, if applicable.
- Maintain records of checking cargo securing arrangement after rounds.

**Objectives**

- Understand the principles of stowage and securing cargoes on board with reference to ship's cargo securing manual.

**Index**

1. Cargo Securing Manual
2. General principles of cargo securing
3. General considerations regarding lashing gear
4. Securing cargo stowed below deck
5. Securing cargo stowed on deck
6. Stowage and securing of containers
7. Out of Gauge (OOG) units, project cargoes and yachts
8. Stowage and securing of vehicles and wheel based cargoes
9. Checking cargo lashings and record keeping

**Description**

**1) Cargo Securing Manual**

SOLAS Chapter VI and VII require the vessels to be provided with a ship specific "Cargo Securing Manual" (CSM). All cargoes, other than solid and liquid bulk cargoes, cargo units and cargo transport units shall be loaded, stowed and secured throughout the voyage in accordance with the cargo securing manual approved by the administration. The contents of CSM are usually as follows:

- **Part I - General**
  - Ship Data
  - Definitions
  - General Information
  - Principal sources of danger

- **Part II - Securing devices and arrangements**
  - Specification of fixed cargo securing devices
  - Specification of portable cargo securing devices
  - Inspection and maintenance schemes

- **Stowage and securing of cargo**
  - ❖ Handling and safety instructions
  - ✓ General principles of cargo securing
  - ✓ Safe handling of cargo securing devices
  - ✓ Evaluation of forces acting on cargo units
  - ✓ Forces acting on typical cargo units
  - ✓ Procedures for calculation of forces in semi- standardized and non-standardized lashing arrangements
    - Maximum securing load (MSL)s for different securing devices
    - Safety factor
    - Simplified method – rule of thumb
    - Assumptions of external forces
    - Balance of forces – advanced method and alternative method
    - Calculated example 1 and 2
  - ❖ Application of portable securing devices

- **Requirements for vessel specific type**
  - ❖ RO-RO Vessels
  - ✓ Longitudinal and transverse distances between fixed Cargo Securing Devices
  - ✓ Cargo securing arrangements for RO-RO ships exposed to angle of heel after damage or flooding or other considerations relevant to the effectiveness of the cargo securing arrangement
  - ✓ Number of lashings and lashings angles
  - ❖ Container Carriers
  - ✓ Handling and Safety Instructions
  - ✓ Stowage and Securing Instructions
    - Stowage and securing principle on deck and under deck
    - Stowage and Securing Plan
  - ❖ Other allowable stowage patterns
  - ❖ Bulk Carriers
  - ❖ Timber Deck Cargoes

- **Appendix**
  - ❖ Appendix I – Assessment of MSL for uncertified cargo securing devices
  - ❖ Appendix II – Log for maintenance of cargo securing equipment
  - ❖ Appendix III – Extracts from the IMO Assembly Resolution A.533(13) – stowage and securing of cargo units and vehicles on ship
  - ❖ Appendix IV – Extracts from various timber deck codes
  - ❖ Appendix V – Annex 1-12 to the code of safe practice for cargo stowage and securing (CSS Code) as applicable
  - ❖ Appendix VI – User guide for lashing program provided on board

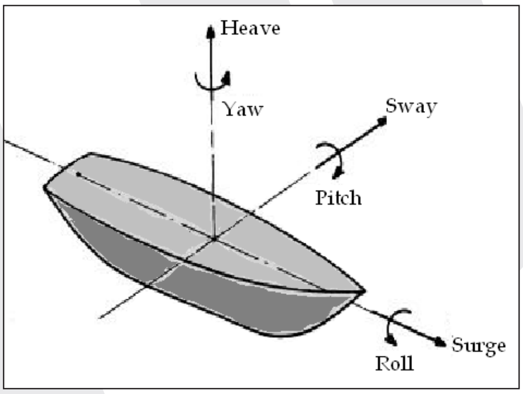
## 2) General principles of cargo securing

> The purpose of lashing cargo is to restrict the movement of the cargo unit mainly in two dimensions, longitudinal and athwartship, which cause sliding or tipping. Any movement of cargo units in seaway is likely to cause damage to cargo, damage to the ship and dangers to the crew. Cargo lost overboard will be posing dangers to the environment. Hence the securing arrangements shall be adequate to ensure that there will be NO movement of the cargo at all. Lashings are likely to get slackened during sea motions rendering them ineffective. Lashings require careful tightening prior departure, and checking/ tightening during sea passage (weather permitting).

- Force exerted is a direct product of the acceleration experienced by it. Factors affecting the acceleration forces experienced by the cargo units depend on the ship size, GM of ship and the stowage location of cargo unit. Tables /diagrams giving a broad outline of the accelerations which can be expected in various positions on board the ship in adverse sea conditions and with a range of applicable metacentric height (GM) values are provided in the CSM. Ships are provided with software which facilitates easy assessment of lashing forces on cargo units.

- Cargo stowage and lashing requirement shall be planned considering the vessel's stability, structural strength, nature of cargo, centre of gravity of the cargo unit and the expected voyage conditions. Prior loading, the stowage and lashing plan shall be discussed with the cargo supervisor and the lashing gangs. The lashing operation shall be carefully monitored. Personnel engaged in lashing operation and checking lashings should be properly qualified and experienced and should have a sound practical knowledge of procedures.

- Movement of cargo units on deck surface would depend on the acceleration forces and the frictional forces countering these. Cargoes with low friction coefficient or with less contact surface are more likely to shift. Cargoes shall be stowed tightly to avoid sliding and stowed on materials such as soft boards or dunnage to increase friction. Dunnage further helps distribute the weight across a wide area. Relevant deck areas shall to be clean, dry and free from oil and grease.




- Miscellaneous sea motions cause different accelerations in the cargo units stowed on board. Cargo shall be secured taking into account all the dynamic forces that are likely to be experienced during sea transport considering the most severe weather condition expected.

- In considering the number and strength of the securing points and items of cargo securing gear to be used, the following elements should be taken into account:
  - duration of the voyage
  - geographical area of the voyage
  - sea conditions which may be expected
  - size, design and characteristics of the ship
  - dynamic forces under adverse weather conditions
  - types of cargo units to be carried
  - intended stowage pattern of the cargo units
  - weight of cargo units

- Lashings in general shall be kept as short as possible and the securing gear should be adapted to the cargo to be carried. Care should be taken to distribute the forces as evenly as possible, keeping the acceleration forces to a minimum. Acceptable calculation methods shall be used to cross check on the lashings effectiveness.

A vessel shall sail out only when the cargo is well secured. To avoid undue delays in sailing the lashing process shall be coordinated with loading/ discharging operations.

- Lashings shall be attached only to the lashing points on the cargo and on the ship's hull designed especially for this purpose. All fixed securing devices and portable lashing gear is provided with the certificate showing Maximum Securing Load (MSL) which shall be carefully checked before the gear is put to use. Locations and details of fixed securing fittings are provided in the ship's securing plan.

Stowage and securing of IMDG Cargoes is permitted ONLY in accordance with IMDG Document of Compliance of the vessel and IMDG code.

- Suitable securing equipments of adequate strength should be available in sufficient quantity for the purpose of lashing including sufficient reserves. The methods of evaluating required strength are provided in the CSM. Same are calculated on the basis of lashing forces. CSM also provides procedures for inspection, maintenance and discarding of lashing gear.

- Safe means of access to cargo spaces shall be ensured clear for the purpose of checking and tightening lashing of cargo during sea passages. Cargo stowage shall be planned without obstructing the operating controls of stern doors, entrances to accommodation and LSA/FFA. This becomes particularly important while carrying deck cargoes.

- All cargoes should be stowed and secured in such a way that the ship and persons onboard are not put to risk. The cargo securing devices on board shall be handled safely considering all required personal safety precautions.

> Cargo lashing shall not be used for lifting purposes. Principles of good seamanship shall always be followed for securing cargoes.

- The normal practice of utilizing timber dunnage and of keeping downward leading lashings short and tight should be followed. A near vertical lashing is of great benefit in resisting the cargo item's tendency to tip; a near horizontal lashing will greatly resist sliding forces.

- Where practicable, cargo units should be provided with a cargo stowage and securing declaration, stating that the cargo has been properly stowed and secured, taking into account the IMO/ILO guidelines for packing cargo in freight containers or vehicles. In general, cargo carried in containers, road vehicles, ship borne barges, railway wagons and other transport units should be properly packed and secured within these units. Relevant expertise should be called for, if found necessary, when considering the shipment of a cargo with unusual characteristics, i.e. cargo which may require special attention to location, stowage/securing and weather conditions.
  - Different commodities should be compatible with each other or suitable separated
  - Cargo must be suitable for the ship and vice versa

- If the duty officer considers that a cargo is not safely secured to a cargo unit, measures should be taken to avoid shifting of the cargo. If adequate measures are not possible, due to the nature of the cargo or lack of securing points, the cargo unit should not be taken on board.

**3) General considerations regarding lashing gear**

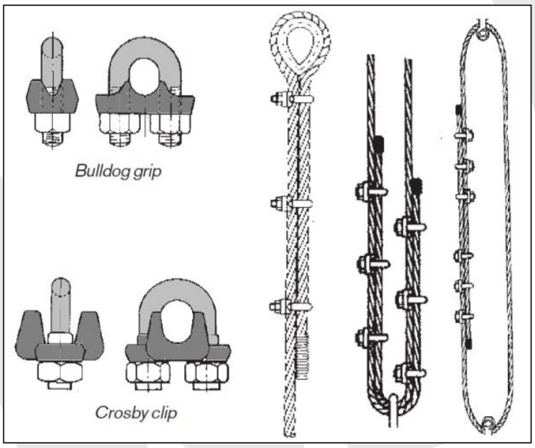
- A turnbuckle shall be used with the tension force acting in one straight line. It shall never be allowed to become the fulcrum of angled forces. The screws on turn buckles shall have adequate extension after securing to facilitate further tightening of lashings during voyage. The eyes of the turnbuckle should be seized/ stopped against its own body to prevent the screws working back under load.

- Lashing chains' maximum securing load will depend very much on material quality used in the lashing chain. These shall be maintained well and prior to use checked for signs of rust and corrosion. The advantage of using chains is that these do not stretch. These are widely used in the securing of freight containers, timber cargoes and vehicle trailers. However, being awkward to handle, tiresome to rig and difficult to cut to length, these are not preferred in other applications.

- Maximum securing load (MSL) is defined in the CSS Code as the load capacity for a device used to secure cargo. The required number and MSL of lashings may be calculated according to annex 13 to the code of safe practice for cargo stowage and securing (CSS Code). The lashing material should be made of material having suitable elongation characteristics.

- When using lashing wires and clips for the purpose of lashing, following points shall be considered. Ends of cut off lengths of wire rope must be suitably whipped. Wire clips/ bull dog grips shall match the diameter of the wire rope. At least four grips shall be used to make an eye on a wire rope of diameter 19 mm or more. For wires of less than 19mm diameter, three clips shall suffice. The U-bolt of the wire clips should preferably be applied to the dead end of the wire rope. The distance between two consecutive clips shall not be more than six times the wire diameter. The nuts of the grip shall be tightened until the dead end of the wire rope is visibly dented. Wire lashings shall be kept clear of sharp corners/ edges to avoid chafing. The most common of general purpose wires is16mm diameter of 6x12construction galvanized round strand with 7 fibre cores having a certificated minimum breaking load of 7.74 tonnes force.

A spanner or bar must never be used to tighten a hand tension ratchet of webbing lashing, as recoil could seriously injure the user. Webbing should be kept away from acid, alkalis, corrosive materials or chemicals.




| Material | MSL |
|---|---|
| Shackles, deckeyes, twistlocks, lashing rods, D-rings, stackers, bridge fittings, turnbuckles of mild steel | 50% of breaking strength |
| Fibre rope | 33% of breaking strength |
| Wire rope (single use) | 80% of breaking strength |
| Wire rope (re-useable) | 30% of breaking strength |
| Steel band (single use) | 70% of breaking strength |
| Chains | 50% of breaking strength |
| Web lashings | 50% of breaking strength |
| The MSL of timber should be taken as 0.3 kN/cm² normal to the grain. | |

- Plastic (PVC) coated wires (18mm diameter and 6x24 construction) are commonly used for purposes where there is a need to avoid the risk of cutting or chafing by bare wire rope. Slippage is likely to occur at much reduced loads in such ropes. The plastic coating needs to be stripped from the wire where the bulldog grips are to be applied.

- Web lashings made of synthetic fibres are also used onboard ships for securing of cargo. In general these are manufactured from impregnated woven polyester fibre and therefore stretch more than wire ropes. Web lashings should be used and handled with great care.

Pre-tensioned more elastic web lashings shall preferably be used. Relatively broad flat surfaces and reduced cutting nature allow the web lashings to be turned around and tightened against the pipes with short spans, producing a most acceptable stowage. Tension on a hand ratchet can be obtained easily up to 0.54 tonnes and then with increasing difficulty up to a maximum of 0.60 tonnes. It shall be noted that maximum securing load of web lashings decreases considerably if the synthetic fibre strap is ripped.


- Fibre ropes of up to 24mm in diameter are likely to be used for lashing light cargoes stowed below decks. Difficulty is likely to be encountered in maintaining the tautness of the fibre rope lashings when these are subjected to load stresses. A sisal rope of 24mm diameter has a breaking strain of 7.5 tonnes, and a polyester rope 9 tonnes. Composite rope (diameter 10mm) often referred to as 'lashing rope' is made up of wire fibres and sisal or polypropylene fibres which are interwoven thus adding to the flexibility of sisal and polypropylene some of the strength of steel. The breaking strain of composite ropes is about 0.8 tonnes for sisal based and 1.8 tonnes for polypropylene based ropes. nylon rope are not recommended for deck cargo securing purposes as these are likely to absorb moisture and suffering reduction in strength.

- **Rule-of-thumb and advanced methods**

  Annex 13 of the CSS Code gives the two methods of accessing the efficiency of securing arrangements of non-standardized cargo (not container lashings). Either of the two methods the rule-of-thumb method or the advanced calculation method may be used to establish whether or not the chosen system of lashings is sufficient to prevent the piece of cargo moving during an ocean voyage, provided severely adverse weather conditions are not encountered and provided the ship is navigated in a proper and seamanlike manner.

❖ **Rule of thumb method**

- ✓ The total of the MSL values of the securing devices on each side of the unit of the cargo (port as well as starboard) should be equal to the weight of the unit.
- ✓ Basic requirements for rule-of-thumb method
- There must be a balanced number of lashings on each side of the unit, that number depending upon the size, shape and weight of the unit
- Some of the lashings should have a fore-and-aft component as well as an athwartships component.
- Lashings that are led directly forward or directly aft, and therefore have no athwartships component, should not be included in the assessment calculations.
- Lashings that lead down from the unit at an angle of more than 60° to the horizontal should not be included in the assessment calculations. Such lashings prevent tipping but not sliding.
- All lashings should be made up in the same way, compromising the same components, so that they have the same elasticity.

✓ 40:40:10:10 rule for lashing directions
A tried –and-tested formula is to have 40% of the lashing's strength to port and 40% to starboard, with 10% leading forward and 10% leading aft.

**4) Securing cargo stowed below deck**

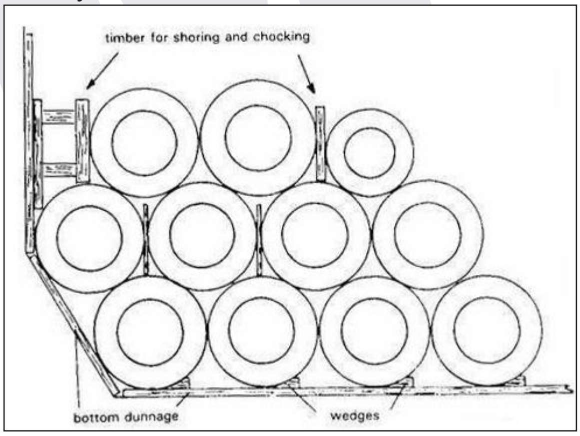
- When stowing cargo under deck, the best way to achieve a secure stow is by stowing the units compactly.

- The lashings are in general most effective on a cargo unit when they make an angle with the deck of between 30° and 60°. Additional lashings may be required, when these optimum angles cannot be achieved. Cargo units with high position of the centre of gravity are prone to tipping. These shall be loaded where the moments are restricted. Transverse lashing angles to the deck should not be greater than 60°. Additional lashings at angles of greater than 60° may be required to prevent tipping.

- Stowage and securing of steel coils

  - Coils of sheet steel are given bottom stow and in regular tiers from side to side of the ship with their axes in the fore and aft direction. Dunnage with engraved concave is laid under each coil. Wedges are used alternatively to chock the coil athwartship movement. When loaded on a second tier over the first, then the coils should be stowed in between the coils of the first tier. A locking coil is placed in middle on the final tier. The last coil next to the ship side on either side is provided with shoring with the ship side frames.

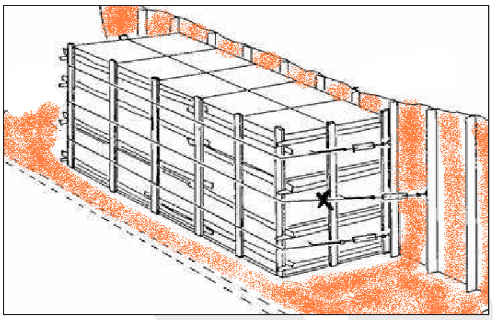
  - The coils are lashed using metallic strips in order to form one large, immovable block of coils in the hold by lashing them together. Generally the coils in three end rows in the top tier should be lashed. To prevent fore and aft shifting in the top tier of bare-wound coils group-lashing should not be applied due to their fragile nature; the end row of a top tier should be secured by dunnage and wires, which are to be tightened from side to side, and by additional wires to the bulkhead.




- Heavy metal products include metal bars, pipes, rods, plates, wire coils etc. These cargoes shall be loaded without exceeding permitted load density and hull stresses. These are stowed compactly from one side of the ship to the other leaving no voids between them. Cargo should be stowed level and the surface of the cargo should be secured. The shoring should be made of strong, non-splintering wood and adequately sized considering the acceleration forces. One shoring should be applied to every frame of the ship but at intervals of not less than 1 m. The friction should be increased by using sufficient dry dunnage between the different layers. Pipes, rails, rolled sections, billets, etc., are stowed in the fore and-aft direction to avoid damage to the sides of the ship in cases of cargo shifts. Wire coils should be stowed flat and tightly so that each coil rests against an adjacent coil.

- Stowing and securing of Unitized and Palletized cargo



Some cargoes are shipped in unitized or palletized form whereby the cargo is placed or stacked on a pallet and secured by strapping, shrink-wrapping or other suitable means. Protective outer packaging such as a pallet box may sometimes be provided with these. Specific pallets may be provided permanently secured together in a sling. Such cargoes are loaded on decks and tank tops which are flush all over. In order to avoid wastage of cargo space, spaces of box shape shall preferably be used for stowing such cargo. The pallets should be stowed without any void space between the loads and the ship's sides to prevent the unit loads from racking. Before stowing units on more than one tier, the strength of the pallet and the commodity pack shall be checked. When stowing the pallets against a bulkhead from side to side, gratings or plywood sheets should be positioned vertically against the stack of the unit loads. Wire lashings should be fitted from side to side keeping the gratings or plywood sheets tight against stow. Additionally, lashing wires can be fitted at different spacing from the bulkhead over stow to the horizontally placed wire lashings in order to further tighten stow. The corners of the pallets and exposed faces shall be protected using plywood sheets.

- Stowage and securing of wood logs under deck

Prior to loading the cubical capacity of the cargo hold and the approximate size of the logs shall be checked in order to plan the stowage utilizing the cargo space in the best way. Logs should generally be stowed compactly in a fore-and-aft direction, with the longer lengths towards the forward and aft areas of the space. Any remaining void forward or aft of the cargo hold shall be filled up with athwartship stow. Extreme pyramiding of logs should be avoided to the greatest extent possible. Compact stow as much as possible shall in general provide for the maximum lashing needs. Unless completely filled the surface of cargo shall be lashed using wire ropes or chains running from side to side.

## 5) Securing cargo stowed on deck

Cargoes commonly carried on deck are containers, timber, yachts and project cargoes. The reason for these cargoes being carried on deck is better utilization of ship's deadweight capacity and available space, being well within the safety parameters for carriage.

- **Timber deck cargo**

  - Carriage of timber on deck offers an added advantage to the timber carrier ships. Timber carriers are constructed with special requirements in accordance with “code of safe practices for ships carrying timber deck cargoes”. These ships when loaded with timber on deck and when the timber on deck is secured in the required manner in accordance with the approved lashing plan for the vessel, are permitted to load cargo to increased drafts called the timber load lines. The Load line convention also mentions the requirements for use of timber load lines.

  - The variable factors with reference to above are the stability of ship and stowage and securing of the timber cargo in the required manner. Fulfilling these criteria, ships can enjoy deeper drafts. The stowage and lashing requirements for timber deck cargoes are as follows.

  - Prior loading timber cargo on weather deck, hatch covers and other openings to spaces below that area should be securely closed and battened down. The air pipes and ventilators shall be suitably protected from deck cargo. The deck shall be free from any accumulations of ice and snow. All deck lashing gear and upright shall be in sound condition ready for use. The access to crew quarters, pilot boarding access, machinery spaces, safety equipments, remote valves, sounding pipes and all other areas regularly used in the necessary working of the ship shall be kept free. Guard rails or life lines spaced not more than 330 mm apart vertically shall be provided on each side of the deck cargo to a height of at least 1 metre above the cargo.

  - The height of the timber deck cargo above the weather deck on a ship within a seasonal winter zone in winter should not exceed one third of the extreme breadth of the ship. The height of timber on deck shall not obstruct the navigation bridge visibility as per IMO visibility criteria. The cargo shall not project overhanging shoulders to head seas. And the deck load density of deck and hatch covers shall not be exceeded in any case.

  - The timber deck cargo should be stowed so as to extend over the entire available length of the well or wells between superstructures and as close as practicable to end bulkheads, and athwartships as close as possible to the ship's sides, after making due allowance for obstructions such as guardrails, bulwark stays, uprights, pilot boarding access, etc., provided any area of broken stowage thus created at the side of the ship does not exceed a mean of 4% of the breadth and to at least the standard height of a superstructure other than a raised quarterdeck. The cargo stow shall be compact.


- Lashing used for timber deck cargo shall be adequate for the intended purpose and be shackled to eye plates efficiently attached to the deck stringer plate or other strengthened points as per the ship's lashing plan. Lashings shall be so spaced that each log has at least two lashing running on it.

- All lashings and components used for securing are required to have a breaking strength of not less than 133 kN. These shall not show an elongation of more than 5% after stressing at 80% of their breaking strength. Also these shall not show any permanent deformation after having been subjected to a proof load of not less than 40% of their original breaking strength.

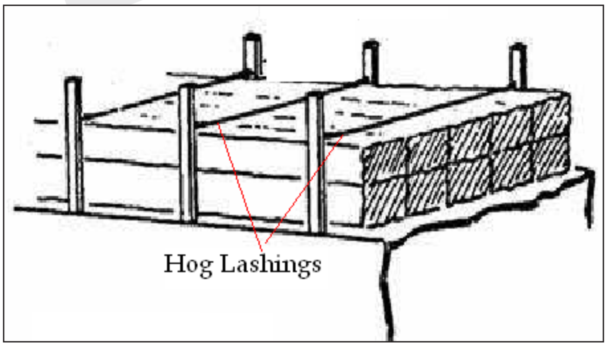
- After tightening each lashing shall have a load of 27 kN in the horizontal part and 16 kN in the vertical part. Having secured initially the bottle screws in the lashing shall be left with at least half threads for further tightening during voyage.

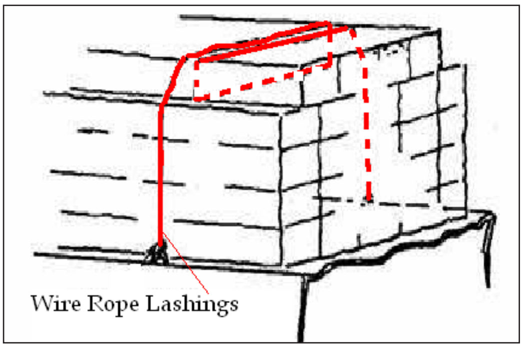
- When required by the nature, height or character of the timber deck cargo, uprights where fitted, they should be made of steel or other suitable material of adequate strength, taking into account the breadth of the deck cargo. These are fixed to deck by angles, metal sockets or equally efficient means spaced at intervals not exceeding 3 m.

- On loose or packaged sawn timber, the spacing between lashings shall be 3m for stow height of 4 m and below and 1.5m for a stow height of above 4m. The packages stowed at the upper outboard edge of stow should be secured by at least two lashings each. Rounded angle pieces of suitable material and design should be used along the upper outboard edge of stow to bear the stress and permit free reeving of the lashings.

- On the timber deck cargo stowed over the hatches and higher, additionally a system of athwartship lashings (hog lashings) joining each port and starboard pair of uprights near the top of stow shall be provided. Hog lashings are normally used over the second and third tiers and may be set "hand tight" between stanchions. A lashing system to tighten the stow is provided whereby a dual continuous wire rope (wiggle wire) is passed from side to side over the cargo and held continuously through a series of snatch blocks or other suitable device, held in place by foot wires. Wiggle wires are fitted in the manner of a shoelace to tighten stow. Wire rope lashings are used in addition to chain lashings. Chain lashings which are passed over the top of stow and secured to substantial pad eyes or other securing points at the outboard extremities of the cargo.

- All lashing and components used for the securing of the timber deck cargo should be tested, marked and certified according to national regulations and the respective certificates shall be maintained on board. A further visual examination of lashings and components should be made at intervals not exceeding 12 months.

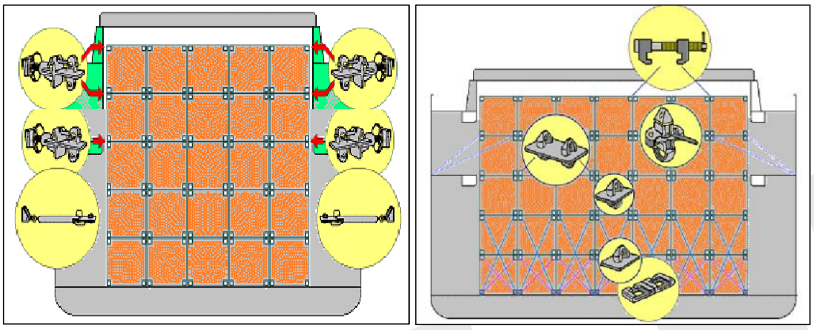


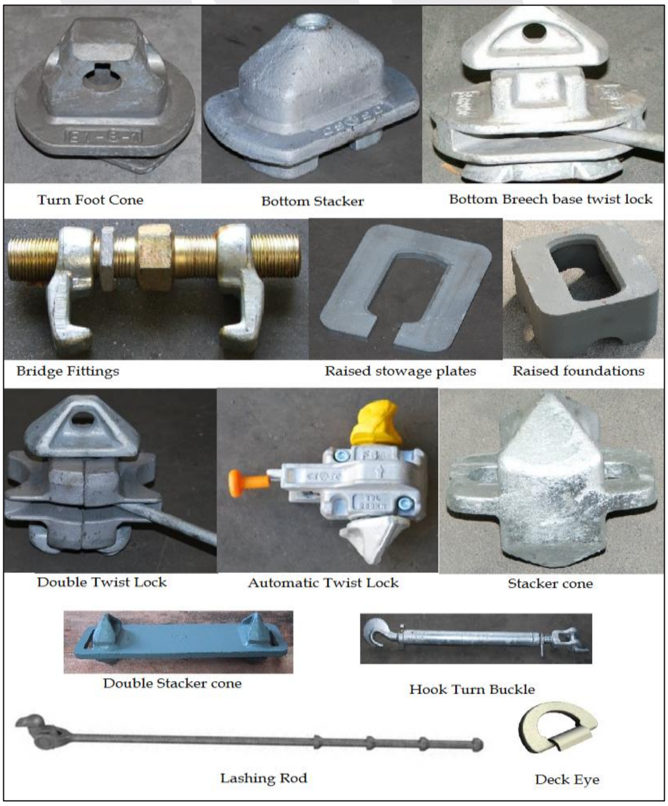

**6) Stowage and securing of containers**

- Containers are carried both under deck and above deck generally stowed lengthwise in the fore and aft direction. Cellular container ships are designed to carry containers and are provided with fittings under and above deck for proper stowage and securing.

- Under deck stowage of containers on container ships:
  These ships' cargo holds are provided with cell guides which are closely spaced facilitating stowage of containers compactly. The cell guides are usually provided with 40 feet length slots for accommodating 40' containers. These containers are loaded without any extra lashing, twist locks or container stackers. However, when 20 feet containers are loaded in these slots, these are usually locked by stacker cones in between tiers and stowing a 40 foot container on the top most tiers. The permitted stack weight in each stack for cargo holds shall not be exceeded in any row. Cell guide size being for forty feet containers, when used for twenty feet units requires stowage in accordance with the container securing manual provided on board for twenty foot units. This is also known as following dynamic stack weight stowage.



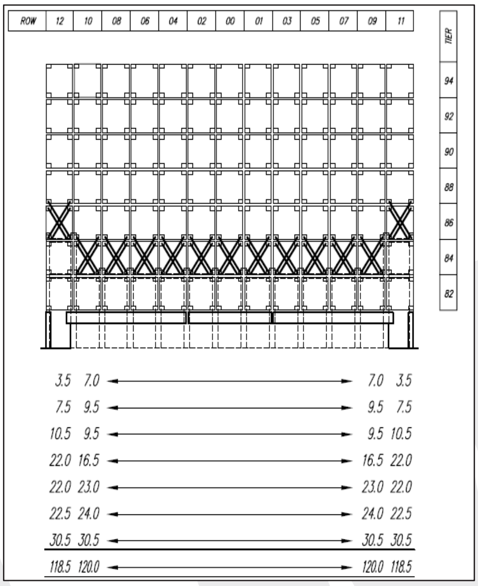
- Stowage and securing of containers under deck on conventional multipurpose general cargo vessels:
- Conventional multipurpose general cargo vessels are provided with container shoes on the tank top where the single twist locks are fitted in. From this tier onwards the container stacking is continued. The tiers in between are locked by automatic double twist locks and stacker cones. The top tiers are interlocked by using bridge fittings. The full stow is secured as one huge block. The bottom two tiers are lashed using wire lashings and turnbuckles. The intermediate and top tiers are secured sideways and to decks using tension buttress.



➢ Stowage of containers on container ships on deck

The governing factors for loading of containers on deck are permitted deck stack weights, lashing forces considering the additional effects of wind and sea, stability & GM of the ship and the navigation visibility criteria.

❖ Container ships are usually provided with lashing bridges to facilitate safe securing of containers on deck. Stowage and securing again is done in accordance with the CSM. Lashing eyes are fitted on decks for securing containers. The bottom two tiers are lashed using lashing rods and turn buckles. The extreme tiers on either side are provided with additional lashings to in order to support the containers against tipping in athwartship motion. Further tiers are locked using automatic twist locks.

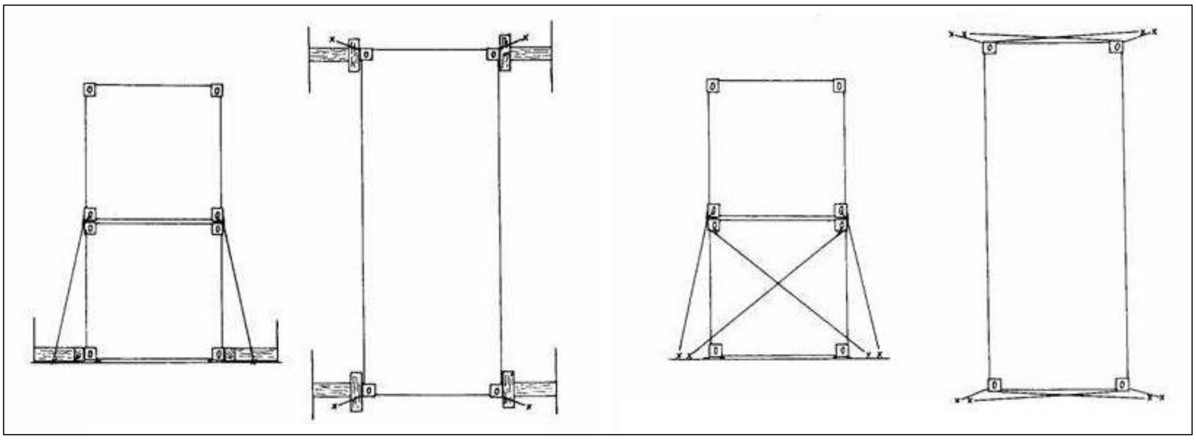




➢ Stowage of containers on conventional general cargo ships on deck

❖ Containers carrried on decks of conventional general cargo ships require detailed securing arrangements. Containers carried on deck or on hatches of such ships should preferably be stowed in the fore and- aft direction. Containers should not extend over the ship's sides. Adequate supports should be provided when containers overhang hatches or deck structures. Deck load density shall not be exceeded in any case. All containers should be effectively secured in such a way as to protect them from sliding and tipping. Hatch covers carrying containers should be adequately secured to the ship. Container shoes if available shall be used in conjunction with the twist locks for stowing containers on deck.

❖ Containers shall be secured using wire ropes or chains lashings. The containers shall be shored using Timber not exceeding 2 m in length. Lashings should be kept, when possible, under equal tension. Loading general cargo on top of containers is not recommended as the top cover of containers is usually not strong. The corner posts of the containers are the strong members which bear the load on the tiers above containers.



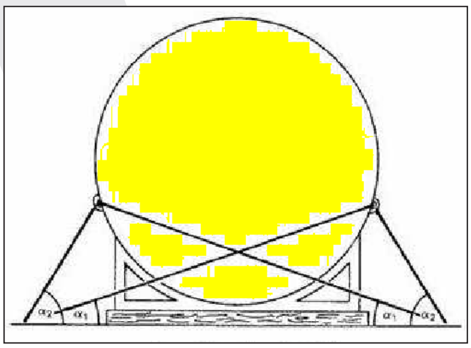
❖ Prior securing containers on deck, following points shall be considered regarding mechanical weaknesses in the cargo securing system. This could result because of

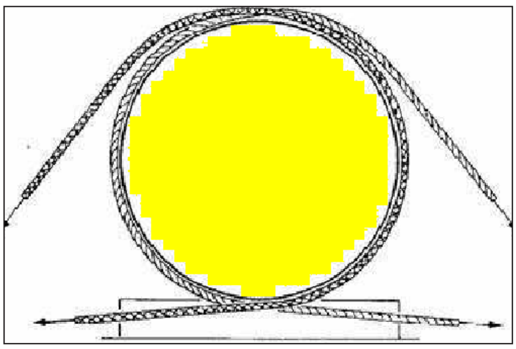
- ✓ unsecured hatch covers, permitting small lateral movements of the entire stow and slackening of the securing system
- ✓ weak deck fittings and weak/damaged lashing gear
- ✓ inadequate number of wire lashings to overcome static and dynamic loads on the containers stow
- ✓ pairing of penguin hooks with wire lashings, possibly weakening the connection to the corner fitting of the container
- ✓ improper stowage configuration of outboard 20-foot containers in a 40-footspace, leaving one end of each container stack unsecured
- ✓ structural weakness of the containers, strained with the carriage of heavy, dense cargo compounded by stowage of this container below another heavy container

**7) Out of Gauge (OOG) units, project cargoes and yachts**

➢ Cargoes of unusual sizes and heavy weights are often required to be shipped for various project works. These cargoes generally cannot be stowed as per normal carriage procedures in the cargo holds of the vessel. Same may be carried on open decks or when in a container vessel as break bulk OOG unit.

➢ Project cargoes, yachts and break bulk units require special stowage and securing arrangements. These are usually loaded and lashed under the supervision of competent person, preferably a class surveyor.





➢ Portable tanks, huge pipes or cargoes of cylindrical shapes impose and additional danger or rolling with the roll. These shall be adequately chocked to prevent any roll. The fore and aft longitudinal stowage is again preferred for stowing such units. In the absence of suitable lashing points, the recommended securing arrangements are as shown below. The securing devices should be arranged in such a way as to withstand the transverse and longitudinal forces, which may give rise to sliding and tipping. The lashing angles against sliding should not be higher than 25° and against tipping not lower than 45° to 60°. The wires are tightened to make a compact stow by using appropriate tightening devices.

- Special stowing cradles may be required for the stowage of yachts. Yachts are usually secured using web lashing firmly secured to the lashing points on the yacht and the ship structure. Care shall be taken while the yacht is slung by slings. Usually strap slings with spreaders are used to load yachts.

- OOG units on container ships come pre-slung on flat rack containers. The cargo is securely lashed on the unit. The over-projecting dimensions of the cargo shall be duly checked and sufficient space shall be allowed for these in the stowage locations. The OOG units loaded under deck in container ships usually do not require any additional lashings and are secured on the tiers. However when OOG units are loaded on deck, these may require additional lashings.

**8) Stowage and securing of vehicles and wheel based cargoes**

- Vehicles intended for the carriage of cargo in sea transport shall be in sound structural condition and have an adequate number of securing points of sufficient strength. These shall be so as to withstand the forces, in particular the transverse forces, which may arise during the sea transport. The stowage of vehicles and trailers shall be in accordance with CSM.

- The maximum securing load, MSL, of lashings should not be less than 100 kN. Lashings are attached to the securing points with hooks or other devices so designed that they cannot disengage from the aperture of the securing point if the lashing slackens during the voyage. Lashings should be attached to the securing points on the vehicle in such a way that the angle between the lashing and the horizontal and vertical planes lies preferably between 30° and 60°.

- Road vehicles should be stowed so that the chassis are kept as static as possible by not allowing free play in the suspension of the vehicles. Where jacks are used on a vehicle, the chassis should be strengthened in way of the jacking-up points and the position of the jacking-up points should be clearly marked. Vehicles with diesel engines should not be left in gear during the voyage. Parking brakes, where provided, of each vehicle or each element of a combination of vehicles shall be applied.

- Wheel-based cargoes, which are not provided with rubber wheels or tracks with friction increasing lower surfaces, should always be stowed on wooden dunnage or other friction increasing material such as soft boards, rubber mats, etc. The brakes of a wheel-based unit, if so equipped, should be set. The wheels of wheel-based cargoes should be blocked to prevent shifting.

- To prevent any lateral shifting of wheel-based cargoes not provided with adequate securing points, such cargoes should, where practicable, be stowed close to the ship's side and close to each other, or be blocked off by other suitable cargo units such as loaded containers, etc. Any movable external components attached to a wheel-based unit, such as derricks, arms or turrets should be adequately locked or secured in position.

- Uncoupled semi-trailers shall be supported by trestles or similar devices placed in the immediate area of the drawplates facilitating unrestricted connection of the fifth-wheel to the kingpin. Trailer brakes should be released ONLY after coupling. It must be remembered that designs of tug masters vary from port to port, and the trestle should not be placed so that restriction occurs at the discharge port. The trestles should also be placed so that it is under a flat area of the semi-trailer, and not inclined to tipping down.

- Road vehicles and semi-trailers shall be stowed so that the chassis are kept as static as possible minimizing free play in the suspension. This can be done by securing the vehicle to the deck as tightly as the lashing tensioning device will permit, and in the case of compresses air suspension systems, by first releasing the air pressure where this facility is provided.

- Caterpillar treaded vehicles such as bulldozers and cranes are prone to sliding when parked on bare steel decks owing to the low degree of frictional resistance between the threads and the deck. Such vehicles shall be stowed on dunnage or soft boards before being secured.

**9) Checking cargo lashings and record keeping**

- Suitable entries shall be made in the ship's logbook regarding the routine inspection carried out for cargo lashings. Entries shall mention regarding tightening of lashings and any other observation with respect to cargo stowage and lashing. Same shall be duly signed by the responsible officer.

- In addition proper record shall be maintained regarding the inspection and maintenance of the fixed fittings for cargo securing. Entries shall be made regarding the inspection and maintenance of the portable securing gear as well. A computerized system may be used for the purpose. Results of examination/inspection and maintenance/repair undertaken shall be recorded.

> A cargo space shall not be entered during passage at sea unless the same has been confirmed from the master. Formal risk assessment may be necessary prior entering such spaces particularly after experiencing heavy weather. The operations of checking and tightening of cargo lashings shall be taken out by experienced personnel under supervision of a responsible officer.

**Apply Your Knowledge**

1. List the contents of the Cargo Securing Manual.
2. Read the user's manual for cargo lashing software and learn its operation (container ship).

**Function:** Cargo Handling and Stowage

**Competence:** Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

**Task number:** B1.6

**Sub-task Reference number:** B1.6.1, B1.6.2, B1.6.3, B1.6.4, B1.6.5

**Topic:** International Maritime Dangerous Goods (IMDG) Code

**Task Heading**

- Identify all dangerous goods containers on board the vessel, with their IMO classification and stowage position.
- Demonstrate understanding of IMDG Code procedures for identifying a product, its hazards, handling procedures and use of Emergency Schedules (EmS) and Medical First Aid Guide (MFAG) tables.
- Demonstrate understanding of the segregation of IMDG cargo.
- Check the documentation requirements for carrying IMDG cargo on board. Locate the copy of Document of Compliance (DOC) for the carriage of dangerous cargo on board.
- Assist in checking that dangerous goods are being loaded, handled, discharged and stowed in accordance with the plan and IMDG Code requirements.

**Objectives**

- Understand the purpose and use of IMDG code with regards to carriage of dangerous cargoes on board

**Index**

1. International Maritime Dangerous Goods (IMDG) code
2. Salient features of IMDG code
3. IMDG code volumes
4. Dangerous goods classes and divisions
5. Dangerous goods labels
6. Layout of IMDG Code
7. IMDG cargo segregation table
8. IMDG code segregation requirements for containers
9. Emergency Schedule (EmS)
10. Medical First Aid Guide (MFAG)
11. Documentation related to the carriage of dangerous cargo on board
12. Handling of dangerous goods in bulk and packaged form
13. Loss of harmful substances into sea – reporting procedures

**Description**

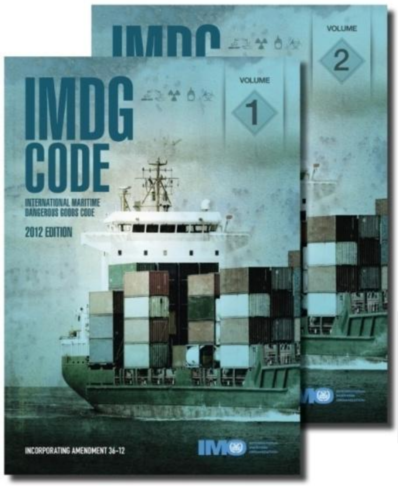
**1) International Maritime Dangerous Goods (IMDG) code**

- IMDG code covers safe procedures with respect to the transport of dangerous goods by sea covering matters such as basic principles, detailed recommendations for individual substances, materials and articles, and a number of recommendations for good operational practice including advice on terminology, packing, labeling, stowage, segregation and handling, and emergency response action.

**2) Salient features of IMDG code**

➢ IMDG code groups dangerous goods into various classes based on the hazards they present in transport. It contains the requirements regarding the packaging of dangerous goods of appropriate strength in a manner safe for sea transport. The code provides hazard warning labels and other identifying marks to identify dangerous goods in transport. The code covers the required standard documentation to be provided for transportation of dangerous goods. The code lays down principles for segregating the dangerous goods which are likely to react dangerously when stowed together. The code lays down principles for deciding on the safe stowage location for the dangerous goods on board ship to ensure safe transport. It provides emergency response advice, including first aid procedures for incidents involving dangerous goods on board ship and the reporting procedures with regards to the same. The code further covers safety guidelines with respect to use of pesticides on board.

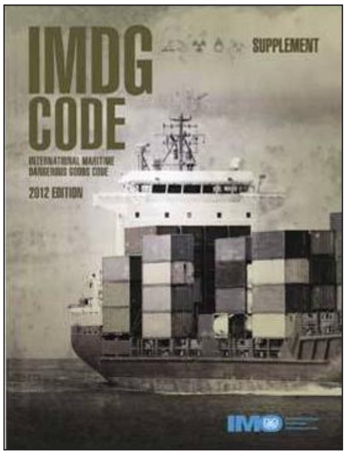
**3) IMDG code volumes**




IMDG is available in two volumes:

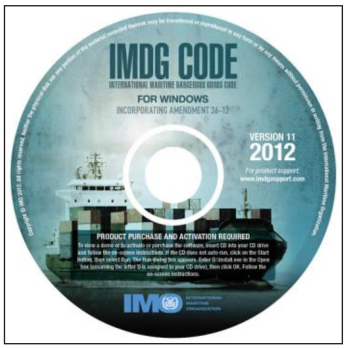
➢ **Volume 1 - contents**
- ❖ General provisions, definitions, training
- ❖ Classification
- ❖ Packing and tank provisions
- ❖ Consignment procedures
- ❖ construction and testing of packaging, IBCs, large packaging, portable tanks and road tank vehicles
- ❖ Transport operations

➢ **Volume 2 - contents**
- ❖ Dangerous Goods List in tabular format
  - ✓ limited quantities exceptions
- ❖ Appendix A- List of generic and N.O.S. (not otherwise specified) proper shipping names
- ❖ Appendix B- Glossary of terms
- ❖ Alphabetical Index




➢ **Supplement**
- ❖ EMS guide
- ❖ Medical first aid guide
- ❖ Reporting procedures
- ❖ Packing cargo transport units (IMO/ ILO/ ECE Guidelines)
- ❖ Safe use of pesticides
- ❖ International code for the carriage of packaged irradiated nuclear fuel, plutonium and high-level radioactive wastes on board ships (INF Code)

Complete IMDG publication is available in the CD format also.




**4) Dangerous goods classes and divisions**

In accordance with the IMDG code the dangerous goods are classified in the following nine classes.

➢ **Class 1: Explosives**

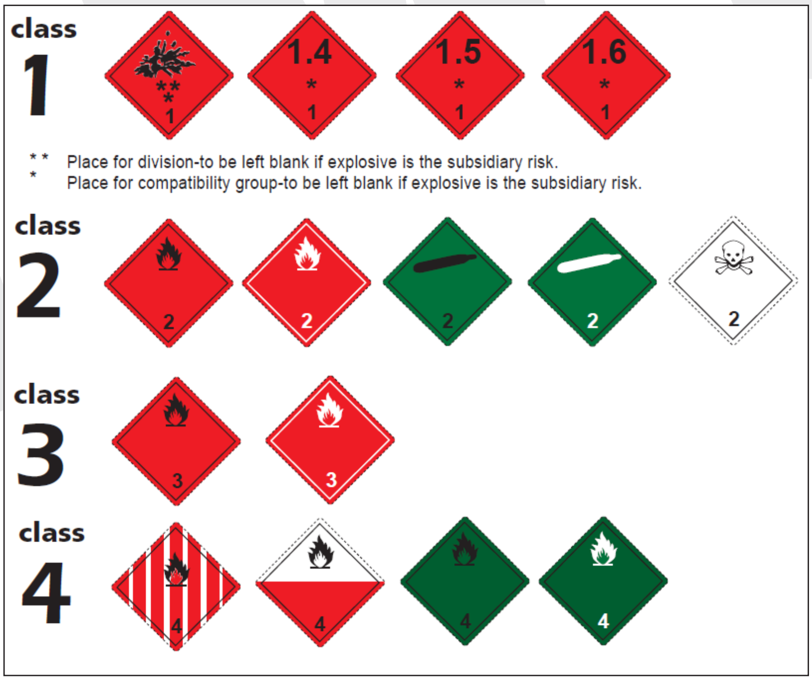
➢ **Class 2: Gases**
- ❖ Class 2.1: flammable gases

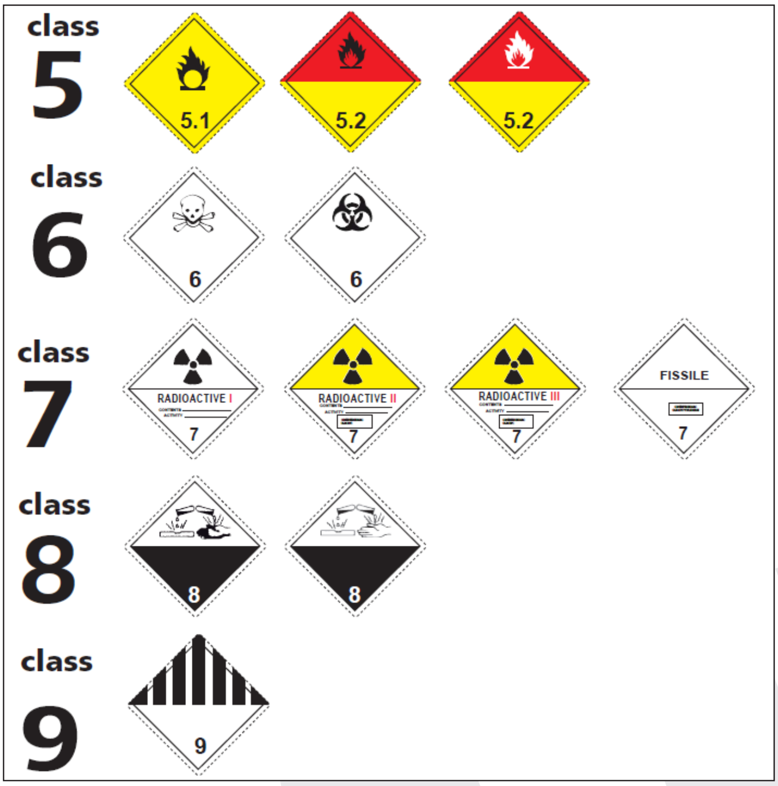
- ❖ Class 2.2: non-flammable, non-toxic gases
- ❖ Class 2.3: toxic gases
- ➢ **Class 3: Flammable liquids**
- ➢ **Class 4: Flammable solids; substances liable to spontaneous combustion; substances which, in contact with water, emit flammable gases**
  - ❖ Class 4.1: flammable solids, self-reactive substances and desensitized explosives
  - ❖ Class 4.2: substances liable to spontaneous combustion
  - ❖ Class 4.3: substances which, in contact with water, emit flammable gases
- ➢ **Class 5: Oxidizing substances and organic peroxides**
  - ❖ Class 5.1: oxidizing substances
  - ❖ Class 5.2: organic peroxides
- ➢ **Class 6: Toxic and infectious substances**
  - ❖ Class 6.1: toxic substances
  - ❖ Class 6.2: infectious substances
- ➢ **Class 7: Radioactive material**
- ➢ **Class 8: Corrosive substances**
- ➢ **Class9: Miscellaneous dangerous substances and articles**

> Marine pollutants and wastes
>
> In accordance with Annex III – MARPOL, many of the substances assigned to classes 1 to 9 are deemed as being marine pollutants. Certain marine pollutants have an extreme pollution potential and are identified as severe marine pollutants.

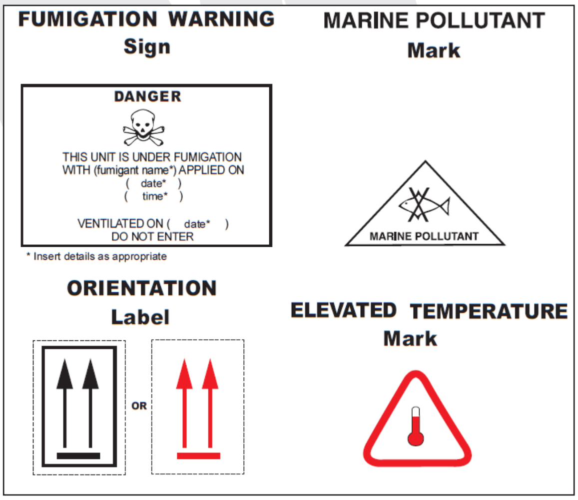
**5) Dangerous goods labels**

➢ **Labels for IMDG class and divisions**






- **Other warning placards**




## 6) Layout of IMDG code

- Dangerous good transported by sea, covered in IMDG code are identified by the “United Nations” (UN) number and the “Proper Shipping Name” (PSN). United Nations number is assigned by the “United Nations Committee of Experts on the Transport of Dangerous Goods” (UN List).

- The code is provided with dangerous goods list (DGL) in a tabular form. The list contains a wide table spread across 2 pages. This table is divided into 18 columns for each individual dangerous good listed. Much of the information contained in the DGL is coded to make it easier to present in a table form.

- The dangerous goods list can be accessed using the UN number provided in column 1 and column 18.In case when the UN number is not known; the alphabetical index in volume 2 can be checked for PSN which will provide the UN number of the cargo.

| UN No. | Proper Shipping Name (PSN) | Class or Division | Subsidiary Risk(s) | Packing Group | Special Provisions | Limited or excepted quantity provisions | | Packing | | IBC | | Portable Tanks and Bulk Containers | | EmS | Stowage and Segregation | Properties and Observations | UN No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Limited quantities | Excepted quantities | Instructions | Provisions | Instructions | Provisions | Tank Instructions | Provisions | | | | |

## 7) IMDG cargo segregation table

Dangerous goods of different classes are likely to react amongst themselves. Some cargoes when present in close proximity of an area where an IMDG cargo has already caused a hazard may further intensify the situation. Hence different classes of IMDG cargoes need to be stowed at certain separations. These segregation requirements are provided in the form of segregation table in the IMDG code which is as follows. The segregation criteria shall be selected on the basis of primary and subsidiary risks associated wit the DG cargo.

| Class Description | CLASS | 1.1 1.2 1.5 | 1.3 1.6 | 1.4 | 2.1 | 2.2 | 2.3 | 3 | 4.1 | 4.2 | 4.3 | 5.1 | 5.2 | 6.1 | 6.2 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Explosives** | **1.1 1.2 1.3** | * | * | * | 4 | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 4 | 2 | 4 | X |
| **Explosives** | **1.3 1.6** | * | * | * | 4 | 2 | 2 | 4 | 3 | 3 | 4 | 4 | 4 | 2 | 4 | 2 | 2 | X |
| **Explosives** | **1.4** | * | * | * | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | X | 4 | 2 | 2 | X |
| **Flammable Gases** | **2.1** | 4 | 4 | 2 | X | X | X | 2 | 1 | 2 | X | 2 | 2 | X | 4 | 2 | 1 | X |
| **Non-Toxic , Non-Flammable Gases** | **2.2** | 2 | 2 | 1 | X | X | X | 1 | X | 1 | X | X | 1 | X | 2 | 1 | X | X |
| **Toxic Gases** | **2.3** | 2 | 2 | 1 | X | X | X | 2 | X | 2 | X | X | 2 | X | 2 | 1 | X | X |
| **Flammable Liquids** | **3** | 4 | 4 | 2 | 2 | 1 | 2 | X | X | 2 | 1 | 2 | 2 | X | 3 | 2 | X | X |
| **Flammable Solids** | **4.1** | 4 | 3 | 2 | 1 | X | X | X | X | 1 | X | 1 | 2 | X | 3 | 2 | 1 | X |
| **Substances Liable To Spontaneous Combustion** | **4.2** | 4 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | X | 1 | 2 | 2 | 1 | 3 | 2 | 1 | X |

| Class Description | CLASS | 1.1 1.2 1.5 | 1.3 1.6 | 1.4 | 2.1 | 2.2 | 2.3 | 3 | 4.1 | 4.2 | 4.3 | 5.1 | 5.2 | 6.1 | 6.2 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Substances , Which , In Contact With Water , Emit Flammable Gases | 4.3 | 4 | 4 | 2 | X | X | X | 1 | X | 1 | X | 2 | 2 | X | 2 | 2 | 1 | X |
| Oxidizing Substances | 5.1 | 4 | 4 | 2 | 2 | X | X | 2 | 1 | 2 | 2 | X | 2 | 1 | 3 | 1 | 2 | X |
| Organic Peroxides | 5.2 | 4 | 4 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | X | 1 | 3 | 2 | 2 | X |
| Toxic Substances | 6.1 | 2 | 2 | X | X | X | X | X | X | 1 | X | 1 | 1 | X | 1 | X | X | X |
| Infectious Substances | 6.2 | 4 | 4 | 4 | 4 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 1 | X | 3 | 3 | X |
| Radioactive Material | 7 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | X | 3 | X | 2 | X |
| Corrosive Substances | 8 | 4 | 2 | 2 | 1 | X | X | X | 1 | 1 | 1 | 2 | 2 | X | 3 | 2 | X | X |
| Miscellaneou s Dangerous Substances & Articles | 9 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |

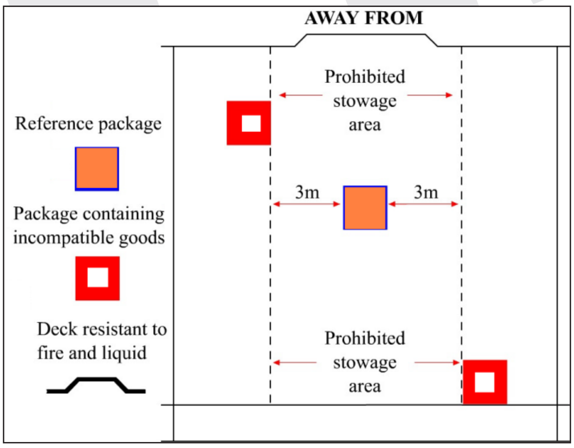
* = Refer to special provisions for Explosives (Clause 7.2.7.2 of the IMDG Code)
X = No segregation required except if specifically indicated in the Dangerous Goods List

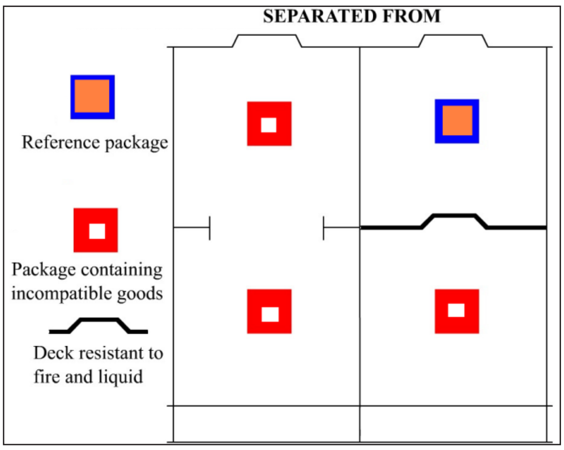
❖ **1 = Away From**

Effectively segregated so that the incompatible goods cannot interact dangerously in the event of an accident but may be transported in the same compartment or hold or on deck, provided a minimum horizontal separation of 3 metres, projected vertically is obtained

❖ **2 = Separated From**

In different compartments or holds when stowed under deck; provided the intervening deck is resistant to fire and liquid, a vertical separation, i.e. in different compartments, may be accepted as equivalent to this segregation. For "on deck" stowage, this segregation means a separation by a distance of at least 6 metres horizontally

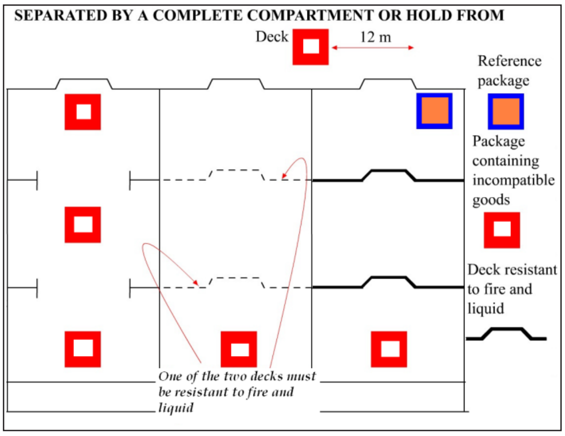


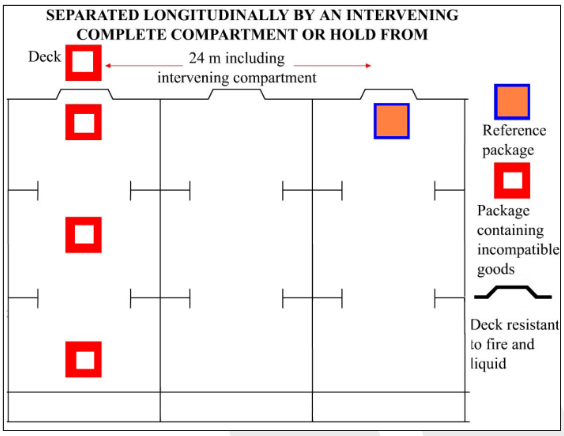




❖ **3 = Separated by a complete compartment or hold from**

Either a vertical or a horizontal separation, if the intervening decks are not resistant to fire and liquid, then only a longitudinal separation, by an intervening complete compartment or hold, is acceptable; For "on deck" stowage, this segregation means a separation by a distance of at least 12 metres horizontally. The same distance has to be applied if one package is stowed "on deck", and the other one in an upper compartment

❖ **4 = Separated longitudinally by an intervening complete compartment or hold from**
Vertical separation alone does not meet this requirement. Between a package "under deck" and one "on deck" a minimum distance of 24 metres, including a complete compartment, must be maintained longitudinally. For "on deck" stowage, this segregation means a separation by a distance of at least 24 metres longitudinally.




**8) IMDG code segregation requirements for containers**

Being in freight containers the stowage segregation requirements for the IMDG cargoes are modified. The segregation terms as mentioned above, in case of containers shall be interpreted as mentioned in the separate table of IMDG Code.

**9) Emergency Schedule (EmS)**

- The guidance contained in EmS sections of the IMDG supplement is intended for fire and/or spillage (leakage) emergencies on board a ship involving packaged dangerous goods (not cargoes in bulk) transported in accordance with the provisions of the IMDG Code.

- This guide provides procedures to respond to a fire or a spillage of IMDG cargo without external assistance. The recommendations are based on the fire safety provisions contained in SOLAS and the IMDG Code.

- The procedures for action in fire and spillage are provided in two sections with unique codes as FA, FB, FC…… and SA, SB, SC …. respectively. The schedules are described under respective headers. The codes to be used for procedures for a specific UN number cargo are mentioned in the subsequent lists.

- The guidance should be integrated into the contingency plan for shipboard emergencies which should be specific to the individual ship and taking into account the available equipments on board.

- Contacting shore-based experts at an early stage is recommended to deal with a fire or spillage on board a ship.

**10) Medical First Aid Guide (MFAG)**

- This guide is included in the IMDG code supplement after EmS. It provides first aid procedures for accidents involving dangerous goods where the personnel are exposed or have come in contact with dangerous goods. To ensure rapid access to the recommendations in an emergency, the MFAG is divided into sections which are grouped to facilitate a three step approach.

- Step1 carries emergency action and diagnosis which is carried out in accordance with the guidelines provided in the form of a flow chart. The emergency action mentions the quick check and directs to a certain table for immediate follow up procedure. For example,
  "Has breathing stopped?" – "Go to Tables 2 and 3"

  These checks are listed in the order of priority and finally conclude with instructions to proceed to diagnosis flow chart. On the diagnosis flowchart also, the actions are mentioned directing to tables. For example
  "The casualty is vomiting" – "Table 10 and appendix 10"

- Step 2 includes tables providing brief instructions for special circumstances inhalation of chemicals or eye exposure to chemicals etc.

- Step 3 carries appendices providing comprehensive information, a list of medicines/ drugs and a list of chemicals referred to in the tables. This list is limited to those few chemicals only which require special treatment.

## 11) Documentation related to the carriage of dangerous cargo on board

- **Document of compliance**

| |
|---|
| A vessel shall not carry any IMDG cargo which is NOT permitted in the DGDOC. |

- ✓ Depending upon the ship specific construction features with relevance to carriage of dangerous goods and associated hazards, the classification society of the vessel lists out the dangerous cargoes permitted to be carried on board and the cargo spaces on board the vessel for carriage of such cargoes. These are mentioned in the vessel's "Dangerous Goods Document of Compliance" (DG DOC).

- ✓ DG DOC has to be consulted in addition to IMDG cargo segregation requirements to plan the stowage of DG cargoes on board.

- ✓ DG DOC takes in account ship specific construction features such as distances from accommodation, presence of watertight bulkheads, under deck and open deck stowage positions, availability of ventilation arrangements and the cargo specific hazards such as nature and properties of cargoes, flash point, type of packaging, in containerized form etc.

- ✓ DGDOC is issued under requirements from SOLAS Ch II-2. The period of validity of the document of compliance is five years for cargo ships and cannot be extended beyond the expiry date of the valid cargo ship safety construction certificate. For passenger ships, the validity of DGDOC is one year and cannot be extended beyond the expiry date of the valid passenger ship safety certificate.

- **Dangerous goods manifest**

Dangerous goods manifest is required by the SOLAS, MARPOL and IMDG code. DG manifest is prepared in the recommended format as mentioned in FAL convention as shown in the picture. This is submitted by the shipper's agent to the vessel's master and the stowage position of DG cargo is recorded on to it. It is then signed by the shipper' agent and countersigned by the master once the DG cargo is loaded on board. DG manifest is required at the discharge port.

**IMO DANGEROUS GOODS MANIFEST**
(IMO FAL Form 7)
(As required by SOLAS 74, chapter VII, regulations 4.5 and 7-2.2, MARPOL 73/78, Annex III, regulation 4.3 and chapter 5.4, paragraph 5.4.3.1 of the IMDG Code)

Page Number

| | | |
|---|---|---|
| Name of ship | 1.2 IMO number | 1.3 Call sign |
| Voyage number | 2. Flag State of ship | 3. Port of loading / 4. Port of discharge |

| ooking/ rence Number | 6. Marks & Numbers Container Id. No(s). Vehicle Reg. No(s). | 7. Number and kind of packages | 8. Proper Shipping Name | 9. Class | 10. UN No. | 11. Packing Group | 12. Subsidiary Risk(s) | 13. Flashpoint (in °C.c.c.) | 14. Marine Pollutant | 15. Mass (kg) Gross/Net | 16. EmS | 17. Stowage position on boar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
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litional information

| | |
|---|---|
| Name of master | 19.1 Shipping Agent |
| Place and date | 19.2 Place and date |
| nature of master | Signature of Agent |

The details mentioned in DG manifest are as follows:

- Parcel number/ container number
- Number and kind of packages
- Proper shipping name (trade name and technical name are not accepted.)
- IMO Class (Primary hazard) - includes IMDG classification number and the relevant division (if applicable). Class 1 substances and articles must always show the division number and compatibility group.
- UN number- corresponding to the number allocated to the proper shipping name.
- Packing group - Where packing group number has been assigned to the substance or article in the IMDG code, i.e. I, II, III or N/A
- Subsidiary risk(S) - If subsidiary risk(s) has been identified in addition to its primary hazard as shown above
- Flash point if 60°C or below (closed cup flash point in °C) – (if applicable)
- Marine pollutant - "Y" indicates the goods are marine pollutant, "N" indicates the goods are non-marine pollutant and "S" indicates the goods are severe marine pollutant
- DG net mass (Kg) / DG gross mass (Kg) - (Net explosive quantities in Kg for DG of Class 1)
- Stowage location
- Port of loading
- Port of discharge

❖ **Dangerous goods declaration**

Each dangerous cargo shipment is accompanied by a dangerous goods declaration. This is a signed certificate or declaration by the shipper that the consignment, as offered for carriage, is properly packaged, marked, labeled or placarded as appropriate and in proper condition for carriage. In case of container shipments, dangerous goods declaration may be combined with the container packing certificate. DG declarations shall be filed on board and maintained discharge port wise.

❖ **Material Safety Data Sheets**
These are provided with IMDG shipments for quick reference for emergency and first aid procedures.

Port authorities are likely to impose huge fines for loading/ discharging IMDG cargo if it is not declared in advance.

❖ **Dangerous cargo stow plan and dangerous cargo list**
A detailed stow plan for all IMDG cargo carried on board and a separate list of IMDG cargo is prepared as is required by various port authorities. The dangerous goods list contains the information such as stow position, container number, line operator, port of loading / discharge, DG class, UN number, proper shipping name, weight, flash point and EMS. The dangerous cargo stowage plan (indicating DG class & location) along with a dangerous cargo list (indicating location, container number, DG class and UN number shall be readily available.

**12) Handling of dangerous goods in bulk and packaged form**

➢ Dangerous goods shall always be carried in full compliance with the IMDG Code.

➢ Full details of the cargo like UN Number, PSN, and MSDS shall be available prior loading any dangerous cargo.

Any sign of damage to the package/ container/ unit such as leaking, broken, torn etc. shall be carefully checked. A damaged DG cargo unit shall never be accepted for shipment.

➢ The packages shall be checked for proper labels and shipment numbers. Containers carrying dangerous cargoes shall be checked against DG manifest. All packages shall be checked for compliance with IMDG packaging and labeling requirements. Packaged dangerous goods in containers shall be provided with a surveyor's report and shippers' declaration for compliance with the IMDG code. However, in regular liner trades this is not necessary, provided a dangerous cargo manifest and a detailed stowage plan indicating location and class of dangerous goods is provided.

➢ Due safety precautions shall be taken while loading the DG cargo as is required for the hazards associated with it. EmS and MFAG procedures shall be readily available for the cargo.

➢ The goods shall be stowed, segregated and secured in accordance with the IMDG code.

➢ During passage adequate precautions shall be taken relating to the specific cargo.

➢ Any spillage or accidental release of IMDG cargo requires prompt reporting as discussed below.

**13) Loss of harmful substances into sea – reporting procedures**

➢ Substances which are identified as "Marine Pollutants" in the "International Maritime Dangerous Good Code" (IMDG code) shall be treated as harmful substances for marine environment. Jettisoning (intentional release) of these substances into the sea is prohibited, except for the purpose of saving life or the ship.

➢ If harmful substances are released accidentally into sea, following actions shall be taken
- ❖ Emergency stations shall be called as considered necessary.
- ❖ Ship's position date / time (UTC) shall be noted.
- ❖ Course / reduce speed shall be adjusted if harmful substances are released due to heavy weather.
- ❖ Hazards associated with the cargo for personnel, as well as risk of fire / explosion etc. shall be evaluated

- ❖ The shipping company office and the nearest coastal state shall be informed. When in port P&I club shall also be informed.
- ❖ Appropriate action shall be taken to reduce or stop further release of harmful substance
- ❖ The cause of release of harmful substance along with estimated quantity released shall be estimated.
- ❖ "Emergency Schedule" (IMDG Code) and MFAG for the cargo shall be referred as appropriate.
- ❖ Any spillage on deck, shall be cleaned if safe to do so, based on information from IMDG code & dangerous cargo manifest
- ❖ Records shall be maintained along with the available evidences.

➢ Reports on incidents involving dangerous goods, harmful substances and marine pollutants

- ❖ A report of an incident shall be made without delay to the fullest extent possible in accordance with MARPOL convention. The format for same is provided in the shipboard SMS manuals as well. Countries have designated organizations (national contact points for safety and pollution prevention) to receive and process all reports on incidents.
- ❖ A report shall be made when any incident occurs involving the loss, or likely loss overboard of packaged dangerous goods into sea OR any incident involving harmful substances/ marine pollutants giving rise to pollution or threat of pollution of the marine environment. The coastal states shall further be kept updated on salvage measures and developments.
- ❖ The reporting procedures and details are provided in shipboard emergency plans which shall be followed.
- ❖ The reports that follow are marked as
  - ✓ Dangerous goods report (DG) – When an incident involves loss or likely loss overboard of packaged dangerous goods
  - ✓ Harmful substances report (HS) - When an incident involves discharge or probable discharge overboard of oil or noxious liquid substances in bulk (annex I and II of MARPOL)
  - ✓ Marine pollutant report (MP) - When an incident involves loss or likely loss overboard of harmful substances in packaged form

**Apply Your Knowledge**

1. On a container ship, discuss the features of loading software provided to check the stowage of dangerous cargoes on board.
2. Locate the DGDOC of the vessel and check the IMDG cargoes permitted to be loaded on board your vessel.
3. Discuss the precautions to be taken while loading IMDG Class 5.1 cargo.

**Function:** Cargo Handling and Stowage

**Competence:** Inspect and report defects and damage to cargo spaces, hatch covers and ballast tanks

**Task number:** B2.1

**Sub-task Reference number:** B2.1.11, B2.1.12, B2.1.13

**Topic:** Inspection of cargo spaces, hatch covers and ballast tanks

**Task Heading**

- Assist in preparing a ballast tank for inspection. Replace tank manholes after inspection.
- Assist in making tank inspections and identify various principal structural members. Make sketches showing the lay-out of the principal structural members.
- Assist in making a tank inspection report.

**Objectives**

- Understand the importance and procedure of carrying out ballast tank inspections

**Index**

1. Ballast tanks
2. Ballast tanks inspection
3. Tank inspection report

**Description**

**1) Ballast tanks**

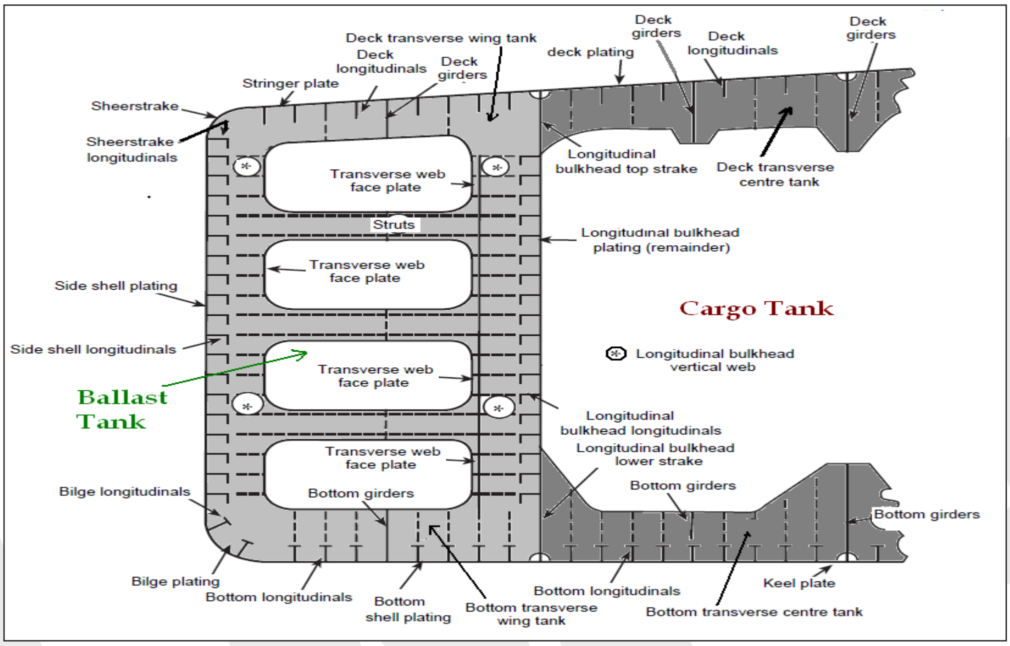
- A ballast tank is a tank used primarily for the carriage of salt water ballast. Ballast tanks are provided for carrying ballast on board in order to achieve suitable stability condition and favorable trim when the ship does not have any cargo onboard. Ballast tanks in general provide coverage around cargo spaces and cargo tanks on sides and bottom.

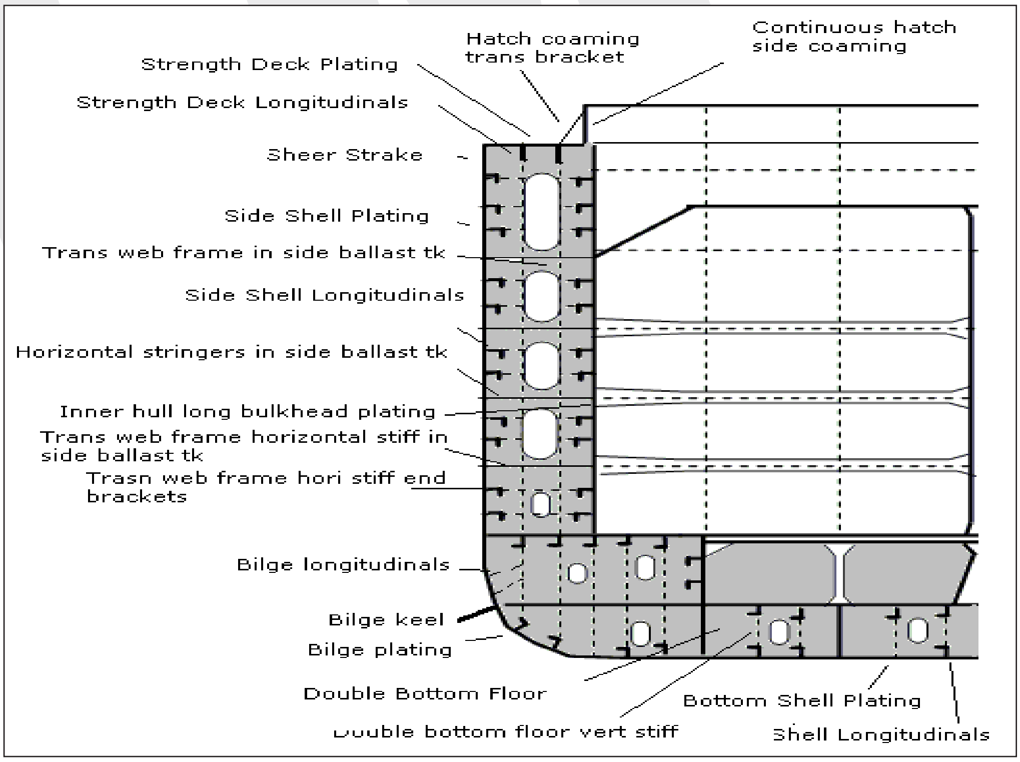
- Tanks used for carrying ballast are generally peak tanks, double bottom tanks, side tanks, hopper tanks and topside tanks. Hopper tanks and topside tanks are found mainly on bulk, OBO and gas carriers. The main strengthening parts, fittings and accessories found in tanks are as discussed below.

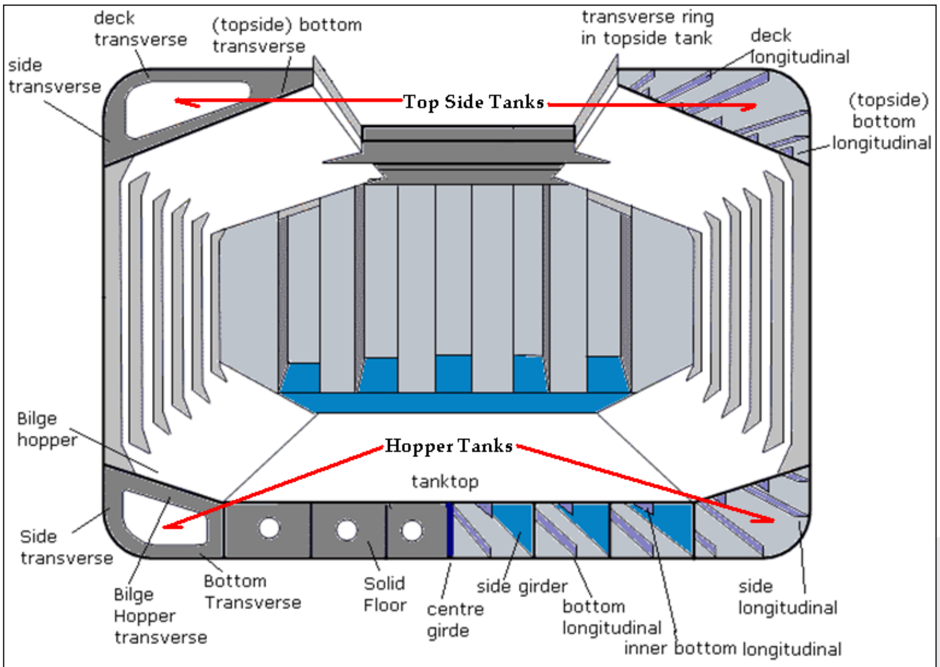
- **Double bottom tanks**
  - ❖ These are double bottoms spaces between inner bottom and outer bottom of the vessel commonly used as tanks for carrying ballast and fuel.

- **Side tanks**
  - ❖ These tanks are usually provided along the parallel body of the vessel. Spaces covered by side tanks are volumes between longitudinal bulkheads forming cargo hold sides and the shipside, running from weather deck to the ship's bottom. The full length is subdivided into individual tanks which are used for ballast. The ballast tanks on sides are common on container ships and tankers. The double hull requirements for construction of tankers are fulfilled by ballast tanks on sides and double bottom tanks.

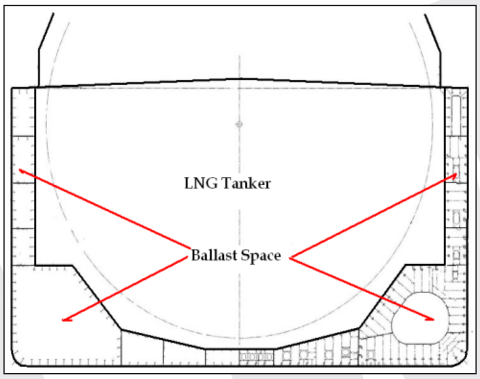
- **Hopper tanks and topside tanks**
  - Topside ballast tanks are tanks that normally extend along the upper edges of the cargo hold lengthwise. Hopper tanks are provided along the bottom edges of the cargo hold again running along the length of the vessel. Hopper and top side tanks facilitate bulk carrier operations by providing smooth surfaces in the cargo holds of the bulk carrier. Most of the stiffeners running along the four corners of cargo hold are enclosed in these tanks. Hopper tanks further facilitate the cargo to get collected at the centre of the tank top. Top side tanks further provide slanting surface which up to great extent help trimming the surface of the cargo. In gas carriers these tanks facilitate an efficient use of vessel's volume on lengths of hull where spherical or cylindrical cargo tanks are fitted.

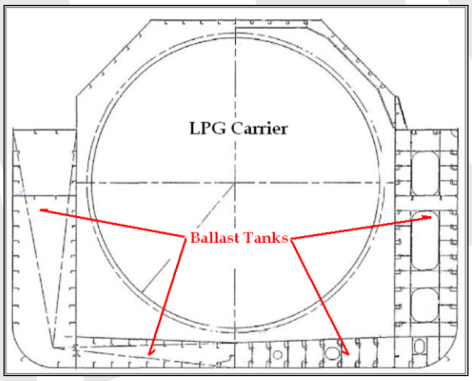




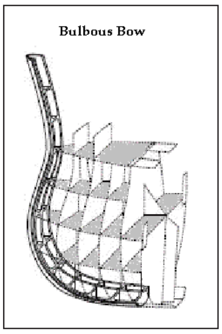
Bulk carrier Top Side Tanks, Hopper tanks and double bottom




➢ **Forepeak tank**

❖ Forepeak tank is used as a water ballast tank. The tank is located forward of the collision bulkhead and the use of forepeak tank for ballast facilitates trim adjustment in an effective way. The space inside the bulbous bow may be included in the forepeak tank or may be kept separate.




## 2) Ballast tanks inspection

➢ Ballast tanks because of sea water provide suitable conditions for speedy corrosion of steel. The bulkheads and ship's stiffeners are exposed to severe corroding environment. Bulkheads forming boundaries between ballast tanks and cargo spaces further need special care. Ballast tanks are also likely to develop huge amounts of silt inside the tanks resulting in reducing the cargo carrying capacity of the vessel. Hence routine inspection and maintenance of ballast tanks becomes a must.

➢ The tanks are inspected, cleaned and maintained thoroughly during dry docking of the vessel. The ballast tank inspections are a part of annual, periodic and renewal surveys of safety construction certificate survey.

- Inspections are usually carried out against a set of standards available in the form of a checklist. The inspections shall be so planned in order to cover all the tanks within a specified duration. The checklists are designed to collect textual descriptions of the conditions found. This includes finding anomalies relative to material degradation and deformation. The inspectors shall look for defects or assess condition based on work process instructions. The findings are recorded and supported by photographs.

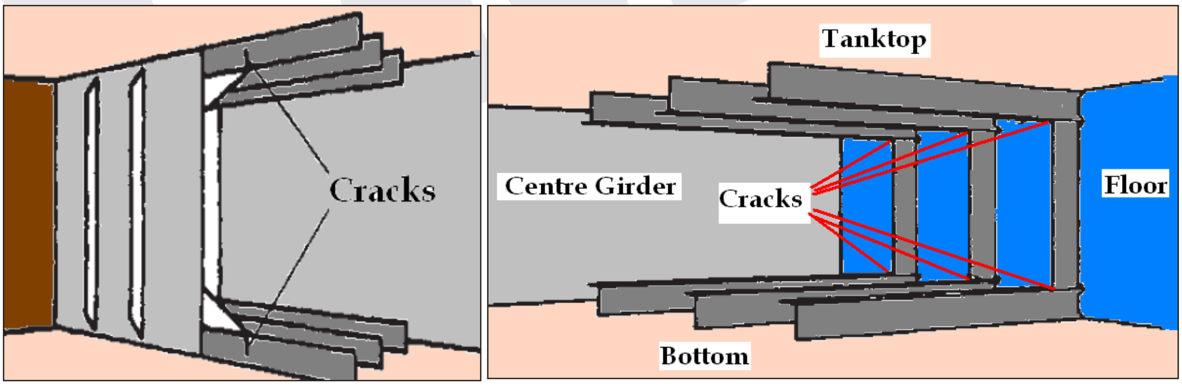
- Ballast tank inspection requires formal risk assessment. Enclosed space entry procedures should be strictly followed.

- Usually the traditional inspections assess the compartment condition based on the entire compartment with a focus on the coating condition. The examination comprises of
  - Overall inspection
  - Coating condition assessment
  - Close up visual inspections
  - Suspect areas examination
  - Critical area (fatigue hotspot) inspection
  - Anode inspection
  - In extreme cases where felt necessary, thickness measurement is normally carried out by means of ultrasonic test equipment.

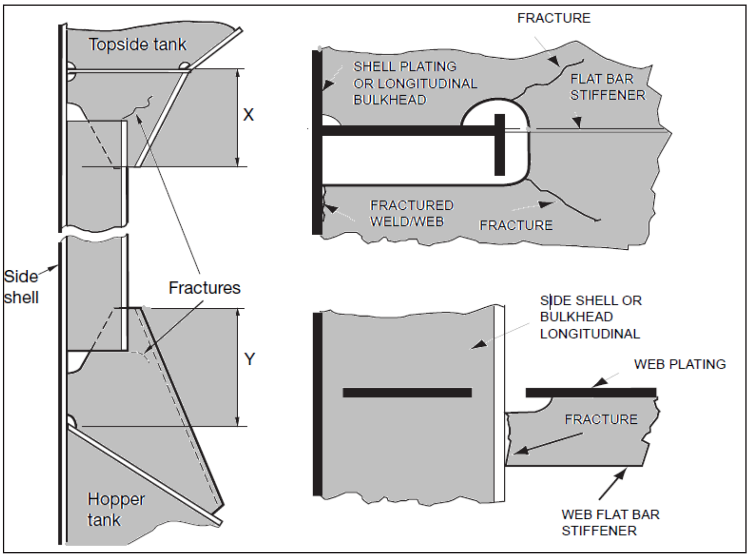
- Depending on the apparent condition of the paint coating and rust, the investigation is planned. When carrying out inspections of tanks, particular attention should be paid to any cracking, deformation or deterioration of coating. Suspected areas and critical areas which are subject to high corrosion risk are inspected in detail.

- Coating condition is defined as follows
  - Good - condition with only minor spot rusting
  - Fair - condition with local breakdown at edges of stiffeners and weld connections and/or light rusting over 20% or more of areas under consideration, but less than as defined for POOR condition.
  - Poor - condition with general breakdown of coating over 20% or more of areas or hard scale at 10% or more of areas under consideration.

- The checks during ballast tank inspections include checking
  - Cracks at the intersections of longitudinals and transverse members
  - Cracking of longitudinals at areas of structural discontinuity such as those provided in the double bottom below cargo hold bulk heads or at the side walls of bilge wells for cargo holds
  - Cracks in transverse webs in bilge hoppers initiating from the slot openings for longitudinals and at the knuckled corners of the lower ends of the hoppers
  - Cracks at or near the connection of the stool of the transverse bulkhead and the tank top
  - Corrosion and wastage of steel, especially in the upper part of the topside tanks
  - Fractures at the boundaries bulkhead stools, particularly in way of shelf plates, shedder plates, deck, inner bottom, etc.
  - Buckling of the plating, leading to the failure and collapse of the bulkhead under water pressure in an emergency situation
  - Excessive wastage/corrosion, in particular at the mid-height and bottom of bulkheads, which may look in deceptively good condition
  - Corrosion at bulkhead plating adjacent to the shell plating
  - Bulkhead trunks which form part of the venting, filling and discharging arrangements between the topside tanks and the hopper tanks
  - Bulkhead plating and weld connections to the lower/upper stool shelf plates, weld connections of stool plating to the lower/upper stool shelf plates and inner bottom and weld connections to topside tanks and hopper tanks
  - Areas where coatings have broken down and there is evidence of corrosion or wastage
  - Connection trunks provided between topside and bilge hopper spaces
  - Transverse web frames in way of hopper longitudinal
  - Bottom longitudinals with associated brackets or flat bar stiffeners at web frames and penetration through watertight bulkheads
  - Side longitudinals with associated tripping brackets in way of web frames and transverse swash bulkhead (continuation of stool sloped plates)
  - Condition of manhole doors and access ladders and the condition of ladder will indicate condition of tank – unless ladder has been renewed




  - Special attention has to be paid for wastage or cracks at edges of opening/slots for bottom hopper longitudinals ,or cracks at edges of opening/slots for deck longitudinals when inspecting the structural members
  - Wastage or cracks at edges of opening/slots for cut out side longitudinals, buckling or excessive corrosion at the corners of webs, connection of webs to longitudinals wash bulkhead also should be checked. Horizontal flat bar connection to side longitudinals
  - Flat bar connections to hopper longitudinals and flat bar connections to deck longitudinals are also could be weak areas requires attention.




- ❖ Connection of inboard strake to the topside-sloped plate
- ❖ Shipside gussets (brackets) connection to side longitudinals and lower hopper longitudinal. Also check the shipside gussets for any buckling/excessive corrosion
- ❖ General condition of ballast trunk access opening, drop valves recess and pipe connection to sloped plate, valve opening extended spindle or hydraulic lines with the fastening
- ❖ Sounding pipes and of hold bilges passing through topside tank, thinning around the U clamp fastening area due to flexing, loose clamps, scarphing arrangement in the topside tank adjacent to engine room and forepeak and end brackets of all longitudinals to engine room bulkheads and collision bulkhead
- ❖ Pitting corrosion under suction bell mouth if topside tanks are not connected to double bottom tanks
- ❖ Watertight division/bulkhead for excessive corrosion/buckling and excessive corrosion at the lightning holes and for possible cracks

➢ The condition of sacrificial anodes in the ballast tanks shall be checked. The usual life of thee anodes is usually 2.5 years scheduled to be changed in dry dock.

**3) Tank inspection report**

➢ Detailed tank inspection report shall be submitted to the shipping company office in the specified formats. These are further submitted to the classification societies. The tank inspection report in general is as shown in the attached picture.

M.V. ---------------------------------------------------- Date : ----------------

WATER BALLAST TANK No.

TANK / IDENTITY:

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| | AREAS INSPECTED | INSPECTION (1) | CORROSION: COATING(%) BREAKDOWN (2) | CORROSION: BLISTERING / CRACKING / PEELING(%) (2) | CORROSION: SCALE: TYPE (3) | CORROSION: SCALE: THICKNESS | CORROSION: PITTING: INTENSITY % (2) | CORROSION: PITTING: AVE.DEPTH MM. | CORROSION: ANODES WASTAGE (%) | DEFECTS (4): FRACTURES | DEFECTS (4): BUCKLING | DEFECTS (4): WELD SEAMS | DEFECTS (4): THINNING | RESIDUES (mT) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UPPER SPACE | DECKHEAD PLATING | | | | | | | | | | | | | |
| UPPER SPACE | DECKHEAD LONGLS | | | | | | | | | | | | | |
| UPPER SPACE | AFT BHD PLATING | | | | | | | | | | | | | |
| UPPER SPACE | OUTBOARD BHD PLATING | | | | | | | | | | | | | |
| UPPER SPACE | INBOARD C/BHD PLATING | | | | | | | | | | | | | |
| UPPER SPACE | INBOARD C/BHD STIFFENERS | | | | | | | | | | | | | |
| UPPER SPACE | SWASH BHD PLATING | | | | | | | | | | | | | |
| UPPER SPACE | SWASH BHD STIFFENERS | | | | | | | | | | | | | |
| UPPER SPACE | FWD BHD PLATING | | | | | | | | | | | | | |
| UPPER SPACE | FWD BHD STIFFENERS | | | | | | | | | | | | | |
| UPPER SPACE | BOTTOM PLATING | | | | | | | | | | | | | |
| UPPER SPACE | BOTTOM LONGLS | | | | | | | | | | | | | |
| UPPER SPACE | NOTE: - THIS SPACE DOES NOT APPLY TO Nos 2 (P&S) & 11 (P&S) | | | | | | | | | | | | | |
| ATHWART SPACE | DECKHEAD PLATING | | | | | | | | | | | | | |
| ATHWART SPACE | DIAPHRAGM PLATING | | | | | | | | | | | | | |
| ATHWART SPACE | DIAPHRAGM STIFFENER | | | | | | | | | | | | | |
| ATHWART SPACE | BOTTOM PLATING | | | | | | | | | | | | | |
| ATHWART SPACE | NOTE: - THIS SPACE BETWEEN UPPER SPACES (P&S) ONLY IN TANK Nos 5 (C), 7 (C) & 9 (C) | | | | | | | | | | | | | |
| | ENTRANCE HATCH / MANHOLE | | | | | | | | | | | | | |
| | ACCESS LADDERS & WALKWAYS | | | | | | | | | | | | | |
| | PIPING, COUPLINGS & FITTINGS | | | | | | | | | | | | | |
| | PIPE PENETRATIONS IN DECK | | | | | | | | | | | | | |
| | PIPE PENETRATIONS IN SLOPE PLATE | | | | | | | | | | | | | |

Inspected by : ----------------------------------------------------

**Pressure Test of Tank Boundaries**

☐ PORT ☐ FWD ☐ UPPER ☐ ALL

☐ STBD ☐ AFT ☐ LOWER

X = Mark areas tested NA = Not applicable D = Defects noted

| Remarks and Details of Defects (4) | NARRATIVE REPORT | PHOTOS ATTACHED | REPAIRS DONE / MAINTENANCE | (R) REPAIR ORDER | (D) DOCK SPECS | FOLLOW-UP REQUIRED |
|---|---|---|---|---|---|---|
| | | | | | | |

NOTE :

(1) INSPECTION : X = Inspected NA = Not applicable (2) For coating breakdown and pitting intensity, please refer to assessment scale.



## Apply Your Knowledge

1. Assist the chief officer in making tank inspections of a double bottom and a topside tank. Make sketches showing the lay-out of principal structural members in both the cases.
2. Discuss the types of paints used inside ballast tanks on board your vessel.

**Function:** Cargo Handling and Stowage

**Competence:** Inspect and report defects and damage to cargo spaces, hatch covers and ballast tanks

**Task number:** B2.1

**Sub-task Reference number:** B2.1.14

**Topic:** Inspection of cargo spaces, hatch covers and ballast tanks

**Task Heading**

- Assist in inspection and cleaning of fresh water tanks.

**Objectives**

- Understand the importance and procedure of carrying out fresh water tank inspection and cleaning

**Index**

1. Introduction
2. Fresh water tanks – construction and fittings
3. Cleaning and painting of fresh water tank

**Description**

**1) Introduction**

Fresh water used on board shall be free from causes of infection, be bright, clear and virtually colorless. It should be aerated which should bubble when shaken, otherwise it has an insipid taste. All fresh water produced on board ship is provided with systems such as electro-silver ionization systems to disinfect it automatically. Closer attention needs to be given to the quality of freshwater in ships' storage and distribution systems in relation to the growth of various potentially dangerous bacteria, or to the presence of toxic chemicals. The harmful bacteria are likely to affect the digestive system by ingestion through drinking and the respiratory system through a fine mist as created by shower or tap sprays of wash water.

**2) Fresh water tanks – construction and fittings**

- These tanks are independent tanks normally sited above the inner bottom, independent of the hull, readily accessible for inspection, cleaning and coating. Forepeak tanks by nature are much more susceptible to damage and hence are not used for fresh water. Aft-peak tanks also are not preferred due to access and cleaning being restricted in these tanks. In ships, with only one freshwater storage tank sited in the double bottom, an alternative reserve drinking water tank is provided for use in emergency.

- Manhole accesses to freshwater tanks are sited clear of possible sources of contamination. No piping other than piping containing freshwater of

> Enclosed space entry permit procedures shall be followed for inspection and maintenance routines of freshwater tanks. (Refer task C7.1.2.1)

> Persons inspecting or working in freshwater tanks should wear clean clothing and footwear preferably the one which has not been used for any other work area. Additionally, the personnel shall not be suffering from any communicable disorder, diarrhoea or skin infection.

the same standard as the tank contents is allowed to pass through a freshwater tank. Air pipes, filling pipes and where practicable sounding pipes, are provided sufficiently high above the deck to prevent fouling. Air pipes are of the swan neck type sited in a protected position where the entry of sea water on deck is prevented. Sight glasses or gauges are provided to indicate the water level in the storage tanks in order to avoid the use of sounding rods to the extent practicable.

**3) Cleaning and painting of fresh water tank**

- Freshwater tank structure when new is thoroughly wire brushed, scrubbed and primed before coating with cement wash or a proprietary coating system such as epoxy finishes and thoroughly aired before filling. When using epoxy paints, it is essential that the coatings are applied and allowed to cure strictly in accordance with the manufacturer's instructions; else the water stored can subsequently become unfit for use.

- For cleaning, inspection and maintenance the tanks shall be emptied, opened up, ventilated and inspected at intervals usually at intervals of 12 months. The cleaning process shall include disinfection with a solution of 50 ppm chlorine. Additionally tanks should be thoroughly pumped out at approximately 6 month intervals. After thorough cleaning, the tanks are closely inspected for any signs of corrosion and damages etc. The surfaces are recoated as necessary, aired and then refilled with clean freshwater.

- It is further recommended that at every refit, tanks should be super-chlorinated at a concentration of 50 ppm for a period of not less than 4 hours and then completely flushed out and refilled at 0.2 ppm concentration. The water in use is chlorinated to a concentration of at least 0.2 ppm. It is recommended that, initially a concentration of 0.5 ppm in the storage tanks is aimed for.

| **Amount of chlorine compound required for a 0.5 ppm chlorine solution** | | | | |
|---|---|---|---|---|
| | *Amount of chlorine compound required* | | | |
| | *High-test calcium hypochlorite 70%* | *Chlorinated lime 25%* | *Sodium Hypochlorite solution* | |
| | | | *5%* | *10%* |
| for each: | *g* | *g* | *ml* | *ml* |
| 1,000 litres | 0.8 | 2 | 10 | 5 |
| 10 tonnes | 8 | 20 | 100 | 50 |

- The various elements of the freshwater production, treatment, and delivery system shall be inspected, cleaned, flushed out, back washed, re-charged or items replaced where appropriate, in accordance with the makers' instructions.

- Items of fresh water system such as filters may require careful and frequent attention on a monthly basis to clean. Same may necessitate changing the media to ensure that the apparatus has not become contaminated by bacteria or other foreign matter. Calorifiers should be opened up and inspected scaled and cleaned periodically and before draining should be raised to a temperature of 70°C for at least 1 hour to ensure destruction of bacteria which may have colonized the lower and cooler zone of the unit.

- The hoses used for filling fresh water tanks shall be disinfected every 6 months, or whenever any contamination is suspected. Hoses further shall be thoroughly flushed through and completely filled with a solution of 50 ppm residual free chlorine which should then be allowed to stand for a period of at least 1 hour before the hoses are emptied and re-stowed.

- Guidance for the manual chlorination and super-chlorination of freshwater tanks is given in the ship captain's medical guide. The procedures as per the shipboard PMS shall be followed for inspection and maintenance of fresh water system.

- It is recommended that water be tested for bacterial and chemical contamination in accordance with flag state requirements and as per the shipboard SMS procedures. This could vary from every 3 to 6 months. The local port health authority may arrange to take samples and have these analysed.

**Apply Your Knowledge**

1. Check the location and capacity of the fresh water tanks provided on board your vessel.
2. Identify the chlorinating agent used on board your vessel for fresh water.
3. Discuss when and where were the fresh water tanks cleaned and inspected on your vessel.

## Semester 5

## Function 3: Controlling the operation of the ship and care for persons on board and Ship Security

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Ensure compliance with pollution prevention requirements

**Task number:** C 1.1

**Sub-task Reference number:** C1.1.8

**Topic:** Bunkering procedures

**Task Heading**

- Demonstrate understanding of the drip sampling procedure.

**Objectives**

- To understand the importance and procedure of Bunker sampling.

**Index**

1) Importance of bunker sampling
2) Sampling procedure
   a) Sampling method
   b) Drip sampling procedure
   c) Number of samples

**Description**

**1) Importance of bunker sampling**

- For satisfactory operation of the engines, the fuel used has to comply with minimum specifications with regards to its various contents. The most common factor is the water content in the fuel. Further, the regulations in MARPOL Annex VI outline the limits of sulphur content in the fuel. Fuel sampling and analysis is therefore essential to assess the quality of the fuel received onboard in order to reduce/ minimize the risk of breakdown of machinery or of claims arising. Only desired ISO grade fuel as mentioned in the charter party shall always be ordered.

- Bunker fuel samples should be sent to the laboratory for testing as soon as possible after completion of bunkering. Fast, reliable testing service shall be used to analyse the samples. If off-spec bunkers have been delivered and are found to be unsuitable for use, the bunkers should be off-loaded and replaced by new on-spec bunkers.

- Before taking bunkers on board the supplier's oil specification must be checked. The Bunker Delivery Note (BDN) of the barge must be checked for all characteristics and quantities contained in BDN. In case it appears that the quality is unacceptable or the fuel has excessive difference in one or more parameters with those specified by this office, owners or charterers the bunker must be refused and the company superintendent (and charterers if they have arranged bunkers) immediately notified.

- The BDN should have the following information, as required by Annex VI of Marpol 73/78.
  - Name and IMO number of receiving ship
  - Port
  - Date of commencement of delivery
  - Name, address and telephone number of marine fuel oil supplier
  - Product name(s)
  - Quantity (metric tons)
  - Density at 15°C (kg/m$^3$)
  - Sulphur content (% m/m)
  - Declaration, by appending signatures of the suppliers that the fuel oil supplied conforms to MARPOL ANNEX VI.

- ➢ The ship shall keep the BDN in record with all of the above items clearly stated, so that it is available for inspection easily. The documents are to be kept for a period of three years since the date of supply.
- ➢ When new bunkers are taken on board, it should be put to use only after the analysis report is received. At ports known for inferior quality of fuel supply, strict follow up of procedures is of great importance. Even with slightest doubt on quality in these ports request should be made to office for analysis of sample soonest possible.

**2) Sampling procedure**

Full record of the information about the barge, cargo officer, supplier, time, date, and circumstances etc. shall be maintained. A request to witness sampling form shall be filled up and the supplier's representative shall be invited to witness the sampling procedures. In rare cases, if the supplier declines to attend the witnessing of sampling, it is essential that this fact is recorded in the ship's log book at the time as contemporaneous evidence for future reference in case there is dispute. Further a letter of protest should be issued.

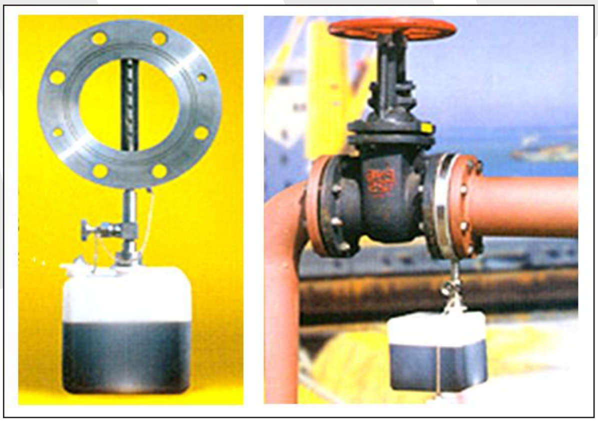
**a) Sampling method**

The primary sample is obtained by one of the following methods:
- ❖ manual valve-setting continuous-drip sampler
- ❖ time-proportional automatic sampler
- ❖ flow-proportional automatic samplers

Sampling equipment should be used in accordance with manufacturer’s instructions, or guidelines, as appropriate.

**b) Drip sampling procedure**

❖ **Sampling device**



- ✓ Proper sampling during a bunker transfer operation is extremely important, because continuous drip sampling at the point of custody transfer is the only secure way to ascertain the quality of the product received by the buyer.
- ✓ Drip sampler is inserted at the manifold between the two flanges.
- ✓ It shall be ensured that vessel has a proper sampling device at the vessel's bunker manifold.
- ✓ The sampling device and collection container should be clean and ready for use.
- ✓ A continuous drip sample shall be taken. The needle valve of the sampler shall be adjusted to give a slow and continuous drip throughout the whole bunkering period. Secure the needle valve with a security seal provided and record the seal number to prevent any tampering. Minimum four litres of sample shall be collected.
- ✓ In case it is needed to break the seal on the needle valve to make adjustments, the bunker barge cargo officer or his representative shall be present while adjusting the drip and replacing the security seal.

❖ During sampling attention shall be paid to:
- ✓ The form of set up of the sampler
- ✓ The form of the primary sample container
- ✓ The cleanliness and dryness of the sampler and the primary sample container prior to use
- ✓ The setting of the means used to control the flow to the primary sample container
- ✓ The method to be used to secure the sample from tampering or contamination during the bunker operation

### c) Number of samples

- Four samples would be required to be taken at the time of bunkering as follows. When bunkering fuel of the same grade from two or more barges at one bunkering, these samples would be required for each one of the barges.
  - ✓ Retained sample (this sample is retained on board for a period of at least 90 days after consuming the bunker oil to act as evidence in case it is suspected that the bunker supplied is out of specification)
  - ✓ Sample for supplier
  - ✓ Sample to be sent for analysis
  - ✓ MARPOL sample for showing the sulphur content (this sample is retained on board until the fuel oil is substantially consumed, but in any case for a period of not less than 12 months from the time of delivery, which is to be used solely for determination of compliance with Annex VI of MARPOL 73/78

- Four sample bottles of 750 ml. each shall be filled. Each bottle shall be filled partly at a time and contents shaken in order to mix well. Fill up three fuel quality testing sample bottle labels and one MARPOL sample bottle label. Seal all bottles and sign all labels, jointly with the supplier’s representative and attach them to the sample bottles.

- A tamper proof security seal with a unique means of identification should be installed by the local supplier’s representative in the presence of the ship's representative immediately after collection of the retained sample. A label containing the following information should be secured to the retained sample container:
  - place where sample is taken and sampling procedure
  - location at which, and the method by which, the sample was drawn
  - date of delivery
  - name of bunker barge/bunker installation
  - name and IMO number of the receiving ship
  - signatures and names of the supplier’s representative and the ship's representative
  - details of seal identification
  - bunker grade(i.e. 380 Cst RMG 35 or as appropriate)

- In extreme circumstances where suppliers representative refuses to accept or sign the representative samples a letter of protest should be issued to the supplier and immediate contact should be made with the office.

- One bottle of sample is sent for testing to the nominated laboratory together with the chief engineer’s form and a copy of the BDN (fuel quality sample).

### Apply Your Knowledge

1. Observe the sampling procedure while bunkering on board your vessel. Discuss how and where the samples retained on board are stored and the associated record keeping.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Ensure compliance with pollution prevention requirements

**Task number:** C 1.1

**Sub-task Reference number:** C1.1.9, C1.1.10, C1.1.11

**Topic:** Bunkering procedures

**Task Heading**

- Demonstrate understanding of the emergency shutdown procedure during bunkering.
- Participate and understudy the team leaders in an emergency response exercise for controlling spillage of oil (pipeline failure, equipment failure, structural failure, stranding).
- Participate and understudy the team leaders in a drill for clean-up of hazardous cargo spillage.

**Objectives**

- Understand emergency shutdown procedures during bunkering.
- Understand the procedure of emergency response exercises for controlling spillage of oil/ hazardous cargo

Please read this task in conjunction with tasks A5.1.2.6, A5.2.3, A5.2.6, A5.2.7 and C1.1.4

**Index**

1) Emergency shutdown procedure during bunkering
2) Emergency response exercise for controlling spillage of oil and hazardous cargo spillage

**Description**

**1) Emergency shutdown procedure during bunkering**

- Throughout the bunkering operation a responsible person holding experience of and trained in the operation should be stationed at the manifold area to observe the hose and connections for leaks on both the bunker vessel and the receiving vessel. The responsible person on the bunker vessel should have means to immediately stop the operation if leakage is observed or on request from the receiving vessel.

- A safe radio communication should be maintained between the bunker vessel and the receiving vessel during the entire bunkering operation. The communication equipment shall be regularly tested during the operation.

- If any of the receiving vessel's personnel discovers an oil spill either on deck outside fixed containment, or on the water, or believes an oil spill is likely (such as in case of weather deteriorating), he or she shall request immediate shutdown of the bunkering operation.

- This can be done through the following means:
  - Informing the supply barge verbally on VHF
  - Informing the personnel stationed on deck near manifold verbally or by visual signals
  - Informing the supply barge by pre-agreed emergency alarm sounded on ship’s whistle

- Some bunkering companies may place an emergency stop button linked to the barge’s transfer pump, by the ship’s bunkering station. This can be used by the ship’s officer in charge of bunkering should the need arise to stop the bunker barge pumping the fuel. The same shall be tested prior commencing operation.

- The delivering vessel's personnel shall immediately activate the emergency shutdown device at the request of any person on the receiving vessel.

- It should be possible to stop the bunkering supply pumps momentary at a place close to the manifold of the bunker barge.

- As a precautionary measure, in case of tank change-overs or when the bunker tank is observed to be overflowing, the supply line valve shall NEVER be shut; rather an alternative tank line valve shall be opened to contain the spill prior closing the valve of full tank.

**2) Emergency response exercise for controlling spillage of oil and hazardous cargo spillage**

The emergency response exercises for controlling spillage of oil/ hazardous cargo spillage is detailed in the shipboard SOPEP, SMPEP and NTVRP. The drill process shall usually involve respective shipboard emergency teams performing duties as follows:

- **Command team/ bridge team**
- ❖ Raise general emergency alarm followed by the pa announcement identifying the source of spill, area of spill.
- ❖ Stop all operations such as bunkering, ballasting or deballasting or internal transfer
- ❖ Alter course/ position and/or speed, if at sea depending upon the prevailing weather and traffic conditions and the area of navigation
- ❖ Refer to SOPEP/ SMPEP/ VRP
- ❖ Inform coastal authorities as recommended and shipping company
- ❖ Change list and/or trim in order to minimize overboard escape of oil/ chemical
- ❖ Consider transferring of liquid and/or anchor if required to minimize oil outflow
- ❖ Consider the possibility of proceeding to port of refuge for repairs
- ❖ Monitor weather/ tide/ swell forecasts
- ❖ Monitor the slick progress
- ❖ Take photographs if possible
- ❖ Take statements from all involved

> Oil Spill Dispersant shall not be used for cleaning purposes without the express permission from the

- **Emergency team/ special duty team**

- ❖ On scene coordination by the team leader as follows:
- ✓ Advising the command team regarding progress in containing the oil spill on board
- ✓ Making arrangements to plug all scuppers and drip trays
- ✓ Making arrangements to use absorbent materials to clean up spill that has spilled on deck
- ✓ Ensure that no oil is washed over side
- ✓ Will ensure that oil clean-up is done by the team from outboard to inboard
- ✓ Measures taken to ensure that all spill is contained on board
- ✓ To reduce the risk of fire and explosion
  - All non-essential air intakes are shut
  - shut down accommodation and ER ventilation
  - shut all external doors and ports in accommodation
- ✓ No smoking regulations enforced on board
- ✓ Obtain names of shore personnel assisting vessel
- ✓ Additionally in the event of tank overflow – To be coordinated on scene by the chief engineer in case of bunkering and chief officer in case of cargo operations
  - Stop all operations (bunkering, transfer, cargo operation as applicable) immediately
  - Inform the bunker barge/ cargo terminal at the earliest to stop pumping
  - Open valves to empty tanks as available and then close the overflowing tank valves
  - Do not resume operations till the source of spill has been identified and rectified

> MSDS shall be referred to for handling of hazardous chemicals with regards to precautions related to manual handling, fire and toxicity hazards and pollution prevention

- Lower the oil level within tank by dropping back to empty tank or slack tank if possible
- Clean up measures to collect all the spilled oil as per SOPEP recommendations
- Determine quantity of oil lost
- Obtain sample of oil from deck/ water

- **Other teams** shall assist as Instructed depending upon the case.

- **Follow up actions**

- If oil has spilled to sea/ dock, the local P and I representative shall be informed.
- Determine the type of oil that has spilled overboard.
- If oil in harbour, estimate the area covered.
- Monitor weather forecasts, check tide and current.
- Assess the risk to shore line.
- Inform shipping company for any additional assistance required.
- Lodge note of protest.

- **Evidence collection and record keeping**

- Ship's course and speed (chart course, steered course, gyro and magnetic compass) at the time of the spill – if pollution occurred at sea shall be recorded along with prevailing weather conditions (particular wind direction and force) at the time of spill (keep any weather records), tide and current and draught of ship.

**Reporting Pollution Incidents under MARPOL**

Details of who to report the pollution incidents to are provided in SOPEP/ SMPEP.
For ships in a port at the time of an incident, or probable/potential incident, notification should also be made to the local authorities in addition.
The master or other person having charge of any ship involved in an incident is required to make the report. If this cannot be done, then the owner, charterer, manager or operator of the ship, or their agent is responsible for making the report.

**Apply Your Knowledge**

1. Participate in an emergency drill for oil pollution during bunkering and discuss the role of the team leader.
2. Describe the emergency shutdown procedures that are laid down for bunkering operations on your ship.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Ensure compliance with pollution prevention requirements

**Task number:** C 1.1

**Sub-task Reference number:** C1.1.12

**Topic:** Bunkering procedures

**Task Heading**

- Participate in a Bunker line pressure testing operation and state how frequently is it required.

**Objectives**

- Understand the purpose and procedure of bunker line pressure testing.

**Index**

1) Bunker line pressure test
2) Bunker line pressure test procedure
3) Bunker line pressure test precautions

**Description**

**1) Bunker line pressure test**


- The piping from bunkering connections to control valves on subsidiary pipe and from outlet of transfer pump to valves on subsidiary pipe (to each tank) shall be pressure tested. The intention of conducting pressure testing of the bunker line is to ensure that the bunker line is maintained in sound condition avoiding any chances of oil spill or pollution resulting due to unexpected rupture of the bunker line.
- Bunker lines must be pneumatically pressure-tested at least annually and records maintained. However this is not the test accepted under USCG regulations and hydrostatic test is mandatory.

**2) Bunker line pressure testing procedure**

- **In dry dock**

❖ When conducting pressure testing, the bunkering piping is first filled with fuel oil or similar liquid. Then all the valves connected to bunkering piping are closed or sealed by blind plates and the designated pumps are used to pressurize to 1.5 times maximum allowable working pressure (MAWP). The full length of the bunker pipe is then examined for its condition.

❖ Bunker lines are pressure tested under static liquid pressure of at least 1.5 times the maximum allowable working pressure. Overflow and high level alarms (where fitted) are to be tested and recorded as part of the ship's planned maintenance alarm testing routines. Bunker valves and remotely operated valves are checked for correct operation, and glands inspected and lubricated to ensure that they are free to operate. Actuators are checked not leaking and micro-switches are not loose or defective.

❖ The bunkering piping shall then be properly marked (date of test, pressure etc.).

- **Onboard pneumatic test**

- A special blank is fabricated with air connection with shut off valve and a pressure gauge fitting. This is mounted at the bunker manifold on one side and the other side is blanked off. A spoon blank is fitted at the first (or as nearest as possible) flange coupling after the deck penetration.
- The isolated section of pipeline is then pressurized. The air supply is then shut off and steady pressure for 15 minutes is checked. Leakage / loss of pressure when noted is followed by visual inspection and soap bubble test at all weld seams, especially at the deck penetration. The defected area is identified and rectified.
- The bunker main on deck has to be pressure tested to at least 1.25 times the maximum allowable working pressure (MAWP), usually an air pressure of 6-7 bar. Record is maintained in log books for such testing.

**3) Bunker line pressure testing precautions**

- A proper risk assessment identifying the hazards and required mitigating precautions is to be carried out.
- Testing with gas (including air) could be dangerous and the following precautions should be taken:

- Pressure should be increased gradually in ‘steps’ of about 0.5 bar.
- The gauge used for testing must be calibrated against a standard gauge.
- If the source of gas supply is at a higher pressure than the test pressure, a pressure reducing valve, pressure gauge and a relief valve set to open at the test pressure should be fitted.
- If flexible piping is involved, all fittings should be securely fitted to avoid “whiplash”.
- This shall be carried out by a responsible ship’s engineer under supervision of the chief engineer or as required by company SMS procedures.

**Apply Your Knowledge**

1. Check the marking of your vessel’s bunker line regarding pressure testing. Discuss the procedures followed in this respect.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Ensure compliance with pollution prevention requirements

**Task number:** C 1.2

**Sub-task Reference number:** C1.2.8

**Topic:** Pollution prevention regulations

**Task Heading**

- Read and discuss the criteria for disposal of cargo residues with STO.

**Objectives**

- The task covers the criteria for disposal of cargo residues generated on board the vessels.

> Please read this task in conjunction with tasks C1.2.3 and C1.2.6

**Index**

1) Cargo residues
2) Discharge of cargo residues outside special areas
3) Discharge of cargo residues within special areas
4) Miscellaneous

**Description**

**1) Cargo residues**

"Cargo residues" means the remnants of any cargo which are not covered by other annexes to the MARPOL convention and which remain on the deck or in holds following loading or unloading, including loading and unloading excess or spillage, whether in wet or dry condition or entrained in wash water but does not include cargo dust remaining on the deck after sweeping or dust on the external surfaces of the ship.

**2) Discharge of cargo residues outside special areas**

Discharge of the following garbage into the sea outside special areas shall only be permitted while the ship is en route and as far as practicable from the nearest land, but in any case not less than:

- ❖ 12 nautical miles from the nearest land for cargo residues that cannot be recovered from holds using commonly available methods for unloading. These cargo residues shall not contain any substances classified as harmful to the marine environment, taking into account MEPC guidelines.
- ❖ For animal carcasses, discharge shall occur as far from the nearest land as possible, taking into account the MEPC guidelines.
- ❖ Cleaning agents or additives contained in cargo hold, deck and external surfaces wash water may be discharged into the sea, but these substances must not be harmful to the marine environment.
- ❖ When garbage is mixed with or contaminated by other substances prohibited from discharge or having different discharge requirements, the more stringent requirements shall apply.

**3) Discharge of cargo residues within special areas**

Discharge of the following garbage into the sea within special areas shall only be permitted while the ship is en route and the following conditions are satisfied:

- ❖ Discharge of cargo residues that cannot be recovered from holds using commonly available methods for unloading, where all the following conditions are satisfied:
  - ✓ Cargo residues, cleaning agents or additives, contained in hold washing water do not include any substances classified as harmful to the marine environment, taking into account MEPC guidelines.
  - ✓ Both the port of departure and the next port of destination are within the special area and the ship will not transit outside the special area between those ports.
  - ✓ No adequate reception facilities are available at those ports.
  - ✓ Where the above conditions are being fulfilled, discharge of cargo hold washing water containing residues shall be made as far as practicable from the nearest land or the nearest ice shelf and not less than 12 nautical miles from the nearest land or the nearest ice shelf.

- ❖ Cleaning agents or additives contained in deck and external surfaces wash water may be discharged into the sea, but only if these substances are not harmful to the marine environment.

| **Garbage type**[1] | **All ships except platforms**[4] | |
|---|---|---|
| | **Outside special areas Regulation 4 (Distances are from the nearest land)** | **Within special areas Regulation 6 (Distances are from nearest land or nearest ice-shelf)** |
| Food waste comminuted or ground[2] | $\geq$3 nm, en route and as far as practicable | $\geq$12 nm, en route and as far as practicable[3] |
| Food waste not comminuted or ground | $\geq$12 nm, en route and as far as practicable | Discharge prohibited |
| Cargo residues[5, 6] not contained in washwater | $\geq$ 12 nm, en route and as far as practicable | Discharge prohibited |
| Cargo residues[5, 6] contained in washwater | | $\geq$ 12 nm, en route and as far as practicable (subject to conditions in regulation 6.1.2) |
| Cleaning agents and additives[6] contained in cargo hold washwater | Discharge permitted | $\geq$ 12 nm, en route and as far as practicable (subject to conditions in regulation 6.1.2) |
| Cleaning agents and additives[6] in deck and external surfaces washwater | | Discharge permitted |
| Animal Carcasses (should be split or otherwise treated to ensure the carcasses will sink immediately) | Must be en route and as far from the nearest land as possible. Should be >100 nm and maximum water depth | Discharge prohibited |
| All other garbage including plastics, synthetic ropes, fishing gear, plastic garbage bags, incinerator ashes, clinkers, cooking oil, floating dunnage, lining and packing materials, paper, rags, glass, metal, bottles, crockery and similar refuse | Discharge prohibited | Discharge prohibited |

1 When garbage is mixed with or contaminated by other harmful substances prohibited from discharge or having different discharge requirements, the more stringent requirements shall apply.

2 Comminuted or ground food wastes must be able to pass through a screen with mesh no larger than 25 mm.

3 The discharge of introduced avian products in the Antarctic area is not permitted unless incinerated, autoclaved or otherwise treated to be made sterile.

4 Offshore platforms located 12 nm from nearest land and associated ships include all fixed or floating platforms engaged in exploration or exploitation or associated processing of seabed mineral resources, and all ships alongside or within 500 m of such platforms.

5 Cargo residues means only those cargo residues that cannot be recovered using commonly available methods for unloading.

6 These substances must not be harmful to the marine environment.

## 4) Miscellaneous

- Cargo hold washings are the material left after the cargo residues have been removed and disposed of accordingly, which is entrained in wash-water resulting from the cleaning of cargo spaces and hatches. After unloading bulk cargoes many ships will wash their holds or decks to remove this excess or spilt material as it could contaminate the next cargo. In such cases this material can be disposed of at sea so long as it is inert, the content has been minimized by removing as much cargo residue as possible and any disposal complies with the MARPOL Regulations.

- Cargo materials contained in the cargo hold bilge water is not treated as cargo residues provided that the cargo material is not classified as a marine pollutant in the IMDG code and the bilge water is discharged from a **loaded** hold through the vessel's fixed piping bilge drainage system.

- If the material is a marine pollutant, a hazardous or noxious material, or a material that could cause secondary pollution on contact with the sea (such as petroleum coke, which if disposed of at sea, can cause a sheen on the surface, which will put the ship in contravention of Annex 1 of MARPOL 73/78), then any washings should be disposed of on shore through appropriate reception facilities.

- If the detergent/chemical used for hold/ tank cleaning, is a substance that falls within Annex I (Oil) or Annex II (Noxious Liquid Substance) then the washing effluent generated from any washing process using the particular substance may require to be handled in accordance with the particular Annex. The associated restrictions as to its disposal overboard can therefore apply.

- If the cargo is one of those mentioned in MARPOL Annex III respective discharge regulations shall apply. Disposal of harmful packaged substances – Annex III of MARPOL – Disposal at sea is prohibited. These can only be discharged to shore based reception facilities.

- All ships of 100 gross tons and over are required to have an approved garbage management plan and garbage record book. Minimization of cargo residue wash down and discharge should form part of the ship's garbage management plan. Discharge of any type of garbage must be entered in the garbage record book. Violation of these requirements may result in penalties. Discharges of cargo residues also require start and stop positions to be recorded. Port state control officers may check these records.

- The cleaning of cargo residues from a vessel within the twelve nautical mile limit may be permitted in the some circumstances. Same shall be checked in accordance with local regulations.

- The disposal regulations for cargo residues under various **annexes I &II** are as follows:
  - Noxious liquid substances – Annex II of MARPOL – discussed under task G1.1.20
  - Oil or Oily mixtures (including tank washings) from the cargo area of an oil tanker – Annex I to MARPOL

Discharge of oil or oily mixtures from the cargo area of an oil tanker is prohibited except only when

- ✓ the tanker is not within a special area
- ✓ the tanker is more than 50 nautical miles from the nearest land
- ✓ the tanker is proceeding en route
- ✓ the instantaneous rate of discharge of oil content does not exceed 30 litres per nautical mile
- ✓ the total quantity of oil discharged into the sea does not exceed
  - for tankers delivered on or before 31 December 1979, 1/15,000 of the total quantity of the particular cargo of which the residue formed a part, and
  - for tankers delivered after 31 December 1979, 1/30,000 of the total quantity of the particular cargo of which the residue formed a part
- ✓ the tanker has in operation an approved oil discharge monitoring and control system and a slop tank arrangement
- ✓ When cargo tank washing are retained on board, these are often discharged ashore using techniques of 'Load on Top' which is discussed in detail under task F1.1.27.

**Apply Your Knowledge**

1. Considering the last cargo carried on board as grain in bulk, discuss the precautions adopted for minimizing the cargo residues generating from hold sweepings. Also discuss the disposal procedures for hold sweepings so generated in accordance with applicable MARPOL regulations.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Ensure compliance with pollution prevention requirements

**Task number:** C 1.2

**Sub-task Reference number:** C1.2.9

**Topic:** Pollution prevention regulations

**Task Heading**

- ➢ Identify the Emission Control Area under MARPOL Annex VI.

**Objectives**

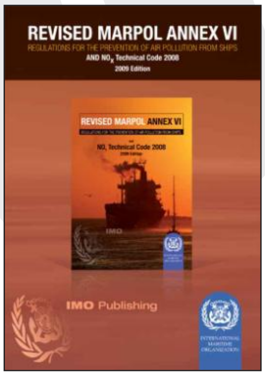
- ➢ Understand the MARPOL Annex VI regulations with respect to emission control areas and procedures to control air pollution from ships.

**Index**

1) Introduction
2) Sulphur oxides (SOx) and particulate matter
3) Emission control area
4) Fuel oil quality and availability
5) Port state control on operational requirements

**Description**

**1) Introduction**




MARPOL Annex VI was adopted in 1997. It limits the air pollutants contained in ships exhaust gas, incinerators etc., including sulphur oxides (SOx) and nitrous oxides (NOx), volatile organic compounds and ozone depleting substances. Regulations have been made for ozone-depleting substances, volatile organic compounds, shipboard incineration, reception facilities, fuel oil quality and availability.

**2) Sulphur oxides (SOx) and particulate matter**

- ➢ The sulphur content of any fuel oil used on board ships shall not exceed the following limits
- ❖ 4.50% m/m prior to 1 January 2012
- ❖ 3.50% m/m on and after 1 January 2012
- ❖ 0.50% m/m on and after 1 January 2020

- ➢ The worldwide average sulphur content of residual fuel oil supplied for use on board ships shall be monitored as per IMO guidelines.

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| Under the revised MARPOL Annex VI, the global sulphur cap is reduced initially to 3.50% (from the current 4.50%), effective from 1 January 2012; then progressively to 0.50 %, effective from 1 January 2020, subject to a feasibility review to be completed no later than 2018. The limits applicable in Emission Control Areas for SOx and particulate matter were reduced to 1.00%, beginning on 1 July 2010 (from the original 1.50%); being further reduced to 0.10 %, effective from 1 January 2015. |

- ➢ Emission control requirements
  While ships are operating within ECAs, the sulphur content of fuel oil used on board ships shall not exceed the following limits.
  - ✓ 1.00% m/m on and after 1 July 2010
  - ✓ 0.10% m/m on and after 1 January 2015

- ➢ Limitations in sulphur content, applies to all fuel oils (heavy fuel oils, marine diesel oils and

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|---|
| From 1 January 2010, in EU territory are 0.1% sulphur limit starts to apply to all types of marine fuel used by ships at berth in EU ports and by inland waterway vessels. This applies to any use of the fuel e.g. in auxiliary engines, main engines, boilers. |

gas oils) and regardless of use on board.

As a substitute to low sulphur fuel, approved exhaust gas cleaning systems are on trial for fitting on board. In exhaust gas cleaning systems (EGCS) sulphur oxides in the exhaust gas stream are captured and neutralized by scrubbing water.

**3) Emission control area**

Emission control area means an area where the adoption of special mandatory measures for emissions from ships is required to prevent, reduce and control air pollution from NOx or SOx and particulate matter or all three types of emissions impacts on human health and the environment. Emission control areas include those listed in, or designated under, regulations 13 and 14 of this Annex

Emission Control Area with reference to MARPOL Annex VI

SOx and particulate matter Emission Control Areas include

- ❖ Baltic Sea area
- ❖ North Sea
- ❖ North American Area
- ❖ United States Caribbean Sea Area (with effect from 1 Jan 2013)

The North American Sea Area mentioned above includes the sea area located off the Pacific coasts of the United States and Canada, the sea areas located off the Atlantic coasts of the United States, Canada, and France (Saint-Pierre-et-Miquelon) and the Gulf of Mexico coast of the United States, the sea area located off the coasts of the Hawaiian Islands of Hawaii, Maui, Oahu, Moloka´i, Ni´ihau, Kaua´i, Lāna´i, and Kaho´olawe.

The United States Caribbean Sea Area includes sea area located off the Atlantic and Caribbean of the Commonwealth of Puerto Rico and the States Virgin Islands.
The coordinates of the above areas are mentioned in MARPOL.

**4) Fuel oil quality and availability**

- ➢ If a ship is found not to be in compliance with the standards for compliant fuel oils the competent authority can require the ship to present a record of the actions taken to attempt to achieve compliance and provide evidence that it attempted to purchase compliant fuel oil in accordance with its voyage plan and, if it was not made available where planned, that attempts were made to locate alternative sources for such fuel oil and that despite best efforts to obtain compliant fuel oil, no such fuel oil was made available for purchase. A ship shall notify its Administration and the competent authority of the relevant port of destination when it cannot purchase compliant fuel oil.
- ➢ Details of fuel oil for combustion purposes delivered to and used on board shall be recorded by means of a bunker delivery note which shall contain at least the information specified in appendix V to this Annex.6 The bunker delivery note shall be kept on board the ship in such a place as to be readily available for inspection at all reasonable times. It shall be retained for a period of three years after the fuel oil has been delivered on board. The bunker delivery note shall be accompanied by a sealed representative sample of the fuel oil delivered.

**5) Port state control on operational requirements**

A ship, when in a port or an offshore terminal is subject to inspection by port state controls concerning operational requirements under Annex VI, where there are clear grounds for believing that the ship staff is not familiar with essential shipboard procedures relating to the prevention of air pollution from ships. Ships may be detained in cases of violations and enforcement.

**Apply Your Knowledge**

1. Check if at any occasion, your vessel has picked up low sulphur fuel/ diesel oil and the areas where the same were used.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Ensure compliance with pollution prevention requirements

**Task number:** C 1.2

**Sub-task Reference number:** C1.2.10

**Topic:** Pollution prevention regulations

**Task Heading**

- Attend in the engine room when oily water separator is in operation and demonstrate understanding of its operation.

**Objectives**

- Understand the oily bilge water discharge regulations as set in MARPOL
- Understand the functioning of oily water separator and oil content monitor

**Index**

3) Discharge of oily bilge water
4) Operation of oily water separator
5) Operation of oil content monitor (OCM) and automatic stopping device
6) Malfunctioning of oily water separator
7) Standard discharge connection
8) Use of oily water separator and oil content monitor

**Description**

**1) Discharge of oily bilge water**

- Oily bilge water means water which may be contaminated by oil resulting from things such as leakage or maintenance work in machinery spaces. Any liquid entering the bilge system including bilge wells, bilge piping, tank top or bilge holding tanks is considered oily bilge water.
- As regulated by MARPOL annex I, the oily bilge water can NOT be discharged directly into sea. A tank named as oily bilge water holding tank is provided for collecting oily bilge water on board prior to its discharge, transfer or disposal.

**Criteria for Discharge of Oily Bilge Water**

(From ships of 400 gross tonnage and above, excluding ships, such as hotel ships, storage vessels etc., which are stationary except for non-cargo-carrying relocation voyages)

**Outside Special Areas**

Discharge of oily bilge water is prohibited except when all the following conditions are satisfied:

- ❖ the ship is proceeding en route
- ❖ the oily mixture is processed through an approved oil filtering equipment, oil content monitoring and automatic stopping device (and alarm system for ships of gross tonnage $\geq$ 10000)
- ❖ the oil content of the effluent without dilution does not exceed 15 parts per million
- ❖ the oily mixture does not originate from cargo pump room bilges on oil tankers
- ❖ the oily mixture, in case of oil tankers, is not mixed with oil cargo residues.

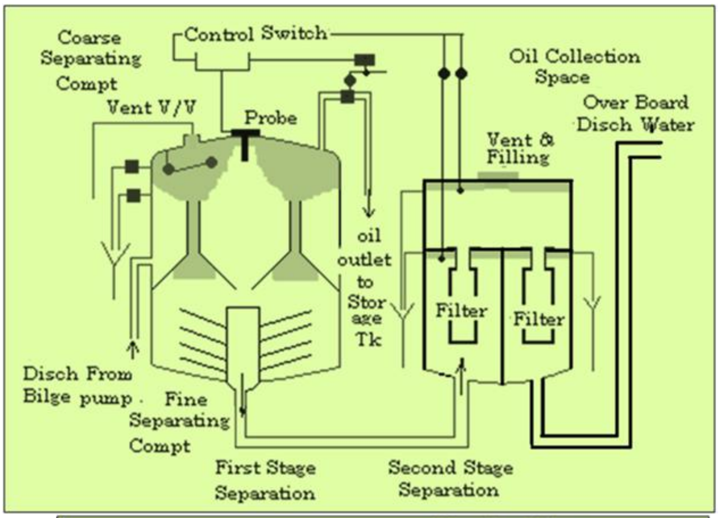
**Inside Special Areas**

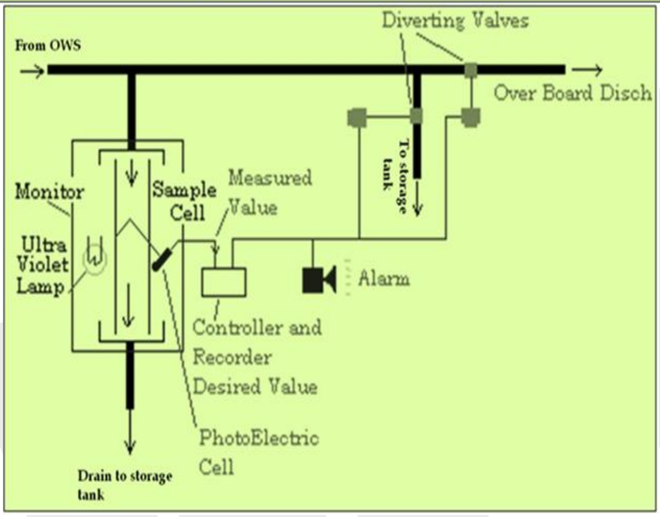
Discharge of oily bilge water is prohibited except when all the following conditions are satisfied:

- ❖ the ship is proceeding en route
- ❖ the oily mixture is processed through an approved oil filtering equipment, oil content monitoring system, automatic stopping device and alarm system
- ❖ the oil content of the effluent without dilution does not exceed 15 parts per million
- ❖ the oily mixture does not originate from cargo pump room bilges on oil tankers
- ❖ the oily mixture, in case of oil tankers, is not mixed with oil cargo residues
- ❖ In respect of the Antarctic area, any discharge into the sea of oil or oily mixtures from any ship shall be prohibited.

**2) Operation of oily water separator**

- ➢ During operation, the complete unit is first filled with clean seawater. The oily water mixture is then pumped through the separator inlet pipe into the coarse separating compartment. Here, as a result of lower density, some oil separates and rises intro the oil collection space. The remaining oil water mixture now flows down in the fine separating compartment and moves slowly between the catch plates. More oil separates out onto the underside of the catch plates and travel outwards until it is free to rise into the oil collecting space. The almost oil free water passes into the central pipe and leaves the separator unit. The purity at this point will be 100 ppm or less. An automatically controlled valve releases the separated oil into the storage tank. Air is released from the unit by a vent valve. Steam or electric heating coils are provided in the upper and sometimes lower parts of the separator, depending upon the type of oil to be separated (heating reduces viscous drag of oil and thus makes separation of oil and water easier).
- ➢ For further purity, the almost oil free water, as mentioned above, passes to a filter unit. The water flows in turn through two filter stages and oil removed passes to oil collecting spaces. The first stage filter removes physical impurities and promotes some fine separation. The second stage filter uses coalesce inserts to achieve the final de-oiling. (Coalescence is the breakdown of the surface tension between oil droplets in an oily water mixture which causes them to join and increase in size.)
- ➢ The oil from the collecting spaces is drained away manually, as required, usually about once a week. The filter inserts will require changing, the period of useful life depending upon the operating conditions. The capacity of the supply pump is kept not exceeding 110% of the rated capacity of the OWS. A sampling point is provided in a vertical section of the water effluent piping as close as is practicable to the separator outlet.




### 3) Operation of oil content monitor (OCM) and automatic stopping device

- Regulations with respect to the discharge of oily water set limits of the oil concentration upto 15 ppm. An oil content monitor is provided in order to measure these values and provide continuous records. An alarm is provided to indicate when the permitted level is exceeded. The OCM records the date, time and alarm status, and operating status of the oily bilge separator. OCMs are provided with a memory card that records important data when the OWS is in use. The recording devices are designed to store data for at least 18 months and are able to display or print a protocol for official inspections as required. In addition a ppm display is also provided on the monitor.

- The principle used for monitoring oil content is 'ultra violet fluorescence'. A sample is drawn from the overboard discharge and passes through sample cell. An ultra violet light is directed at the sample and the fluorescence is monitored by a photoelectric cell. The measured value is compared with the maximum desired value in the controller/ recorder. Where an excessive level of contamination is detected an alarm sounds and the flow is diverted. The discharge liquid is then passed to a storage tank.

- The automatic stopping device is a device used to automatically stop any discharge overboard of oily mixture when the oil content of the effluent exceeds 15 ppm. The automatic stopping device consists of a valve arrangement installed in the effluent outlet line of the oily bilge separator which automatically diverts the effluent mixture from being discharged overboard back to the ship's bilges or bilge tank when the oil content of the effluent exceeds 15 ppm.

- The layout of the installation of OCM and automatic stopping device is so arranged so that the overall response time between an effluent discharge from the OWS exceeding

15 ppm, and the operation of the automatic stopping device preventing overboard discharge is not more than 20 sec.

**4) Malfunctioning of oily water separator**

- The principle of separation on which the oily water separator functions is the gravity differential between oil and water. The force acting on an oil globule to move in the water is proportional to the difference in weight between the oil particle and a particle of water of equal volume. Also the resistance to move the globule depends on its size and viscosity of the fluid. Hence the rate of separation greatly depends on the size of oil/water globule, ambient temperature of the system and use of sea water
- In order to ensure effective performance, supply pumps to the separator shall be so selected that the churning of the oily water mixture is minimized. This is best achieved by positive displacement pumps such as slow running double vane, screw, reciprocating or gear pump.

**5) Standard discharge connection**
To enable pipes of reception facilities to be connected with the ship's discharge pipeline for residues from machinery bilges and from sludge tanks, both lines shall be fitted with a standard discharge connection in accordance with the standard dimensions.

**6) Use of oily water separator and oil content monitor**

- The oily water separator is not to be used without prior permission of chief engineer. The chief engineer, prior to the transfer operation, must confirm vessel's position with the bridge, with due consideration to the estimated duration of the operation.
- The bilge overboard valve must be kept locked in the shut position at all times and not be opened without the consent of chief engineer. The keys shall be kept by the chief engineer in a secure place.
- Pumping operations shall be carefully monitored in the engine room at all times and all operations shall be duly recorded in the oil record book and signed by the person in charge of the operation. Use of oily water separator should be avoided during long UMS periods and a responsible engineer must be in the engine room.
- The quantity of bilges pumped overboard should be carefully matched with the capacity of the bilge pump, keeping in mind that the pump will not be operating at 100 % capacity.
- The heating system, if applicable, for the oily water separator is to be used at each operation for efficient separation.
- The oily water separator should be flushed with sea water or fresh water (as applicable) before and after each use for a minimum of 15 minutes.
- The failure of OWS must be recorded in the oil record book along with entries for the sealing of the overboard valve. Entries are to be made again in the oil record book when the proper operation of the system is restored along with the entries for the removal of the seal which was fitted to the overboard valve.

**Apply Your Knowledge**

1. Locate the OWS and OCM system on board your vessel and understand its operation with reference to its operations manual.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Ensure compliance with pollution prevention requirements

**Task number:** C 1.2

**Sub-task Reference number:** C1.2.11

**Topic:** Pollution prevention regulations

**Task Heading**

- Read and discuss the regulations governing sewage disposal with STO.

**Objectives**

- Understand the sewage discharge regulations in accordance with MARPOL Annex IV.
- Understand the principles of working of sewage treatment plants used on board

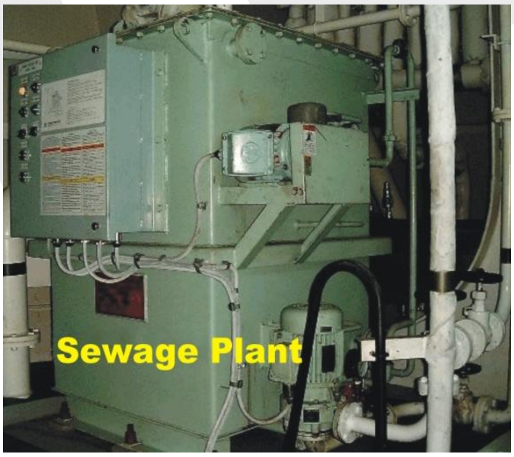
**Index**

1) Introduction
2) Sewage discharge regulations
3) Test standards for sewage treatment plant
4) Need of sewage treatment
5) Chemical sewage treatment
6) Biological sewage treatment
7) Standard discharge connections

**Description**

**1) Introduction**

- Sewage includes the following
  - drainage and other wastes from any form of toilets and urinals
  - drainage from medical premises dispensary, sick bay, etc. via wash basins, wash tubs and scuppers located in such premises
  - drainage from spaces containing live animals
  - other waste waters when mixed with the drainages defined above




- Sewage holding tank is a tank used for the collection and storage of sewage. The discharge of sewage in territorial waters is usually controlled or banned by national legislation. International legislation is in force to cover any sewage discharge within specified distance from land under MARPOL. As a result, and in order to meet certain standards almost all ships have sewage treatment plant installed.

**2) Sewage discharge regulations**

- As per MARPOL Annex IV, the 'Baltic Sea' has been declared a special area with regards to sewage disposal regulation with effect from 1st January 2013.

- Discharge of sewage from ships excluding "passenger ships when in special areas"

  Sewage may be discharged in to the sea on fulfilling the following criteria:
  - Sewage stored in holding tanks is not discharged instantaneously but at a **moderate rate** when the ship is en route and proceeding enroute at not less than 4 knots.
  - For sewage which is comminuted and disinfected using an approved system, the ship is at a distance of more than 3 nautical miles from the nearest land. And the effluent shall not produce visible floating solids nor cause discoloration of the surrounding water.

OR

For sewage which is not comminuted or disinfected, the ship is at a distance of more than 12 nautical miles from the nearest land.

- ❖ When the sewage is mixed with wastes or waste water covered by other Annexes of MARPOL 73/78, the requirements of those annexes shall be complied with in addition to the requirements of this Annex.

- ➢ Discharge of sewage from passenger ships when in special areas will be prohibited from 1st January 2016 onwards. Else they will require an approved sewage treatment plant to be installed on board and the effluent shall produce visible floating solids nor cause discoloration of the surrounding water.

- ➢ Reception facilities are provided at ports and terminals of the reception of sewage where it may be discharged without causing delay to ships, adequate to meet the needs of the ships using them.

- ➢ “International Sewage Pollution Prevention Certificate” is issued valid for a period specified by the Administration which shall not exceed five years. The test results of the sewage treatment plant are laid down in the ship’s “International Sewage Pollution Prevention Certificate”.

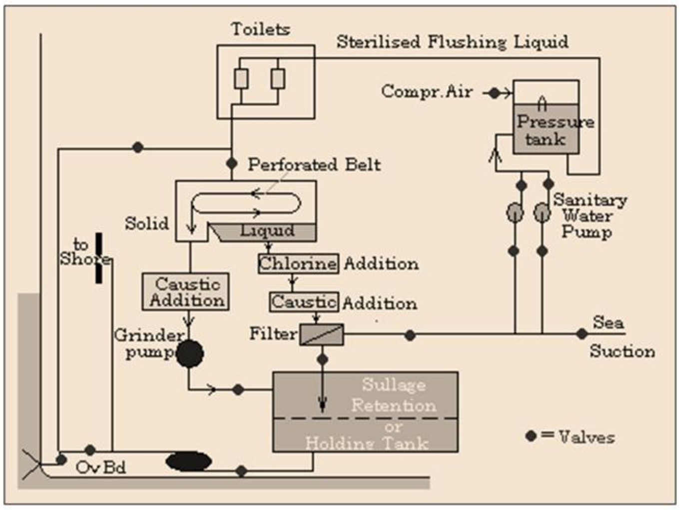
**3) Test standards for sewage treatment plant**

- ➢ Sewage treatment plant shall satisfy the following effluent standards when tested
- ❖ Thermo-tolerant Coliform Standard
- ❖ Total Suspended Solids Standard
- ❖ Biochemical Oxygen Demand and Chemical Oxygen Demand
- ❖ pH
- ❖ Zero or non-detected values

**4) Need of sewage treatment**

As sewage absorbs oxygen for break down, when it is discharged in excessive amounts sewage could reduce the oxygen content of the water to the point harming marine life. Untreated sewage as a suspended solid is unsightly and pungent smells are associated with sewage as a result of bacteria which produce hydrogen sulphide gas. Thermo-tolerant coliforms bacteria when found in pathogenic colonies can cause dysentery, typhoid, para typhoid etc.

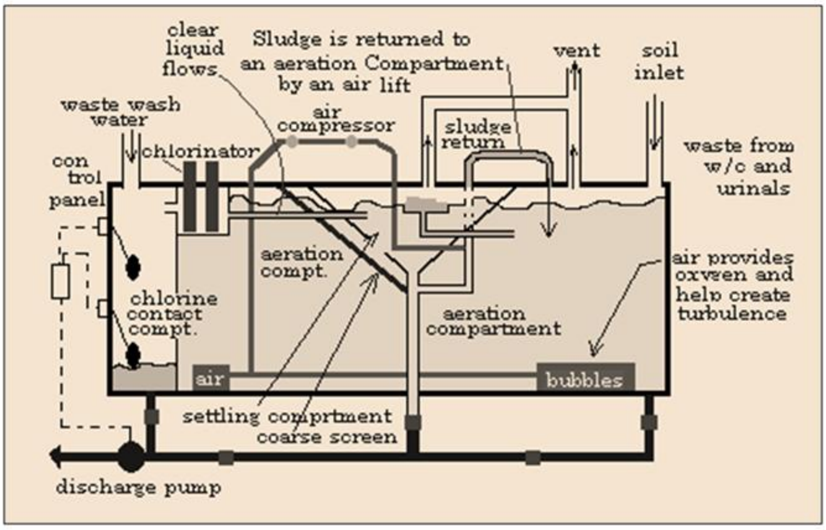
**5) Chemical sewage treatment**




It comprises of a storage tank which collects the solid material for disposal in the permitted areas or to a shore reception facility. The system minimizes the collected sewage, treats it and retains it until it can be discharged. A perforated rubber belt is used to separate liquids from solids in the separating tank. The liquid is then passed through the treatment tanks to a pneu-press arrangement (compressed air pressure tank) for use as a flushing fluid at the toilets. Treatment by chlorine and caustic based compounds makes the liquid affluent acceptable for the purpose. Solids are chemically inerted by a caustic compound and delivered via grinder pump to the holding tank. Capacity of the tank is 2 Litres per person per day. The tank is pumped out to sea or to shore. Tank size is small because liquid effluent passes mainly to the flushing system.

**6) Biological sewage treatment**

- The biological system utilizes bacteria to completely breakdown the sewage in to acceptable substance for discharge into any waters. The extended aeration process provides a climate in which oxygen-loving bacteria multiply and digest the sewage, converting it into sludge. These oxygen-loving bacteria are known as aerobics.




**7) Standard discharge connections**

To enable pipes of reception facilities to be connected with the ship's discharge pipeline, both discharge lines shall be fitted with a standard discharge connection in accordance with the specific standards.

**Apply Your Knowledge**

1. Locate the sewage treatment plant on board your vessel.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Ensure compliance with pollution prevention requirements

**Task number:** C 1.2

**Sub-task Reference number:** C1.2.12

**Topic:** Pollution prevention regulations

**Task Heading**

- Practice the use of the International Maritime Solid Bulk Cargoes (IMSBC) Code for determining emergency procedures for cargo being carried, if applicable.

**Objectives**

- Understanding the hazards associated with the Solid Bulk Cargoes and related precautions with reference to IMSBC code.

Please read this task in conjunction with task B1.3.9

**Index**

1) International Maritime Solid Bulk Cargoes (IMSBC) code
2) General provisions with regards to transport of solid bulk cargoes at sea as per IMSBC code
3) Form for cargo information for solid bulk cargoes
4) Information provided in the IMSBC code
5) Hazards associated with solid bulk cargoes and related precautions
   a) High density cargoes and stresses
   b) Cargo shifting and stability
   c) Liquefaction hazard
   d) Chemical hazard
   e) Health hazards
6) Commonly carried solid bulk cargoes and related carriage procedures
   a) Coal
   b) Sulphur

**Description**

**1) International Maritime Solid Bulk Cargoes (IMSBC) code**


- Any cargo, other than liquid or gas cargo, consisting of a combination of particles, granules or any larger pieces of material generally uniform in composition, which is loaded directly into the cargo spaces of a ship without any intermediate form of containment, is called solid bulk cargo. The transport of solid bulk cargoes at sea is regulated by IMSBC code.

- Bulk cargo shipping name (BCSN) identifies a bulk cargo as listed in the IMSBC Code. The bulk cargo shipping name of the cargo is identified by capital letters in the individual schedules or in the index. When the cargo is a dangerous good, as defined in the IMDG code, the proper shipping name of that cargo is the bulk cargo shipping name.

- IMSBC Code classifies cargoes in three groups A, B and C.
  - Group A consists of cargoes which may liquefy if shipped at moisture content in excess of their transportable moisture limit.
  - Group B consists of cargoes which possess a chemical hazard which could give rise to a dangerous situation on a ship.

- ❖ Group C consists of cargoes which are neither liable to liquefy (Group A) nor to possess chemical hazards (Group B).

**2) General provisions with regards to transport of solid bulk cargoes at sea as per IMSBC code**

- ➢ The shipper shall provide appropriate information on the cargo sufficiently in advance of loading. The cargo information shall include a general description of the cargo, the gross mass of the cargo or of the cargo units, physical and chemical properties of the cargoes and any relevant special properties of the cargo.
- ➢ Prior to loading a solid bulk cargo, the master shall be provided with comprehensive information on the ship's stability and on the distribution of cargo for the standard loading conditions.
- ➢ Before a solid bulk cargo is loaded or unloaded, loading plan shall be agreed between the vessel and the terminal representative. It shall be ensured that the permissible forces and moments on the ship are not exceeded during loading or unloading, and the loading plan includes the sequence, quantity and rate of loading or unloading, taking into consideration the speed of loading or unloading, the number of pours and the deballasting or ballasting capability of the ship.
- ➢ The operations shall be continuously monitored and records such as hourly drafts etc. shall be maintained. If during loading or unloading any of the agreed limits of the ship are exceeded or are likely, the operation shall be suspended and corrective action taken. When unloading cargo, it shall be ensured that the unloading method does not damage the ship's structure.
- ➢ A special list or manifest setting forth the dangerous goods on board and the location thereof shall be maintained. A detailed stowage plan, which identifies by class and sets out the location of all dangerous goods on board, may be used in place of such a special list or manifest.
- ➢ Cargo spaces shall be inspected and prepared for the particular cargo to be loaded. Due consideration shall be paid to bilge wells and strainer plates, for which special preparation is necessary, to facilitate drainage and to prevent entry of the cargoes into the bilge system.
- ➢ Moving parts of deck machinery and external navigational aids may need to be covered from protection from excessive dust.
- ➢ Cargo spaces may require mechanical or natural ventilation or no ventilation depending upon the properties of the cargo. Cargoes emitting toxic or flammable gases will require forced ventilation whereas cargoes likely to heat spontaneously will require surface ventilation only.

**3) Form for cargo information for solid bulk cargoes**

**FORM FOR CARGO INFORMATION**
**for Solid Bulk Cargoes**

| | |
|---|---|
| BCSN (Bulk Cargo Shipping Name) | |
| Shipper | Transport document number |
| Consignee | Carrier |
| Name/means of transport<br>Port/place of departure | Instructions or other matters |
| Port/place of destination | |
| General description of the cargo<br>(Type of material/particle size) | Gross mass (kg/tonnes) |
| Specifications of bulk cargo, if applicable:<br>Stowage factor:<br>Angle of repose, if applicable:<br>Trimming procedures:<br>Chemical properties if potential hazard*:<br>* e.g., Class & UN No. or "MHB" | |
| Group of the cargo<br>☐ Group A and B*<br>☐ Group A*<br>☐ Group B<br>☐ Group C<br>* For cargoes which may liquefy (Group A and Group A and B cargoes) | Transportable moisture limit<br><br>Moisture content at shipment |
| Relevant special properties of the cargo<br>(e.g., highly soluble in water) | Additional certificate(s)*<br>☐ Certificate of moisture content and transportable moisture limit<br>☐ Weathering certificate<br>☐ Exemption certificate<br>☐ Other (specify)<br>* If required |
| DECLARATION<br>I hereby declare that the consignment is fully and accurately described and that the given test results and other specifications are correct to the best of my knowledge and belief and can be considered as representative for the cargo to be loaded. | Name/status, company/organization of signatory<br><br>Place and date<br><br>Signature on behalf of shipper |

### 4) Information provided in the IMSBC code

The information is as follows:

- ❖ BCSN (Bulk cargo shipping name)
- ❖ Description of cargo
- ❖ Characteristics
- ❖ Angle of repose
- ❖ Bulk density(Kg/M$^3$)
- ❖ Stowage factor(M$^3$/T)
- ❖ Size class group
- ❖ Hazard
- ❖ Stowage & segregation
- ❖ Hold cleanliness
- ❖ Weather precautions
- ❖ Loading
- ❖ Precautions
- ❖ Ventilation
- ❖ Carriage
- ❖ Discharge
- ❖ Clean-up
- ❖ Emergency procedures
- ❖ Special emergency equipment to be carried
- ❖ Emergency procedures

- Emergency action in the event of fire
- Medical first aid

**5) Hazards associated with solid bulk cargoes and related precautions**

**a) High density cargoes and stresses**

- Appropriate precautions shall be taken during loading and transport of heavy cargoes or cargoes with abnormal physical dimensions to ensure that no structural damage to the ship occurs and to maintain adequate stability throughout the voyage. Solid bulk cargoes have to be properly distributed throughout the ship to provide adequate stability and to ensure that the ship's structure is never overstressed. The loading conditions may be different from those found normally and improper distribution of such cargo may be capable of stressing either the structure under the load or the entire hull. The information on proper distribution of cargo may be provided in the ship's stability information booklet or may be obtained by the use of loading calculators, if available.
- As far as practicable, high-density cargoes shall be loaded in the lower hold cargo spaces in preference to tween-deck cargo spaces. When it is necessary to carry high-density cargoes in tween-decks or higher cargo spaces, due consideration shall be paid to ensure that the deck area is not overstressed and that the ship's stability is not reduced below the minimum acceptable level specified in the ship's stability data.
- When high-density solid bulk cargoes are loaded at high speed, special care may be necessary to protect cargo space fittings from damage. Bilges shall be sounded after the completion of loading to detect damage in cargo spaces.

b) **Cargo shifting and stability**

- Ship's stability is greatly affected by the shifting of the cargo. Cargo shift can be divided into two types, namely, sliding failure or liquefaction consequence. The likelihood of shifting of cargo due to sliding failure is dependent on the angle of repose for the cargo.
- Cargo spaces shall be loaded as full as practicable WITHOUT resulting in excessive loading on the bottom structure or tween-deck to prevent sliding of a solid bulk cargo. Cargo shall be trimmed sufficiently to equalize the mass distribution on the bottom structure. Shifting divisions and bins, of adequate strength, shall be erected whenever solid bulk cargoes, which are suspected of readily shifting, are carried in tween-deck cargo spaces or in only partially filled cargo spaces.
- Trimming a cargo reduces the likelihood of the cargo shifting and minimizes the air entering the cargo. Air entering the cargo could lead to spontaneous heating. To minimize these risks, cargoes shall be trimmed reasonably level, as necessary.
- Non-cohesive bulk cargoes having an angle of repose less than or equal to 30º, which flow freely like grain, shall be carried according to the provisions applicable to the stowage of grain cargoes. Non-cohesive bulk cargoes shall be adequately trimmed.

**c) Liquefaction hazard**

- Some cargoes classified under Group A may appear to be in a relatively dry granular state when loaded, and yet may contain sufficient moisture to become fluid under the stimulus of compaction and the vibration which occurs during a voyage. A ship's motion may cause a cargo to shift sufficiently to capsize the vessel. Some cargoes which may liquefy may also heat spontaneously.
- Liquefaction of cargo occurs as follows:
  - ✓ the volume of the spaces between the particles reduces as the cargo is compacted owing to the ship motion, etc.

- ✓ the reduction in space between cargo particles causes an increase in water pressure in the space
- ✓ the increase in water pressure reduces the friction between cargo particles resulting in a reduction in the shear strength of the cargo

- ❖ When increase in the water pressure contained in the cargo grains is restricted, the cargo does not liquefy. This happens in case of cargoes containing very small particles or large lumps or the cargoes that contain a high percentage of air and low moisture content.

**Moisture content** means that portion of a representative sample consisting of water, ice or other liquid expressed as a percentage of the total wet mass of that sample.

**Transportable Moisture Limit** (TML) of a cargo which may liquefy means the maximum moisture content of the cargo which is considered safe for carriage in ships. It is determined by the test procedures.

**Moisture migration** means the movement of moisture contained in a cargo by settling and consolidation of the cargo due to vibration and ship's motion. Water is progressively displaced, which may result in some portions or all of the cargo developing a flow state.

**Flow moisture point** means the percentage moisture content (wet mass basis) at which a flow state develops under the prescribed method of test in a representative sample of the material.

**Flow state** means a state occurring when a mass of granular material is saturated with liquid to an extent that, under the influence of prevailing external forces such as vibration, impaction or ships motion, it loses its internal shear strength and behaves as a liquid.

- ❖ A cargo shift caused by liquefaction may occur when the moisture content exceeds the Transportable Moisture Limit (TML). Some cargoes are susceptible to moisture migration and may develop a dangerous wet base even if the average moisture content is less than the TML.

- ❖ Cargoes such as concentrates which may liquefy shall only be accepted for loading when the actual moisture content of the cargo is less than its TML unless the ship is specially constructed or fitted for such cargoes. The ships specially constructed have permanent structural boundaries, so arranged as to confine any shift of cargo to an acceptable limit. Specially fitted cargo ships are fitted with specially designed portable divisions to confine any shift of cargo to an acceptable limit.

- ❖ Adequate measures shall be taken to prevent liquids entering the cargo space in which these solid bulk cargoes are stowed during the voyage. Using water to cool these cargoes while the ship is at sea imposes the threat of liquefaction.

**d) Chemical hazard**

- ❖ Solid bulk cargoes which may possess a chemical hazard during transport, because of their chemical nature or properties, are in Group B. Some of these materials are classified as dangerous goods and others are materials hazardous only in bulk (MHB). It is essential to obtain current, valid information about the physical and chemical properties of the cargoes to be shipped in bulk, prior to loading.

- ❖ The dangerous goods are classified as follows:
- ✓ Class 4.1: Flammable solids - readily combustible solids and solids which may cause fire through friction
- ✓ Class 4.2: Substances liable to spontaneous combustion - materials, other than pyrophoric materials, which, in contact with air without energy supply, are liable to self-heating
- ✓ Class 4.3: Substances which, in contact with water, emit flammable gases

- ✓ Class 5.1: Oxidizing substances - materials while in themselves not necessarily combustible, may, generally by yielding oxygen, cause, or contribute to, the combustion of other material
- ✓ Class 6.1: Toxic substances - materials liable either to cause death or serious injury or to harm human health if swallowed or inhaled, or by skin contact
- ✓ Class 7: Radioactive material - materials containing radio-nuclides where both the activity concentration and the total activity in the consignment exceed the values specified in IMDG code
- ✓ Class 8: Corrosive substances - materials which, by chemical action, will cause severe damage when in contact with living tissue or will materially damage, or even destroy, other goods or the means of transport
- ✓ Class 9: Miscellaneous dangerous substances and articles - materials and articles which, during transport, present a danger not covered by other classes
- ✓ Materials hazardous only in bulk (MHB) - materials which may possess chemical hazards when transported in bulk other than materials classified as dangerous goods in the IMDG Code

❖ Stowage and segregation requirements for dangerous cargoes listed in above categories

- ✓ Incompatible materials shall not be handled simultaneously. Upon completion of loading one cargo, the hatch covers of every cargo space shall be closed and the decks cleaned of residue before the loading of other material is commenced. When discharging, the same procedures shall be followed.

- ✓ Dangerous goods in solid form in bulk shall be loaded and stowed safely and appropriately in accordance with the nature of the goods. Incompatible goods shall be segregated from one another. Dangerous goods in solid form in bulk, which are liable to spontaneous heating or combustion, shall not be carried unless adequate precautions have been taken to minimize the likelihood of the outbreak of fire.

- ✓ Materials of classes 4.1, 4.2, 4.3 and 5.1 shall be kept as cool and dry as reasonably practicable and in general shall be stowed away from all sources of heat or ignition. Electrical fittings and cables shall be in good condition and properly safeguarded against short circuits and sparking. Where a bulkhead is required to be suitable for segregation purposes, cable and conduit penetrations of the decks and bulkheads shall be sealed against the passage of gas and vapour. Cargoes liable to give off vapours or gases which can form an explosive mixture with air shall be stowed in a mechanically ventilated space. General fire precautions such as ‘No Smoking’ signs shall be observed.

- ✓ Cargoes of class 5.1 shall be stowed separated from other combustible materials. Before loading cargoes of this class, particular attention shall be paid to the cleaning of the cargo spaces into which they will be loaded. As far as reasonably practicable, non-combustible securing and protecting materials shall be used and only a minimum of dry wooden dunnage shall be used. Precautions shall be taken to avoid the penetration of oxidizing materials into other cargo spaces, bilges and other spaces which may contain a combustible material.

- ✓ Cargo spaces used for the transport of radioactive materials – Class 7 – such as uranium or thorium ores, of low specific activity (LSA-I) and surface contaminated objects (SCO-I) shall not be used for other cargoes until decontaminated by a qualified person so that the non-fixed contamination on any surface when averaged over an area of 300 $cm^2$ does not exceed the specified levels.

- ✓ Materials of class 8 may be highly corrosive to the ship’s structure. Hosing down of the cargo spaces followed by careful drying shall be considered. Materials presenting corrosive hazards of such intensity as to affect either human tissue or the ship’s structure shall only

> When an incident takes place involving the loss or likely loss overboard of dangerous goods in solid form in bulk into the sea, same shall be reported to the nearest coastal State providing particulars of such an incident without delay and to the fullest extent possible.

be loaded after adequate precautions and protective measures have been taken.

- ✓ Dangerous goods in solid form in bulk, which give off dangerous vapours, shall be stowed in a well-ventilated cargo space. When transporting a solid bulk cargo which is liable to emit a toxic or flammable gas, or cause oxygen depletion in the cargo space, an appropriate instrument for measuring the concentration of gas or oxygen in the air shall be provided together with detailed instructions for its use. Materials which are likely to evolve toxic gases in sufficient quantities to affect health shall not be stowed in those spaces from where such gases may penetrate into living quarters or ventilation systems connecting to living quarters.
- ✓ After discharge of toxic or oxidizing cargoes, the spaces used for their carriage shall be inspected for contamination before being used for other cargoes. A contaminated space shall be properly cleaned and examined before being used for other cargoes. After discharge of cargoes, a close inspection shall be made for any residue, which shall be removed before the ship is presented for other cargoes.
- ✓ To avoid contamination, all foodstuffs shall be stowed separated from material which is indicated as toxic, separated by a complete compartment or hold from all infectious materials, separated from radioactive materials and away from corrosive materials.
- ✓ For cargoes for which in case of an emergency the hatches shall be opened, these hatches shall be kept free to be capable of being opened up. A copy of the instructions on emergency response and medical first aid relevant to incidents involving dangerous goods in solid form in bulk shall be on board.

- ❖ Segregation tables for dangerous cargoes in bulk are provided in the IMSBC code.

**e) Health hazards**

- ❖ Some solid bulk cargoes such as most vegetable products and forest products, ferrous metals, metal sulphide concentrates and coal cargoes are susceptible to oxidation, which may result in oxygen depletion, emission of toxic gases or fumes and self-heating. Appropriate attention shall be paid that cargo spaces and adjacent spaces may be depleted in oxygen or may contain toxic or asphyxiating gases, and that an empty cargo space or tank which has remained closed for some time may have insufficient oxygen to support life. Emergency entry into a cargo space shall be undertaken only by trained personnel wearing self-contained breathing apparatus and protective clothing and always under the supervision of a responsible officer.
- ❖ Some cargoes which, when wetted, are corrosive to skin, eyes and mucous membranes or to the ship's structure. Particular attention shall be paid to protection of personnel and the need for special precautions to be taken prior to loading and after unloading.
- ❖ Chronic and acute risks are associated with exposure to the dust of some solid bulk cargoes. Appropriate breathing protection, protective clothing, protective skin creams, adequate personal washing and laundering of outer clothing, shall be taken as necessary. Ventilation systems shall be shut down or screened and air conditioning systems placed on recirculation during loading or discharge, to minimize dust ingress into the living quarters or other interior spaces.
- ❖ Dust of some solid bulk cargoes may constitute an explosion hazard, especially while loading, unloading and hold cleaning. This risk can be minimized by ventilating to prevent the formation of a dust-laden atmosphere and by hosing down rather than sweeping.

- ❖ Medical First Aid Guide (MFAG) shall be consulted in case of any accidents involving chemically dangerous cargoes.

**6) Commonly carried solid bulk cargoes and related carriage procedures**

**a) Coal**

❖ Coal is carried in three common forms

- ✓ Coal (bituminous and anthracite) – size up to 50 mm MHB B (and A)
- ✓ Brown coal (Lignite) briquettes - size up to 50 mm MHB B manufactured by pressing dried brown coal particles into compressed blocks
- ✓ Coal slurry - a mixture of fine particles of coal and water size under 1 mm

❖ **Hazards**

- ✓ Coals may emit methane, a flammable gas.
- ✓ Coals may be subject to oxidation, leading to depletion of oxygen and an increase in carbon dioxide or carbon monoxide concentrations in the cargo space.
- ✓ Some coals may heat spontaneously and the spontaneous heating may lead to spontaneous combustion in the cargo space.
- ✓ Some coals with high sulphur content may be liable to react with water and produce acids which may cause corrosion.
- ✓ In case of brown coal briquettes, hot spots may develop in a cargo space that has been kept open for more than six days (or less in weather over 30°C).

❖ **Precautions**

- ✓ Prior to loading, the shipper shall provide the details regarding cargo's contract specifications for moisture content, sulphur content and size shall be stated, and especially whether the cargo may be liable to emit methane or self-heat.
- ✓ The cargo shall be 'separated from' goods of classes 1 (division 1.4), 2, 3, 4 and 5 in packaged form and 'separated from' solid bulk materials of classes 4 and 5.1 And 'separated longitudinally by an intervening complete compartment or hold from' goods of class 1 other than division 1.4.Stowage of goods of class 5.1 in packaged form or solid bulk materials of class 5.1 above or below this cargo shall be prohibited. The cargo shall not be stowed adjacent to hot areas.
- ✓ All electrical cables and components situated in cargo spaces and adjacent enclosed spaces shall be checked free from defects. Such cables and electrical components shall be safe for use in an explosive atmosphere or positively isolated.
- ✓ The cargo shall be trimmed as required. Without reasonable trimming, vertical cracks into the body of the coal may form, permitting oxygen circulation and possible self-heating. Brown coal briquettes shall not be dropped more than one metre during loading to minimize the production of dust and fines.
- ✓ The surface of the material shall be trimmed reasonably level to the boundaries of the cargo space to avoid the formation of gas pockets and to prevent air from permeating the body of the briquettes.
- ✓ Based upon the information provided by the shipper, the atmosphere in the space above the cargo in each space shall be regularly monitored for the concentration of methane, oxygen and carbon monoxide and the values recorded.
- ✓ During passage surface ventilation shall be carried out of all cargo spaces carrying this cargo for the first 24 hours after departure from the loading port. When the methane concentrations monitored within 24 hours after departure are at an acceptably low level, the ventilation openings shall be closed and the atmosphere in the cargo spaces shall be

monitored. When atmosphere in the cargo space indicates the presence of methane in excess of 20% of the lower explosion limit (LEL), surface ventilation shall be maintained. This procedure shall be followed until the methane concentrations become acceptably low level. In any event, the atmosphere in the cargo spaces shall be monitored on a daily basis. The ventilation shall be stopped for an appropriate period prior to the gas monitoring.

- ✓ Bilge wells shall be clean, dry and covered as appropriate, to prevent ingress of the cargo. Hold bilge shall be systematically tested during voyage. If the pH monitoring indicates that a corrosion risk exists, bilges shall be frequently pumped out in order to avoid possible accumulation of acids on tank-tops and in the bilge system.

- ✓ Personnel shall not enter the cargo space or enclosed adjacent spaces unless the space has been ventilated and the atmosphere tested and found to be gas-free and to have sufficient oxygen to support life. Emergency entry into the cargo space may be permitted only by trained personnel wearing self-contained breathing apparatus under the supervision of a responsible officer and special precautions are observed to ensure that no source of ignition is carried into the space.

- ✓ Enclosed working spaces such as storerooms, carpenter’s workshops, passageways, tunnels, etc., shall be regularly monitored for the presence of methane. Carbon dioxide and carbon monoxide gas levels shall also be tested prior to entry into the cargo spaces. The recommended threshold limit value (TLV) for carbon monoxide is 50 ppm.

- ✓ In the event of fire, the hold shall be battened down. Exclusion of air may be sufficient to control the fire. **Do not use water**. The use of $CO_2$ or inert gas, if available, should be withheld until fire is apparent. Seek expert advice and consider heading to the nearest port.Water shall not be used for cooling material or fighting coal cargo fires at sea, but may be used for cooling the boundaries of the cargo space.Medical First Aid Guide (MFAG) shall be referred to for administering first aid.

- ✓ Coal slurry is liable to liquefy during sea transport. Spontaneous combustion is possible if the coal dries out but is unlikely under normal conditions. Coal likely to liquefy shall be carried keeping the moisture content of the cargo less than its TML. The cargo shall not be handled during precipitation.

- ✓ During handling of the cargo, all non-working hatches of the cargo spaces into which the cargo is loaded or to be loaded shall be kept closed.

- ✓ The ship shall carry on board appropriate instruments for measuring the following without requiring entry in the cargo space
- concentration of methane in the atmosphere
- concentration of oxygen in the atmosphere
- concentration of carbon monoxide in the atmosphere
- pH value of cargo space bilge samples
- means be provided for measuring the temperature of the cargo

- ✓ Warning notices shall be posted in conspicuous places regarding no- smoking, use of naked flames, burning, cutting, chipping, welding or other sources of ignition in the vicinity of cargo spaces. Care shall be taken to remove any accumulated gases prior to operation of the hatch covers or other openings for any reason, including discharging.

- ✓ Only natural surface ventilation shall be permitted in case of self-heating coals. In such cases, hold temperature of this cargo shall be monitored. This cargo shall only be accepted for loading when the temperature of the cargo is not higher than 55°C.

- ✓ When the carbon monoxide level is observed to be increasing steadily, a potential self-heating may be developing. When the carbon monoxide level in any cargo space reaches 50 ppm or exhibits a steady rise over three consecutive days, a self-heating condition may be developing. In such a case, the cargo space shall be completely closed and all ventilation ceased. Water shall not be used for cooling material or fighting coal cargo fires at sea, but may be used for cooling the boundaries of the cargo space. Advice shall be sought from the shipper.

✓ If a hot spot is detected, the area shall be sprayed with fine water spray and the hot spot shall be removed immediately to prevent spreading. The hot spot cargo shall be spread out on the wharf away from the remainder of the cargo.

**b) Sulphur**

❖ Sulphur is carried in two common forms

✓ Sulphur UN 1350 - crushed lump and coarse grained, particles or lumps of any size, loaded in a damp or wet condition

✓ Sulphur - formed solid prills, granules, pellets, pastilles or flakes, Size approx. 1 mm to 10 mm

***Fine grained sulphur (flowers of sulphur) shall not be transported in bulk.***

❖ Sulphur UN 1350

✓ Hazards
- Flammability likely to ignite readily,
- Dust explosion especially during loading and unloading and after discharge and cleaning

✓ Stowage & Segregation - Separated from foodstuffs

✓ Hold Cleanliness
Requires holds clean and dry as relevant to the hazards of the cargo; NOT to be washed with seawater, Must be thoroughly clean and washed with fresh water.

✓ Does not require any special weather precautions

✓ Loading precautions
- To be trimmed suitably,
- When involved in a fire, a toxic, very irritating and suffocating gas is evolved
- Forms explosive and sensitive mixtures with most oxidizing materials
- Has a liability to dust explosion, which may occur especially after discharge and during cleaning
- The hold trimming plates and tank tops of the cargo spaces for this cargo shall be lime-washed or coated with paint to prevent corrosion. Upper sections shall have a sound coating of paint.
- Electrical circuits for the equipment in cargo spaces for this cargo which is unsuitable for use in an explosive atmosphere shall be isolated by removal of links in the system other than fuses.
- Ventilators of the cargo spaces for this cargo shall be fitted with spark-arresting screens.
- Self-contained breathing apparatus shall be carried on board for emergencies.

✓ During carriage
- Bilges in the cargo spaces carrying this cargo shall be pumped regularly to prevent accumulation of water/acid solution.
- Surface ventilation only shall be conducted, as necessary, during the voyage for this cargo.

✓ Cleaning-up
The cargo spaces shall not be swept. After discharge of this cargo, the cargo spaces, and other structures as necessary, shall be washed out with fresh water to remove all residues of this cargo. Then the cargo spaces shall be thoroughly dried. Wet dust or residues may form highly corrosive sulphurous acid, which is extremely dangerous to personnel and corrosive to steel. Persons involved in cleaning up shall be provided with protective clothing, goggles and facemasks to wear.

- ✓ In case of fire
- Batten down the hold. Use ship’s fixed fire-fighting installation if available. Exclusion of air may be sufficient to control the fire. DO NOT USE WATER.
- For medical first aid, Medical First Aid Guide (MFAG) shall be consulted.

- ❖ Sulphur (formed, solid)

- ✓ Shall be stowed segregated ‘Separated from’ strong oxidizers, such as fluorine, chlorine, chlorates, nitrates (nitric acid), peroxides, liquid oxygen, permanganates, di-chromates or the like

- ✓ Hazards
- non-combustible or has a low fire risk
- If involved in a fire, cargo may generate harmful gases.
- cargo poses no corrosion or dust hazards for human tissue or vessel

- ✓ Hold cleanliness
  Requires holds clean and dry as relevant to the hazards of the cargo; NOT to be washed with seawater

- ✓ Loading precautions
- To be suitably trimmed applying minimal impact, abrasion and crushing when handling to prevent dust from forming.
- Protect machinery, accommodations and equipment from small particles or any dust if formed.
- Persons involved in cargo handling shall wear protective clothing, goggles and dust filter masks.
- Holds including trimming plates and tank tops shall be treated with effective, commercially available protective coating or lime-washed to avoid any potential corrosive reaction between sulphur, water and steel. Upper sections shall have a sound coating of paint. Hatches shall be sealed tightly.
- Surface ventilation only shall be conducted during carriage, as necessary, during the voyage for this cargo.
- A fine spray of fresh water or surfactant is added during loading. Hence bilges shall be sounded and pumped out as necessary throughout the voyage.
- Persons involved in clean-up shall wear hard hats, protective goggles, long-sleeve shirts, long pants, and impervious gloves. Use of approved respirators shall be considered. Holds shall be thoroughly washed using only FRESH WATER following discharge.

**Apply Your Knowledge**

1. Check the cargo declaration form as submitted by the shipper for last two cargoes carried on board your ship and mention the hazards related to the cargoes.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Maintain seaworthiness of the ship

**Task number:** C 2.1

**Sub-task Reference number:** C2.1.2

**Topic:** Ship stability (including understanding of the fundamentals of watertight integrity)

**Task Heading**

- Check the stability booklet for any specific loading limitations.

**Objectives**

- To understand the layout of Stability manual for the vessel and use of its contents

**Index**

1) Introduction
2) General layout of the stability booklet
3) Section 1 - Identification and approval
4) Section 2 - Technical information
5) Section 3 - Guidance for use of stability manual
6) Section 4 - Reference information

**Description**

**1) Introduction**

SOLAS and load line protocol require the master to be supplied with a stability booklet containing such information as is necessary to enable him, by rapid and simple procedures, to obtain accurate guidance as to the ship under varying conditions of loading. For bulk carriers, the information required in a bulk carrier booklet may be contained in the stability booklet. As a supplement to the approved stability booklet, a computer may be used to facilitate the stability calculations.

The information shall include

- a curve of minimum operational metacentric height (GM) versus draught which assures compliance with the relevant intact stability requirements, alternatively a corresponding curve of the maximum allowable vertical centre of gravity (KG) versus draught, or with the equivalents of either of these curves
- instructions concerning the operation of cross-flooding arrangements and
- all other data and aids which might be necessary to maintain stability after damage

This information shall be readily available on the navigation bridge, for the guidance of the officer in charge of the ship. The stability booklet shall be read and the officers shall be well familiar with characteristics of the vessel.

**2) General layout of the stability booklet**

The general layout is as follows:

- Table of contents
- Section 1 - Identification and approval
- Section 2 - Technical information
  1. Capacity plan
  2. Cargo space information
  3. Tank space information
  4. Hydrostatic particulars
  5. Lightship particulars
  6. Load line particulars

7. Stability limits
8. Longitudinal strength criteria
9. Other operational restrictions

- Section 3 - Guidance for use of stability manual
  1. Introduction
  2. Terms, symbols and units
  3. Explanations to the manual
  4. Operation of the ship
  5. Typical approved loading conditions
  6. Control of stability, trim and longitudinal strength
- Section 4 - Reference information
  1. Inclining experiment report
  2. Intact stability criteria
  3. Other information

**3) Section 1 - Identification and approval**

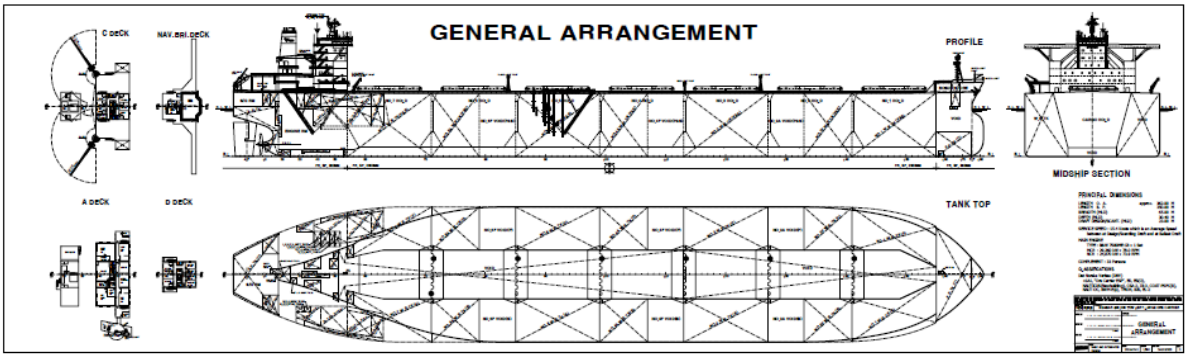
This section contains information to clearly identify the ship with regard to the applicability and approval of this manual. The information in this section includes:

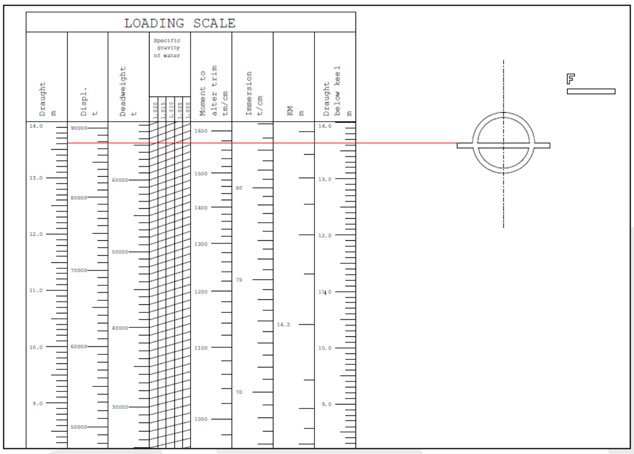
- ship's name and type and purpose of ship
- name of builder and yard number
- date of build/conversion (keel laying or delivery)
- particulars of classification society
- nationality, port of registry and official number
- principal dimensions
- type of main engine, rudder and propeller
- other information, as deemed necessary
- IMO number
- approval certificate of the manual

**4) Section 2 - Technical information**

- **Capacity plan**

This subsection contains a scaled drawing showing the layout of cargo spaces, tanks, stores, machinery spaces and crew/passenger accommodation. The plan provides reference planes and the rise of keel, frames, frame spacing and numbering and location of draught marks forward, mid and aft. The plan also includes position of the deck line relative to the ship, draught to the summer load waterline, draught to the summer timber load waterline, corresponding freeboards and deadweight scale.




➢ **Cargo space information**

This subsection provides information on cargo spaces in the form of suitable tables containing name and number of space, frame numbers at forward and aft end of space, volume at 100% filling and longitudinal, transverse & vertical co-ordinates of the centre of volume with regard to the reference planes.

On break-bulk ships, additionally, the permissible surface load per area for the particular deck or tanktop is given in t/m$^2$. On bulk carriers, the permissible total mass of cargo in the particular space is given. On tankers, additionally, the volume at 98% filling and the moment of inertia of the free surface at 98% filling is mentioned. On container ships, a detailed container stowage plan is provided using an accepted numbering system and presenting the longitudinal, transverse and vertical co-ordinates of the assumed centers of mass of containers. Maximum stack masses and maximum stack heights of containers is also included in this information. On ro-ro ships, the stowage lanes are shown suitably subdivided for identifying longitudinal co-ordinates of stowage positions.

Hold Capacities

| NAME | DESCRIPTION | VNET m3 | LCG m | TCG m | VCG m |
|---|---|---|---|---|---|
| CAPACITY OF Solid Cargo (RHO=1) | | | | | |
| HOLD1 | Hold 01 | 5443.5 | 255.68 | -0.00 | 18.31 |
| HOLD2 | Hold 02 | 11463.8 | 227.38 | -0.00 | 14.43 |
| HOLD3 | Hold 03 | 15531.4 | 199.32 | -0.00 | 13.10 |
| HOLD4 | Hold 04 | 15747.8 | 171.64 | 0.00 | 12.64 |
| HOLD5 | Hold 05 | 16652.1 | 131.06 | 0.00 | 12.61 |
| HOLD6 | Hold 06 | 16652.1 | 102.26 | 0.00 | 12.61 |

➢ **Maximum permissible load**

Maximum permissible load per hold and the load density of the tank top and hatch cover is mentioned in the tabular form for various holds of the cargo ship, bulk/ ore carrier, container ship etc.

- **Tank space information**

This subsection presents information on tank spaces intended for fuel, stores, feed water, domestic water, process liquids and liquid waste in the form of suitable tables showing name and number of tank and designated contents, frame numbers at forward and aft end of tank, volume at 100% filling, density of the liquid, mass at 100% filling, longitudinal, transverse and vertical co-ordinate of centre of volume and maximum value of moment of free surface.

Tank sounding tables and ullage tables are provided as a supplement in separate booklets.

| NAME | DESCRIPTION | VNET m3 | WMAX t | LCG m | TCG m | VCG m | FRSM tm |
|---|---|---|---|---|---|---|---|
| Capacity of Water Ballast (RHO=1.025 t/m3) | | | | | | | |
| FP | Forepeak | 624 | 640 | 279.46 | 0.00 | 7.38 | 163 |
| WBBST1A | Bottom/Side TK 1A CL | 737 | 756 | 260.90 | 0.00 | 8.44 | 1301 |
| WBBST1B | Bottom/Side TK 1B CL | 1255 | 1287 | 249.45 | -0.00 | 7.52 | 6629 |
| WBBST2P | Bottom/Side TK 2 PS | 1270 | 1302 | 227.70 | -7.51 | 6.93 | 697 |
| WBBST2S | Bottom/Side TK 2 SB | 1270 | 1302 | 227.70 | 7.51 | 6.93 | 697 |
| WBBST3P | Bottom/Side TK 3 PS | 1322 | 1355 | 199.36 | -9.82 | 5.26 | 3381 |
| WBBST3S | Bottom/Side TK 3 SB | 1322 | 1355 | 199.36 | 9.82 | 5.26 | 3381 |
| WBDBT4 | Double bottom TK 4 CL | 648 | 664 | 171.70 | 0.00 | 0.95 | 4942 |
| WBBST4S | Bottom/Side TK 4 SB | 1086 | 1113 | 171.02 | 13.10 | 5.75 | 1138 |
| WBBST4P | Bottom/Side TK 4 PS | 1086 | 1113 | 171.02 | -13.10 | 5.75 | 1138 |
| WBWTDHS | Wing TK DH SB | 471 | 483 | 151.75 | 14.35 | 6.43 | 109 |
| WBWTDHP | Wing TK DH PS | 471 | 483 | 151.75 | -14.35 | 6.43 | 109 |
| WBDBT5S | Double bottom TK 5 SB | 799 | 819 | 137.91 | 6.25 | 0.95 | 3987 |
| Capacity of Heavy Fuel Oil (RHO=0.98 t/m3) | | | | | | | |
| HFO01 | HFO Storage TK SB | 1011 | 971 | 151.75 | 11.49 | 11.47 | 139 |
| HFO02 | HFO Storage TK PS | 1015 | 975 | 151.60 | -11.51 | 11.51 | 139 |
| HFO03 | HFO Storage TK SB | 1110 | 1066 | 151.91 | 6.45 | 11.13 | 129 |
| HFO04 | HFO Storage TK PS | 1099 | 1055 | 151.88 | -6.43 | 11.05 | 129 |
| HFO05 | HFO Storage TK SB | 815 | 783 | 151.95 | 1.93 | 10.74 | 62 |

- **Hydrostatic particulars**

Hydrostatic particulars are presented for the ship on even keel or design trim without deflection, in a table against draught, to the bottom of keel over a range from light ship to 115% of the maximum draught or to the depth of hull, whichever is less. The tabulated interval for drafts is 5 cm or less.

| TKC m | DISV $m^3$ | DISM t | TPC t/cm | KM m | MTM/ MCTC tm/m | XB m | XF m |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

| TKC m | KM for trimmed conditions (m) | | | | | |
|---|---|---|---|---|---|---|
| | t = - 3 m | t = - 2 m | t = - 1 m | t = 0 m | t = 1 m | t = 2 m |
| | | | | | | |

| TKC m | KN 10° m | KN 20° m | KN 30° m | KN 40° m | KN 50° m | KN 60° m | KN 70° m | KN 80° m |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

- **Lightship particulars**

This subsection presents data resulting from the inclining experiment and deadweight survey. These include lightship mass, longitudinal, transverse and vertical centre of mass including the relevant reference planes, calculated and measured deflection of the hull, if appropriate, place and date of the inclining experiment; and name of approval authority.

- **Load line particulars**

This subsection contains a statement giving the type of load line assigned (type A, B, etc.)and a table showing for the appropriate load line marks mentioning the values of draught to bottom of keel, freeboard, displacement mass in seawater and deadweight. Furthermore, the maximum permissible draught at the forward perpendicular if necessary for bow height consideration is also stated. Additionally minimum draught forward and aft is also stated with regard to ship handling in heavy weather.

- **Stability limits**

This subsection contains a pre-calculated table from which the master can determine whether the stability of the ship is acceptable for a given loading condition under the governing stability criteria. This information shows the maximum allowable height of the loaded ship's centre of gravity KGc, i.e. appropriately corrected for free surfaces, against the reference keel draught TKC. If the maximum allowable KGc depends on specific parameters, such as height of deck cargo, layers of containers on deck, trim, or other conditions of service, the table or tables provide for any suitable combination of limiting KGc values. If, in particular the trim is considered not to influence the limiting KGc values, this is clearly stated.

The range of data extends from the lightest anticipated seagoing draught to the minimum freeboard assigned.

| TKC m | Maximum permissible KGc for any operating trim (m) | | | | |
|---|---|---|---|---|---|
| | no containers on deck | 1 tier deck containers | 2 tier deck containers | 3 tier deck containers | 4 tier deck containers |
| | | | | | |

The angle of down flooding is tabulated against the reference keel draught TKC for the ship on even keel or design trim. The critical openings are identified together with their co-ordinates to the common reference planes.

A separate set of information in the form of suitable tables and/or diagrams provide the appropriate damage stability criteria. The form of presentation is similar to the presentation of the intact stability criteria and is named as simplified stability data

- **Longitudinal strength criteria**

- This subsection contains in a tabular form for selected longitudinal positions that is frames or bulkheads, the maximum permissible shear forces and maximum permissible bending moments against frame number and longitudinal co-ordinate.
- Maximum allowable torsional moments are provided in an additional table for ships which are sensible to torsion due to their construction and cargo stowage practice.
- Single hold/ adjacent hold/ alternate hold loading stress calculations
  In large bulk carriers, ore carriers etc., the longitudinal stresses (shear force and bending Moments) become the governing factor when the ship is not fully loaded. While the ships is loaded in a single hold, adjacent holds or alternate holds, the quantities as mentioned for the maximum capacity of hold may not be then safe. Separate calculation tables are provided for estimating the safe cargo quantities.

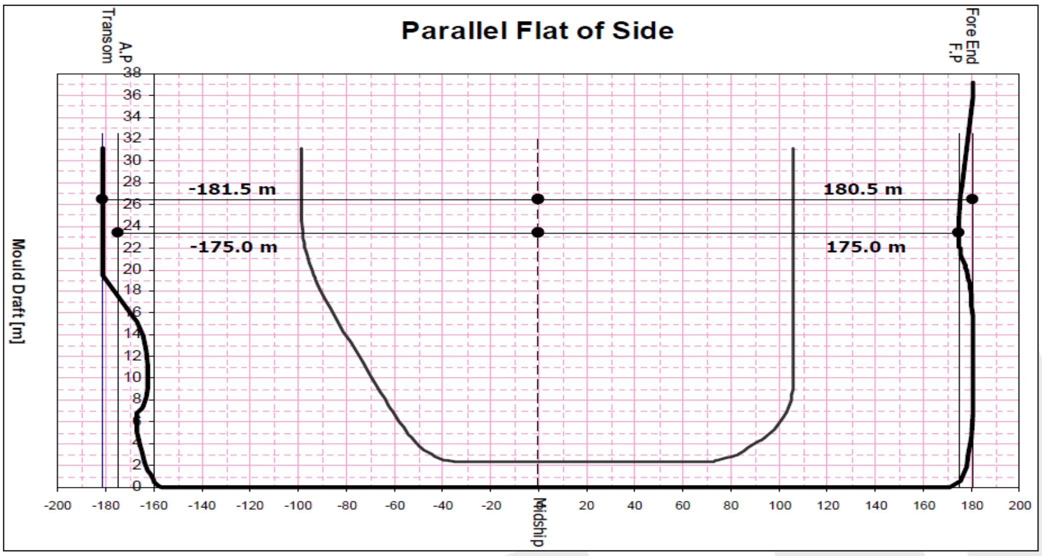
- **Air draft calculations**

For ports bound by air draft restrictions, such as where the vessel has to pass under bridges or where the loading gantries/ shoots require certain clearance from the vessel for safe operation, the air draft and heights of hatch covers above the base line is provided which can be used to calculate minimum draft of the vessel which will enable unrestricted operations.

- **Other operational restrictions**

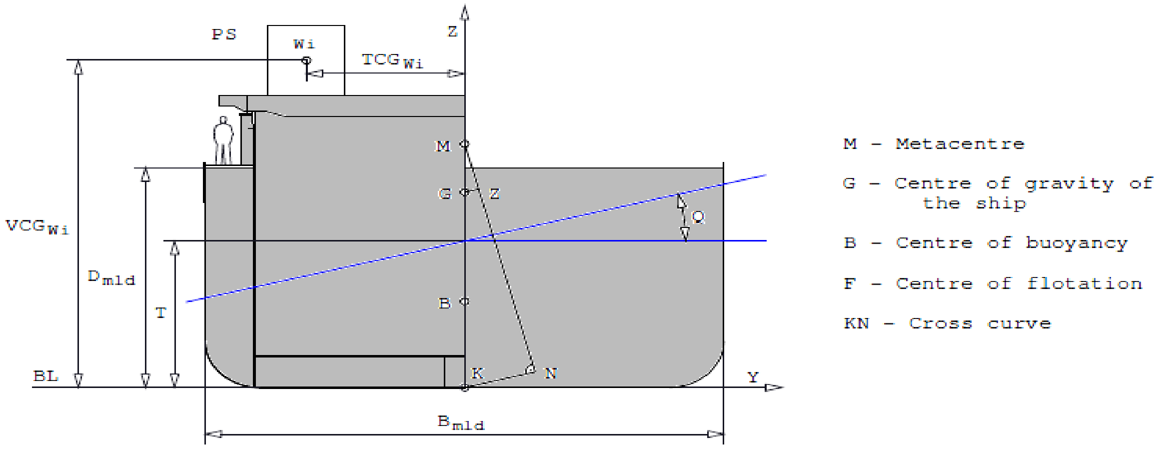
This subsection contains information and operational restrictions related to the loading and the operation of the ship. This includes trim and deck-stowage restrictions due to SOLAS minimum bridge visibility criteria, restrictions to high initial stability with regard to securing of deck cargoes (printed as a supplement named Cargo Securing Manual), stability and trim requirements with regard to damage control (printed as a supplement named damage control plans), operating restrictions with regard to ship handling in heavy weather and maximum permissible draught corresponding to structural strength of the ship. Additionally the section mentions the minimum aft draft for propeller full immersion. Also the minimum safe draft for navigating in heavy weather and the cargo tank/ hold which may be used to carry additional ballast is also mentioned here. In case of using the tank/ hold for heavy weather ballast, the effect of sloshing and free surface effect caused shall be given due consideration.

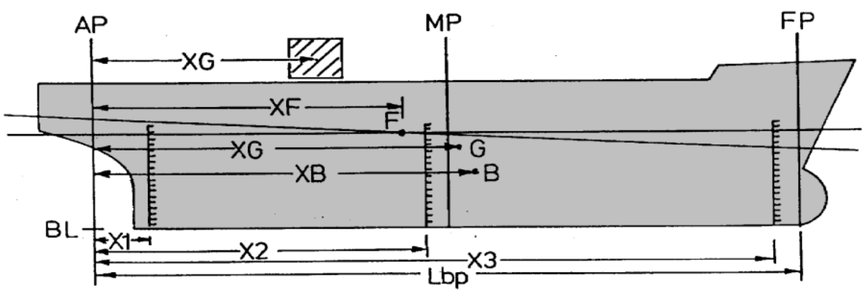
For large vessels the stability booklet also mentions the length of the parallel body of the vessel in a graphical format to be used for positioning the vessel alongside.




### 5) Section 3 - Guidance for use of stability manual

This section provides guidelines regarding the use of the manual on board. The manual provides all necessary information for the proper loading and ballasting of the ship and for the control of stability, draught and structural integrity, as needed. The common symbols and abbreviations used in the manual are mentioned in this section along with their description in the form of sketches.

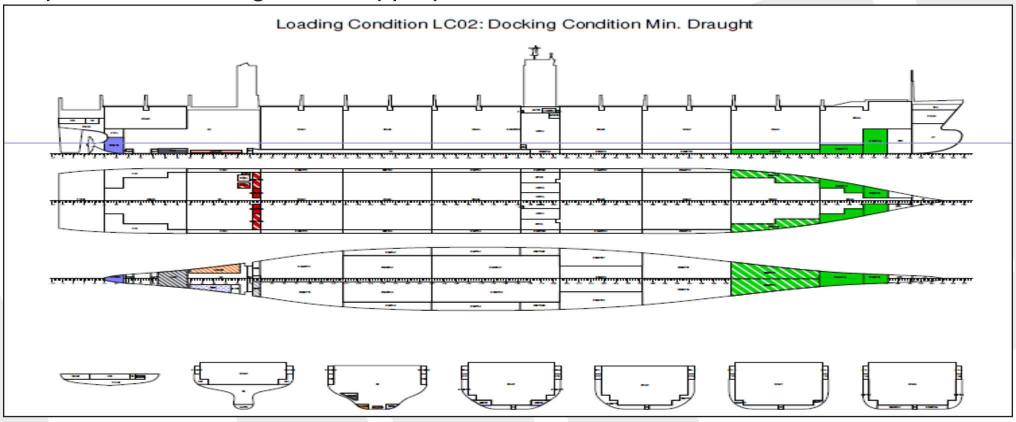



This section further contains explanations to this manual, in particular to technical information including reference planes and signs of trim, applicability of hydrostatic data, applicability of stability limits with regard to trim, height of deck cargo or other parameters and general advice on the use of tables or diagrams with regard to accuracy and interpolation. Specific information is given regarding the effect of hoisted crane booms, filled swimming pool or other heavy top masses on the ship's stability, and the correct use of anti-rolling devices and/or heeling tanks, as applicable.

As a minimum, typical approved loading conditions are compiled and calculated for the ship in lightship condition, docking condition and loading conditions as stipulated in the intact stability code. Loading conditions take into account where icing is likely to occur. As calculated loading conditions are used to obtain a realistic picture of the cargo carrying capabilities of the ship, a limited number of fully loaded conditions are included with approximately half capacity of consumables on departure.

Each presented condition of loading includes a sketch of the ship indicating pictorially the main items of deadweight included in the displacement, side view and top view if useful. Also a table showing lightship mass and all components of the deadweight together with the positions of their centers relative to the defined reference planes is included. Additionally a diagram showing the curve of righting levers plotted against the angle of inclination is also provided. The righting levers are shown corrected for free surface effects. Wind and/or other heeling lever curves may be superimposed on the diagram as appropriate.



LIQUID LOADS

| LOAD | MASS t | WMAX t | LCG m | TCG m | VCG m | FRSM tm | GMCORR m |
|---|---|---|---|---|---|---|---|
| Heavy Fuel oil | 536.8 | 612.8 | 59.60 | 0.00 | 13.06 | 174 | 0.006 |
| Gas oil | 1.5 | 14.9 | 36.29 | -2.70 | 8.16 | 2 | 0.000 |
| Diesel oil | 35.1 | 40.3 | 55.43 | -7.69 | 14.14 | 5 | 0.000 |
| Lubricating oil | 57.8 | 174.1 | 41.78 | -0.02 | 3.88 | 73 | 0.003 |
| Fresh Water | 20.6 | 205.7 | 82.63 | 1.13 | 5.63 | 102 | 0.004 |
| Bilge Water | 66.3 | 110.4 | 45.02 | -7.00 | 7.12 | 132 | 0.005 |
| Technical Water | 6.4 | 64.2 | 46.48 | 3.49 | 0.38 | 6 | 0.000 |
| Cooling Water | 89.4 | 89.4 | 13.87 | 0.00 | 3.53 | 0 | 0.000 |
| Boiler Feed Water | 80.7 | 80.7 | 39.61 | 11.69 | 10.12 | 0 | 0.000 |
| Gray Water | 30.1 | 50.2 | 154.94 | -1.26 | 20.70 | 55 | 0.002 |
| Dirty Oil | 47.3 | 78.8 | 47.68 | -4.09 | 1.05 | 45 | 0.002 |
| Sludge Oil | 140.9 | 234.8 | 40.62 | -3.30 | 2.89 | 393 | 0.014 |
| TOTAL | 1112.8 | 1756.5 | 52.54 | -0.40 | 9.48 | 987 | 0.035 |

BALLAST WATER

| TANK | MASS t | FILL % | LCG m | TCG m | VCG m | FRSM tm | GMCORR m |
|---|---|---|---|---|---|---|---|
| WBBST1A | 755.5 | 100.0 | 260.90 | 0.00 | 8.44 | 0 | 0.000 |
| WBBST1B | 1286.7 | 100.0 | 249.45 | -0.00 | 7.52 | 0 | 0.000 |
| WBBST2P | 1100.1 | 84.5 | 227.74 | -6.74 | 5.68 | 142 | 0.005 |
| WBBST2S | 983.0 | 75.5 | 227.67 | 6.28 | 4.96 | 249 | 0.009 |
| TOTAL | 4125.3 | | 240.57 | -0.30 | 6.59 | 391 | 0.014 |

MASS LOADS

| LOAD | MASS t | LCG m | TCG m | VCG m |
|---|---|---|---|---|
| CREW | 3.0 | 151.80 | 0.00 | 32.00 |
| PROVISION | 5.0 | 151.80 | 0.00 | 22.00 |
| LASHING | 105.0 | 135.00 | 0.00 | 26.00 |
| TOTAL | 113.0 | 136.19 | 0.00 | 25.98 |
| | | | | |
| Lightweight | 22550.0 | 124.70 | 0.07 | 13.95 |
| Deadweight | 5351.1 | 199.26 | -0.31 | 7.60 |
| Total weight | 27901.1 | 139.00 | -0.00 | 12.73 |

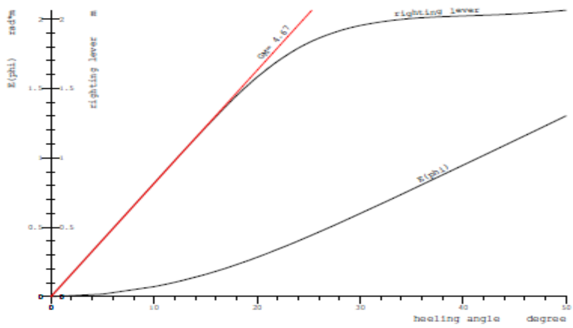
F L O A T I N G   P O S I T I O N

| | | | | | |
|---|---|---|---|---|---|
| Draught moulded | 5.190 | m | KM | 17.45 | m |
| Trim | -0.005 | m | KG | 12.73 | m |
| Heel, SB=+ | 0.0 | deg | | | |
| TA | 5.193 | m | GM0 | 4.72 | m |
| TF | 5.188 | m | GMCORR | -0.05 | m |
| Trimming moment | -404 | tonm | GM | 4.67 | m |

A summary of the appropriate condition displacement, corresponding draught, moment to change trim, longitudinal position of centre of buoyancy, longitudinal position of centre of mass, longitudinal position of centre of flotation, trim over perpendiculars, draught at forward and aft perpendiculars, draught amidships, total free surface moment for initial stability, vertical position of the transverse metacentre, vertical position of the ship's centre of mass, uncorrected and corrected for free surface effects, transverse metacentric height uncorrected and corrected for free surface effects and a statement giving the limiting value or values of stability parameters.

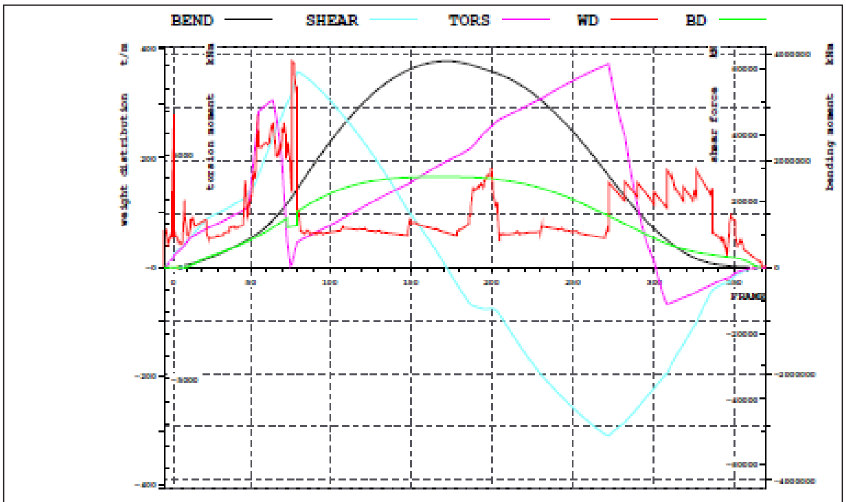
S T A B I L I T Y

| HEEL | 0.0 | 5.0 | 10.0 | 15.0 | 20.0 | 30.0 | 40.0 | 50.0 | 60.0 |
|---|---|---|---|---|---|---|---|---|---|
| KN | 0.000 | 1.523 | 3.038 | 4.531 | 5.956 | 8.348 | 10.246 | 11.891 | 13.261 |
| KG*sin | 0.00 | 1.11 | 2.21 | 3.30 | 4.36 | 6.37 | 8.19 | 9.75 | 11.03 |
| dGZ | 0.000 | 0.005 | 0.010 | 0.015 | 0.019 | 0.028 | 0.039 | 0.073 | 0.122 |
| GZ | 0.00 | 0.41 | 0.82 | 1.22 | 1.58 | 1.95 | 2.02 | 2.06 | 2.11 |
| EPHI | 0.000 | 0.018 | 0.071 | 0.160 | 0.283 | 0.598 | 0.946 | 1.303 | 1.667 |




STABILITY CRITERIA STATUS

| TEXT | REQ | ATTV | UNIT | STAT |
|---|---|---|---|---|
| Area under GZ curve up to 30 deg | 0.055 | 0.600 | mrad | OK |
| Area under GZ curve up to 40 deg. | 0.090 | 0.950 | mrad | OK |
| Area under GZ curve between 30 and 40 deg | 0.030 | 0.349 | mrad | OK |
| Max GZ > 0.2 | 0.200 | 2.106 | m | OK |
| Max. GZ at an angle > 25 deg. | 25.000 | 56.921 | deg | OK |
| GM > 0.15 m | 0.150 | 4.669 | m | OK |
| IMO weather criterion | 1.000 | 2.214 | | OK |
| Max angle of heel 16 deg. due to wind | 16.000 | 2.659 | deg | OK |
| Max angle of heel 0.8*FRB due to wind | 40.728 | 2.659 | deg | OK |
| Damage Stability | 0.300 | 4.669 | m | OK |




| | | | | | X | FRAME |
|---|---|---|---|---|---|---|
| SHEAR FORCE (MIN) | -51129.1 kN | ( 57.9%) | POSITION: | | 214.0 m | 272 |
| SHEAR FORCE (MAX) | 59049.1 kN | ( 72.8%) | | | 60.8 m | 80 |
| SAGGING MOMENT | -9.8 kNm | ( 0.0%) | | | 289.4 m | 369 |
| HOGGING MOMENT | 3873869 kNm | ( 63.1%) | | | 134.4 m | 172 |
| TORSION MOM. (MIN) | -1670.0 kNm | ( 1.2%) | | | 242.8 m | 308 |
| TORSION MOM. (MAX) | 9114.0 kNm | ( 6.4%) | | | 214.0 m | 272 |
| ABSOLUTE AREA UNDER TORS. MOMENT CURVE | 1094959 kNm*m | | | | | |

Simple guidance is given for the manual calculation of stability, draught and trim using suitable form sheets and regarding the use of ship's approved loading and stability computer.

### 6) Section 4 - Reference information

This section contains information which is not necessary for the operation of the ship but deemed useful as reference for the master. These include Inclining experiment report, Intact stability criteria, and any other information deemed useful.

The optional information is contained in the manual, which may be deemed by owners to be useful material appropriate to the operation of the ship. The accuracy and correctness of this information falls under the responsibility of the owners.

Navigators shall exercise prudence and good seamanship, having regard to the season of the year, weather forecasts and the navigational zone, and to take the appropriate action as to speed and course warranted by the prevailing conditions.

**Apply Your Knowledge**

1. Check the stability manual for your vessel and the loadicator if available. Practice use of the loadicator under supervision and compare your results with the manual calculations done with reference to stability manual.
2. Discuss the minimum stability criteria with respect to GM and deadweight followed by your vessel prior proceeding out to sea.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Maintain seaworthiness of the ship

**Task number:** C 2.1

**Sub-task Reference number:** C2.1.3, C2.1.4, C2.1.6

**Topic:** Ship stability (including understanding of the fundamentals of watertight integrity)

**Task Heading**

- Assist with hose testing (weather tightness) of hatches.
- Assist in checking weather tightness of watertight doors.
- Maintain the watertight doors, ports and hatches. Assist in replacing rubber packing as required.

**Objectives**

- To understand the importance of watertight doors and, hatch covers and other closing arrangements fitted on ships to ensure watertight integrity.

Please read this task in conjunction with tasks B2.1.1 to B2.1.5

**Index**

1) Introduction
2) Hatch covers
3) Hatch cover maintenance
4) Testing of hatch covers for weather tightness
5) Watertight doors
6) Weather tight doors
7) Booby hatches/ tank domes
8) Port holes and dead lights
9) Sealing rubber packing

**Description**

### 1) Introduction

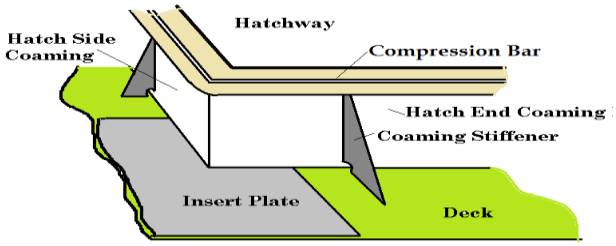
The enclosed spaces onboard provide the buoyancy to the vessel. The buoyancy provided by the volume of the enclosed spaces on board, which are above the waterline, is not used under normal service but is held in reserve. If any extra weights are loaded to increase the displacement, these spaces above the waterline are there to provide the extra buoyancy as required. Reserve buoyancy as provided by subdivided watertight compartments ensure that the ship remains afloat in case of accidental flooding of any one, two or more compartments as specified in the regulations.

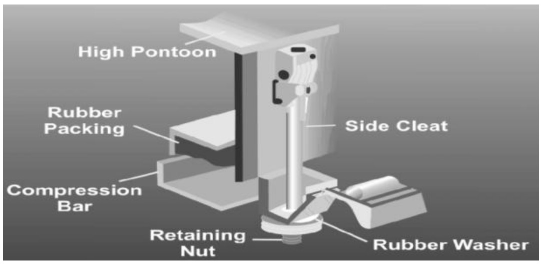
In accordance with the regulations, for safe running of vessel, the openings are required to be maintained watertight or weather-tight, as the case may be, throughout the service of the vessel.

> Watertight means the structure is designed and constructed to withstand a designated head of water pressure and will not permit the water to leak either-way of the partition.
> Weather-tight means that in any sea conditions water will not penetrate into the ship.
> In general, the openings below the freeboard deck are required to be watertight and above freeboard deck as weather tight.

### 2) Hatch covers

Coamings and hatchway covers are fitted to hatchways located on exposed decks. Being on exposed decks the hatch covers are required to be weather tight. These are constructed in accordance with classification rules. The covers are made suitably strong and are provided with means to be secured weather-tight in order to control any progressive flooding.




The hatch covers may turn out non weather tight due to

- ❖ deformation of the hatch coaming or cover due to impact, wear of the friction pads or wear and tear of the cleating arrangement
- ❖ lack of maintenance such as corrosion of plating and stiffeners due to breakdown of coatings, lack of lubrication of moving parts; cleats, joint gaskets and rubber pads in need of replacement, or replaced with incorrect specification parts
- ❖ Insecure hatch covers due to damage or wear of securing devices and incorrect adjustment, hence incorrect pre-tension and load sharing, of cleating systems


Bent compression bar


Damaged drain pipe of coaming


Hatch cleat in poor condition


Cracked hatch cover

Surveys of hatch covers and their coamings are carried out as part of the annual Load Lines survey. Hatch covers and coamings are examined in the open as well as closed positions including verification of proper opening and closing operation. Particular attention is paid to the condition of hatch covers in the forward 25% of the ship's length, where sea forces are normally greatest. If the hatch securing system cannot be properly operated, the ship will be obliged to effect repairs. For each hatch cover set, the following items are checked:

- ❖ cover panels, including side plates, and stiffener attachments of opened covers, by close up survey (for corrosion, cracks, deformation);
- ❖ sealing arrangements of perimeter and cross joints (gaskets for condition and permanent deformation, flexible seals on combination carriers, gasket lips, compression bars, drainage channels and non-return valves);
- ❖ clamping devices, retaining bars, cleating (for wastage, adjustment, and condition of rubber components);
- ❖ closed cover locating devices (for distortion and attachment);
- ❖ chain or rope pulleys, guides, guide rails and track wheels, stoppers, wires, chains, tensioners and gypsies;
- ❖ hydraulic system, electrical safety devices and interlocks;
- ❖ end and inter-panel hinges, pins and stools where fitted.
- ❖ the coamings, with plating, stiffeners and brackets are checked for corrosion, cracks and deformation, especially of the coaming tops.
- ❖ effectiveness of sealing arrangements is checked by hose or chalk testing supplemented by dimensional measurements of seal compressing components.

### 3) Hatch cover maintenance

Important points:

- Planned maintenance schedules shall be followed for the hatch covers, watertight doors, deadlight covers etc.
- The covers shall be frequently checked for overall structural strength.
- The surface of track-ways of rolling covers and of compression bars and other steel work bearing on seals or friction pads shall be checked and maintained smooth.
- Closing securing and cleating system shall be well maintained. Manual cleats shall be checked for adjustment, significant wastage and wear or loss of adjustment capability.
- Hydraulic or mechanically powered openings shall be maintained in accordance with manufacturers recommendations
- Seals and other wear components shall be replaced in accordance with manufacturers recommendations
- Any drains fitted to the inboard side of seal lines shall be cleaned and drained. The non-return valves for prevention of water ingress to holds in the event of boarding seas shall be checked.
- Renewal of components such as seals, rubber washers, peripheral and cross joint cleats shall be made as a panel set, to facilitate equalization of securing loads
- A record of maintenance and component replacement shall be maintained.
- Where a range of cargoes carried requires different gasket materials, a selection of gasket materials of the correct specification should be carried aboard, in addition to other spares.
- After each cargo operation, the hatch cover, bearing surfaces and drainage channels should be cleaned free of debris.
- Containers and other cargoes should not be stowed on hatch covers unless the covers are designed and approved for such carriage. Lashings should not be secured to the covers or coamings unless these are designed to withstand the lashing forces. Cargo securing manual shall be consulted.

### 4) Testing of hatch covers for weather tightness

- **Chalk test**

Chalk is applied to the compression bars of the coamings and the individual panel cross seams. The hatches are then battened down fully and in the proper manner after which they are immediately re-opened and the rubber packing (joints) carefully examined. A clean regular chalk mark on the packaging indicates that sufficient pressure exists between the joint and the adjacent compression bar. If the chalk mark is found to be intermittent or less pronounced at some points than at others then it indicates that weather-tight integrity does not exist over those areas. This method can only be considered as indicative of a possible problem. Upon completion of installation of hatch covers, a chalk test followed by a hose test with a pressure of water of not less than 200Kn/m$^2$ is recommended.

- **Light test**

The hatches are battened down fully and properly for seagoing. The surveyor/observer enters the hold and inspects the underside of the covers from below. In strong sunlight defects are mostly visible with daylight shining through any gaps in the packaging. If the test is being undertaken during poor light conditions strong torchlight properly directed from above will serve the same purpose.

- **Hose test**

A hose test is carried out for testing the apparent weather-tightness of hatch covers. It involves moving along a hatch-cover joint while directing a powerful jet of water at the joint to determine if any water passes through. Hose tests show whether the physical contact between packing rubber and its mating surface is satisfactory in a static condition, as any lack of contact will allow water infiltration. A hose test however does not show if the compression of the packing rubbers is

satisfactory. Hose test cannot be safely carried out when vessel is laden for fear of wet damage to the cargo. Also hose test cannot be carried out if weather conditions/air temperatures are at or below $0^{o}$C.

❖ **Test by ultrasonic equipment**

An ultrasonic transmitter is placed inside the cargo compartment to be tested. The operator uses a receiver to receive the signal so transmitted and converts the ultrasonic signal to an audible level measuring the received signal strength. First the signal is measured with the hatch open to determine the 'open hatch value'. Then, with the compartment secured, the operator passes the receiver around the seals of the hatch covers measuring any received signals. The limits and strength of received signals are marked on the hatch in chalk and subsequently recorded on a sketch. A hatch cover which is tight will not allow any received signal. The hatch cover is then opened and a close-up inspection made in order to analyze the source of the leakage indications.

Ultrasonic techniques are primarily used for hatch covers but have other uses, such as testing of oil tanker hatch openings, side shell doors, watertight bulkheads, access hatches, ventilation and grain loading ports. There are many circumstances where testing is required, as part of a steel pre-loading survey or for class and load line surveys. The method is clean and hatch covers may be tested with loaded cargo. Ultrasonic testing is precise and defective areas are clearly defined. The method is time efficient and non-labor intensive.

**5) Watertight doors**

- ❖ In ships where the watertight bulkheads below the waterline are cut by an opening, watertight doors are provided to close the opening and ensure the watertight integrity of the bulkhead. These doors break the continuity of a structural bulkhead leading to reduction of the strength of bulkhead. Because of this, these are engineered to match the bulkhead's strength as specified by classification society. These doors are generally of the sliding type horizontal or vertical, mostly operated mechanically by hydraulic or electric gear and additionally have manual gear systems. Once closed the door cover settles on the opening, a watertight gasket effectively sealing the opening and the door secured by hydraulic cleats or mechanical bolts.
- ❖ Watertight doors in passenger ships are normally limited to a maximum clear opening width of 1.2 m and are provided with power-operated sliding doors complying capable of being closed simultaneously from the central operating console at the navigation bridge in not more than 60 s with the ship in the upright position. When operating by hand gear complete closure of the door, shall not exceed90sec with the ship in the upright position. Further, either power operated or by hand the sliding watertight door can be closed with the ship listed to 15º either way; and also when water is flowing through the opening applying a static head equivalent to a water height of at least 1 m above the sill on the centerline of the door.
- ❖ In cargo ships, the number of watertight doors is kept to a minimum compatible with the design and proper working of the ship. Where watertight bulkheads have

> Care shall be taken not to put any obstructions which will hinder the operation or closing of the door from a remote location. Such an arrangement is severely dangerous for the safety of the vessel and any such observation during port state control inspections is considered a major deficiency.

penetrations, arrangements are made to maintain the watertight integrity. Watertight doors or ramps are fitted to internally subdivide large cargo spaces on ships such as car carriers. These doors or ramps may be hinged, rolling or sliding doors or ramps.The frames of vertical watertight doors are required not to have groove at the bottom in which dirt might lodge and prevent the door closing properly.

- The watertight doors shall be closed before the ship leaves port. Such doors or ramps shall be closed before the voyage commences. Further, these shall be kept closed during navigation. The time of opening such doors or ramps in port and of closing them before the ship leaves port shall be entered in the log-book. A notice is affixed to each such door to the effect that it is not to be left open. Should any of the doors or ramps be accessible during the voyage, they shall be fitted with a device which prevents unauthorized opening.
- Sliding watertight doors are capable of being remotely closed from the bridge and locally as well are provided to ensure the watertight integrity. Locally the watertight doors are capable of being operated from each side of the bulkhead. The central operating console at the navigation bridge is provided with a diagram showing the location of each door, with visual indicators to show whether each door is open or closed.
- Indicators are provided at the control position showing whether the doors are open or closed, and an audible alarm is to be provided at the door closure. Each power-operated sliding watertight door additionally is provided with an individual hand-operated mechanism. The power, control and indicators are operable in the event of main power failure.
- The use of such doors and hatch covers shall be authorized by the officer of the watch.
- An audible alarm is provided to indicate while the door is being closed.
- These doors are checked for suitable closing and operation during the load line survey. Company's planned maintenance schedule shall be followed for the maintenance of these doors.
- A hose test shall be carried out to check the watertight integrity of these doors. Where a hose test is not practicable because of possible damage to machinery, electrical equipment insulation or outfitting items, it may be replaced by a careful visual examination of welded connections, supported where deemed necessary by means such as an ultrasonic leak test.
- Drills for the operating of watertight doors on passenger ships, shall be conducted weekly.
- In accordance with the latest amendments to SOLAS, shipside doors used for pilot transfer on all ships shall, are required to open inwards. These doors shall be maintained in good condition. Care shall be taken to ensure the weather-tightness of these doors. These doors shall always be kept closed and shall be opened only temporarily during pilot transfer requirements. The doors are generally provided with an indication showing the status on bridge, whether open or close and additionally an alarm for the bilge level in the area.

### 6) Weather-tight doors

Weather tight doors are provided on accommodation entrances and other deck stores and mast houses. These doors are also provided with closing and sealing arrangements for closing them weather tight. The most commonly used system is by closing handles which slip over tightening wedges making the door weather tight. The door sealing gaskets shall be regularly checked and the closing handles shall be regularly greased. The handles generally have split washers which ensure the effective closing. The effective weather-tightness of these doors may be checked in a similar fashion as hatch covers; however chalk test is usually most preferred considering limited area of the door opening and comparatively lesser exposure to sea as compared to hatch covers.

### 7) Booby hatches/ tank domes

Booby hatches/ tank domes on deck cover the entrance openings to cargo holds/ tanks respectively. These are designed with suitable strength as required for the designated deck area, with additional strengthening to provide for the stresses caused due to discontinuity of deck. The openings are provided with covers to maintain weather-tight integrity of deck. The booby hatch/ tank dome covers are made of steel and have rubber packing to seal in the circumference. Booby hatch covers are provided with butterfly bolts for securing in position. The tank domes have further strong securing bows for the purpose. Poorly maintained booby hatches are dangerous and pose threat of heavy water ingress.

These booby haches and tankdomes plating shall be regularly inspected for the corrosion, particularly in the vicinity of welding seems where different metals are used. The gaskets are checked for elasticity and general condition. The closing arrangements and the butterfly bolts are kept well maintained and greased to ensure proper closing.The weather-tightness of the booby hatches is checked in a similar fashion as hatch covers. Chalk test is used as indicative check followed by more vigorous hose test.

Tank dome covers for cargo tanks on tankers, in addition to being weather tight, are required to be gas tight for which these are provided with a more robust construction. These tank dome covers are kept closed and are opened only for inspection and man entry. The effective closing is checked along with pressure testing during surveys at dry dock.

### 8) Port holes and dead lights

On passenger ships, port holes on lower decks above freeboard deck or margin line (in passenger are provided with additional covers called deadlights. These are hard steel covers, provided with butterfly bolts and gasket rim. The gasket rim fits on the porthole circumference and is bolted tight in position by butterfly bolts. Once closed, the deadlight provides a watertight cover for the porthole opening. The butterfly bolts of the deadlight covers shall be well greased and maintained. Deadlights which will not be accessible during navigation shall be closed and secured before the ship leaves port.

### 9) Sealing rubber packing

Sealing between hatch covers and coaming, weather tight doors and ports is achieved by many different types of rubber packing. The weather tightness is achieved by a sponge rubber packing pressed against the edge of a compression bar. Water will not infiltrate a hatch cover if there is physical contact between the packing rubber and compression bar. Whether the rubber is slightly touching the compression bar, or whether the packing rubber is being heavily over-compressed, does not make a difference. In the case of over-compressed rubbers, when packing rubbers are showing a deep permanent set or imprint, the packing rubber may lose its resilience and sealing performance. To ensure effective sealing the rubber packing shall be continuous with minimum breaks and maintained in elastic condition.

**Apply Your Knowledge**

1. Check the company planned maintenance procedures for maintenance of hatch covers, watertight doors, weather tight doors, booby hatch covers, deadlights and tank dome covers as applicable.
2. Discuss the effects of chemicals and paints on the sealing rubber gaskets and precautions to be observed while painting the surfaces containing the sealing gaskets.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Maintain seaworthiness of the ship

**Task number:** C 2.1

**Sub-task Reference number:** C2.1.5

**Topic:** Ship stability (including understanding of the fundamentals of watertight integrity)

**Task Heading**

- Assist in checking all load line related items and maintain good condition at all times, including - all closing appliances, air vents, ventilators, load line marks, etc. (refer condition of freeboard assignment form).

**Objectives**

- To understand the load line certification procedure of the vessel

**Index**

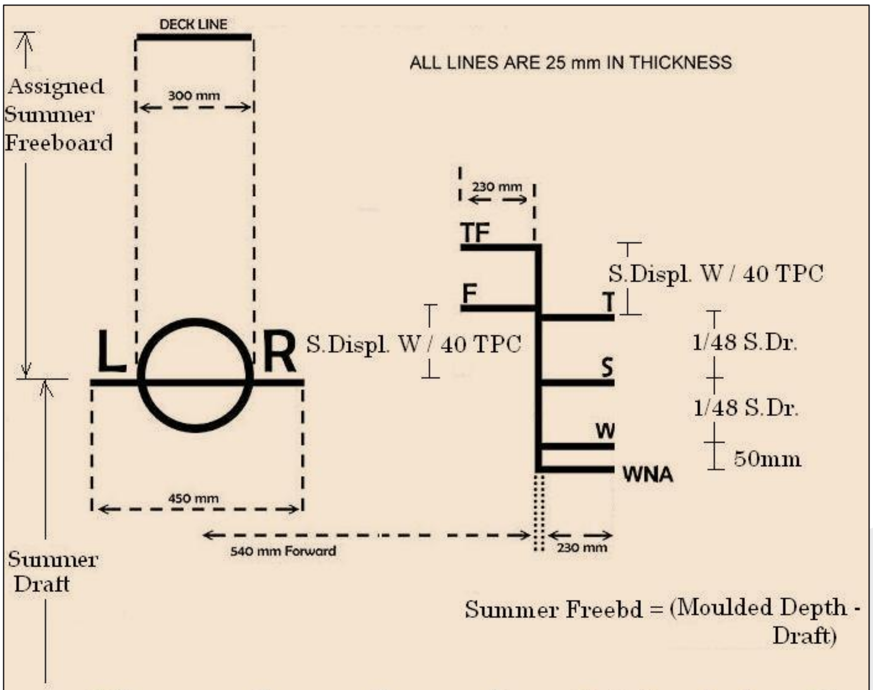
1) Load line marks
2) Load line certificate
3) Load line survey

**Description**

**1) Load line marks**

- The load line mark (Plimsoll mark) consists of a circle of outside diameter 300 mm and line thickness of 25 mm. This is further bisected by a horizontal line 450 mm long and 25 mm thick the upper edge of which passes through the center of the circle. The center of the circle is marked amidships vertically below the deck-line so that, the distance from the center of the ring to the upper edge of the deck-line is equal to the summer freeboard assigned to the ship.

- The deck-line is a horizontal line 300 mm long and 25 mm thick and is marked amidships on each side of the ship so as to indicate the position of the freeboard deck. The deck-line is marked in such a position on the side of the ship so that its upper edge passes through the point amidships where the continuation outwards of the upper surface of the freeboard deck, or of any sheathing of that deck, intersects the outer surface of the shell of the ship.




*Load line marks on the starboard side of the ship*

- The load lines consist of horizontal lines of 230 mm in length and 25 mm thickness extending forward or aft of a vertical line 25 mm thick marked 540 mm forward of the center of the circle of the load line mark. Load lines are drawn perpendicular to the vertical line. The individual load lines are as follows –

- Summer load line - extends forward of the above mentioned vertical line, and aligns horizontally with the line passing through the center of the circle of the load line mark, and is marked 'S'
- Winter load line - extends forward of the vertical line, below summer line, and is marked 'W'
- Winter North Atlantic load line - extends forward of the vertical line, below winter line, and is marked 'WNA'; WNA mark is applicable only to vessels less than 100m in length.
- Tropical load line - extends forward of the vertical line, above summer line, and is marked 'T'
- Fresh Water load line - extends abaft the vertical line, and is marked 'F'
- Tropical Fresh Water load line - extends abaft the vertical line and is marked 'TF'

The vertical spacing between lines is as shown in the picture.

The initials of the classification society of the vessel are marked on the Plimsoll disk.

- Vessels engaged in carriage of timber cargo on deck, when complying with carriage requirements as mentioned in timber code, are permitted to sail at deeper draft and lesser freeboards. These ships have an additional set of load lines marked on their sides which are then used. The details are provided in load line convention chapter IV.

**2) Load line certificate**

- Load line certificate is one of the statutory certificates required under international convention on load lines. The certificate is issued by the classification society for the vessel and is valid for 5 years, subject to annual surveys. Under the harmonized system of surveys, the certification procedure is as follows:

Anniversary date means the day and the month of each year which will correspond to the date of expiry of the relevant certificate. Under Harmonized System of Surveys, the Anniversary date for most of the statutory surveys is

- Initial survey - A complete inspection of all the items relating to the load line certificate before the ship is put into service to ensure they are in a satisfactory condition and fit for the service for which the ship is intended.
- Annual survey – Conducted annually on or near the anniversary date - General inspection of the items relating to the load line certificate to ensure that they have been maintained and remain satisfactory for the service for which the ship is intended.
- Renewal survey – Conducted 5 yearly –Checks as per annual survey but leads to the issue of a new certificate.
- Additional survey - Inspection, either general or partial according to the circumstances, to be done after a repair resulting from casualty investigations or whenever any important repairs or renewals are done
  For vessels on international voyages, the grace period for conducting the annual and renewal surveys is $\pm$ 3 months from the anniversary date.

INTERNATIONAL LOAD LINE CERTIFICATE (1966)

(Official seal of issuing authority.)
(Certificate No. ______)

Issued under the provisions of the International Convention on Load Lines, 1966, under the authority of the Government of the ..............................................................

By

(Insert full official designation of issuing authority)

and duly authorized for assigning purposes under the provisions of the Convention.

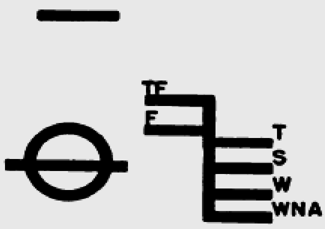
| Name of ship | Official number or distinctive letters | Port of registry | Length (*L*) as defined in Article 2(8) |
|---|---|---|---|
| Freeboard assigned as:[1] | A new ship ..................<br>An existing ship ........... | Type of ship:[1] | Type "A".<br>Type "B".<br>Type "B" with reduced freeboard.<br>Type "B" with increased freeboard. |

| | FREEBOARD FROM DECK LINE | | LOAD LINE |
|---|---|---|---|
| Tropical ........................ | ____ (inches) ................. | (T) ................... | ____ (inches) above (S). |
| Summer ........................ | ____ (inches) ................. | (S) ................... | Upper edge of line at level of center of ring. |
| Winter .......................... | ____ (inches) ................. | (W) .................. | ____ (inches) below (S). |

| Name of ship | Official number or distinctive letters | Port of registry | Length (*L*) as defined in Article 2(8) i.e., 46 CFR 42.13–15 |
|---|---|---|---|
| Winter (North Atlantic) | ____ (inches) ................. | (WNA) ............. | ____ (inches) below (S). |
| Allowance for fresh water for all freeboards | ...................................... | | ____ (inches). |

(All measurements are to upper edge of the respective horizontal lines)

The upper edge of the deck line from which these freeboards are measured is ____ inches above or below the top of the ____ deck at side; i.e., freeboard[1] deck.




Date of initial or periodical survey ________________

This is to certify that this ship has been surveyed and that the freeboards have been assigned and load lines shown above have been marked in accordance with the International Convention on Load Lines, 1966.

This certificate is valid until ________,[2] subject to annual surveys in accordance with Article 14(1)(c) of the Convention, and endorsement thereof on the reverse side of the certificate.

Issued at ________________ (Place of issue of certificate), ________________, 19____ (Date of issue)

(Signature of official issuing the certificate)

[Seal of issuing authority]

- Load line exemption certificate

Ships may be exempted from complying with load line regulations, where they have been granted a load line exemption certificate.

### 3) Load line survey

- In the case of the first survey of a ship for issue of load line certificate full information, particulars and plans relating to the design of the ship are submitted to classification society. Plans showing principal hull scantlings, framing, pillars and girders, and compensation in way of openings in the shell plating and strength decks are submitted.

The nature and physical properties of the materials used for construction of ship, gear and their means of connection is also stated.

- In addition to above, the following information is also submitted:

❖ The type of freeboard to be assigned, that is,
✓ Type A
✓ Type B
✓ Type B with reduced freeboard
✓ Type B with increased freeboard or
✓ Type B with timber freeboard

❖ The employment and intended service including any geographical limits of operation

**Type "A" ship means a ship which is designed to carry only liquid cargoes in bulk and has the characteristics set out below –**
❖ **the cargo tanks of the ship have only small access openings closed by watertight gasketed covers of steel or equivalent material**
❖ **the ship has high integrity of the exposed deck and has a low permeability of loaded cargo compartments**
❖ **the ship satisfies the stability criteria as laid down in Load Line Convention**

**Type 'B'** ship means a vessel other than a Type A

❖ The desired summer freeboard and the corresponding draught

❖ Details and connections of the principal hull castings and forgings and the fabricated construction of shaft brackets, rudders and stabilizing fins

❖ Scantling of enclosed superstructures, deckhouses and all companionways which give access to spaces below the freeboard and superstructure decks

❖ Details cargo hatch covers, coamings, beams and other supports, the securing arrangements for the covers, the details of gaskets etc.

❖ The means of protection to any openings in the casings

❖ Arrangements of ventilators with the details of coamings and the means of securing the openings weather tight

❖ Arrangement of exposed air pipes which lead to tanks below the freeboard and superstructure decks with the details of the air pipes and the means of securing the openings weather tight

❖ Arrangement of cargo ports or similar openings in the ship's side below the freeboard deck or in the sides and ends of superstructures. The lower edges of the ship's side openings are shown in relation to the uppermost seasonal load line. The scantlings, particulars of the doors, the securing arrangements and gasketing are also shown.

❖ Arrangements of scuppers, inlets and discharges indicating the position, type of the valves fitted at the shell and the arrangement of pipe work forming the system. Where the valves and shell fittings are constructed of a material other than steel or bronze, the physical properties of the material are stated.

❖ Arrangement and details of every side scuttle fitted to spaces below the freeboard deck and to enclosed superstructures and of side scuttles fitted in deckhouses and companionways where such structures are protecting openings in the freeboard and superstructure decks.

❖ Arrangements, dimensions and position of freeing ports in the bulwarks to the weather portions of the freeboard and superstructure decks. Where shutters and protective rails are fitted to such openings details are provided.

❖ Arrangement of the guard rails or wires, lifelines, gangways, walkways or under deck passages for the protection of the crew.

❖ Details of the intact stability of the ship at the assigned freeboard. It is stated which superstructures/erections are intended for inclusion in intact stability calculations.

- Flooding calculations and diagrams where applicable under the load line regulations; diagrams show final trim lines in relation to any opening through which progressive flooding might take place e.g. access openings in superstructures and bulkheads (even where fitted with weather tight doors) the tops of ventilator coamings and air pipe openings.

- Damaged stability calculations where applicable, showing angles of heel and details of the residual stability after flooding. Full details of the intact stability for the loaded condition used as a basis for these calculations should also accompany this submission.

- **Initial survey**

- The survey of new ships or existing ships not previously assigned load lines includes:
  - ✓ a complete and thorough examination of the ship's structure both internally and externally.
  - ✓ an examination of all fittings and appliances for the protection of openings giving access to spaces below the freeboard and superstructure decks, the guard rails, the freeing ports and means of access to the crew's quarters
  - ✓ an examination of the stability and, where applicable, loading and ballasting information which is required to be supplied to the master of the ship, and
  - ✓ the determination of all necessary data required for the computation of the freeboard.

- The surveyor carries out such tests as considered necessary to ascertain the above. Ships which comply with the highest standard of structural strength required by the rules of the classification society and with the conditions of assignment in full are assigned the statutory minimum freeboard. The initial load line survey is preferably carried out while the ship is in dry dock.

- The bottom shell plating is examined thoroughly to ensure that its condition is satisfactory along with its means of connection such as riveting or welding.

- Internally the examination includes the plating, framing and means of connection etc., in the double bottom, holds, tween decks, peaks and machinery spaces. Any ceiling sparring, linings and insulation should be removed wherever the Surveyor considers it to be necessary to facilitate inspection.

- The plating and beams of the freeboard and superstructure decks are surveyed and the Surveyor may require portions of deck planking, deck composition or tiling to be removed where deterioration is evident or suspected.

- At each load line survey all tanks which are an integral part of the hull structure are, in general, surveyed internally and maybe pressure tested by liquid to a pressure equivalent to the maximum load experienced in service or by air at a pressure not exceeding 0.141 kg/cm.

- Where such tanks (excluding peak tanks) are used exclusively for the carriage of oil fuel, or for oil fuel and fresh water ballast they are not examined at each load line survey unless as a result of an external survey or for any other reason the Surveyor considers it necessary. Cross-leveling arrangements fitted for stability purposes are examined regularly. If considerable deterioration is considered likely to have taken place since the date

> Failure to comply with the previously certified conditions of assignment, a ship is required to make necessary modifications as required. In the worst scenario, ship’s loadline marks are revised, resulting in having increased freeboard, which in commercial terms would mean reduction of permitted deadweight and thus reduced earning capacity of the vessel.
> Further, any repairs to primary hull structures require attendance by a surveyor at regular intervals to confirm fit-up, alignment, general workmanship and compliance with recommendations. This is followed by Non-destructive testing of completed repairs to primary structure.

of the last load line survey the thicknesses of the shell and deck plating and the means of connection are ascertained by drilling holes or by other acceptable means such as ultrasonic testing.

- ❖ The watertight and oil tight bulkheads forming the boundaries of the main compartments are examined carefully throughout their vertical and transverse extent taking into account any recesses or steps which may be fitted. Where deterioration has taken place the Surveyor may require the thicknesses of the plating to be ascertained by drilling holes or by any other acceptable means such as ultrasonic testing.

➢ **Annual and renewal surveys of ships**

- ❖ The characteristics and details of the fittings, appliances and arrangements approved for the ship, which are recorded relating to the conditions of assignment of freeboard are checked carefully at each periodical inspection.
- ❖ The closing appliances fitted to any openings of enclosed superstructures shall be fully effective and that no alterations should be made.
- ❖ If any alterations or additions have taken place which would materially affect the stability (e.g. significant increase in the light weight of the ship) revised stability information needs to be submitted to classification society for approval.

> No cargo shall be worked at the hatchway where or in whose vicinity survey inspection is being conducted.

- ❖ Items which are given particular attention

- ✓ Hatchways on freeboard deck and hatchways within superstructures which are not enclosed superstructures; all the materials, bearing surfaces and fittings associated with hatches, including rollers, chains, hatchway coamings, beams, covers and securing arrangements are in good and effective condition. Steel covers and their components are examined carefully in place followed by hose tests for checking effective weather tightness.
- ✓ Where alterations to the conditions of assignment have been made the alterations are recorded. Where these alterations may affect the position of the load lines the case is to be submitted to class so that new freeboards may be considered.
- ✓ Any alterations which have been made to the closing appliances of enclosed superstructures are noted. Where alterations have been made to the closing appliances reducing the effectiveness of such superstructures, the Surveyor requests modification or replacement to meet the Regulation requirement.
- ✓ Openings in the ship's side below the freeboard deck and in the sides and ends of enclosed superstructures and means of closing these openings are examined carefully in place and hose tested if considered necessary to ensure water tightness or weather tightness as appropriate.
- ✓ Casings protecting machinery openings and companionways, whether separate or within deckhouses, are examined ensuring that their sills, doors, fastenings, etc. continue to be effective.
- ✓ The Freeing port shutters are checked to hang freely and that any fittings for retaining them in the closed position will not prevent them from opening if a substantial amount *of* water is shipped. Drainage lines and fitting such as Scuppers, overboard discharges and non-return valves are checked for proper functioning.
- ✓ The closing appliances for Ventilators and air pipes such as ball valves, hinged gasket plates, flap valve steel covers etc. are checked to be satisfactorily maintained and are effective.

- ✓ All fittings, such as cargo securing arrangements, and appliances required Ships with reduced freeboards such as timber carriers having timber markings, are checked to be in good condition.
- ✓ At renewal surveys or on any other occasions when the ship is seen out of water the bilge keels are closely examined for damage and cracks, either of which may be the source of fatigue and brittle fracture of the shell plating.
- ✓ The positions of the load line marks and the deck line are checked at each annual survey and, if necessary, they are to be re-marked and re-painted.
- ✓ On completion of the annual survey if the surveyor is satisfied that the load line certificate should remain in force he/she will return the ship's copy suitably endorsed, to the Master drawing his attention to the need to retain this document on the ship. Also the report of annual survey is submitted to class headquarters.

**Apply Your Knowledge**

1. Your ship is due for a load line survey. Describe in brief how you would plan to check that all load line related items are in good order.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Maintain seaworthiness of the ship

**Task number:** C 2.2

**Sub-task Reference number:** C2.2.2, C2.2.3

**Topic:** Ship construction

**Task Heading**

- Under supervision, inspect the doubler /striker plate under the sounding pipe and understand its purpose.
- Under supervision, open and inspect an air pipe.

**Objectives**

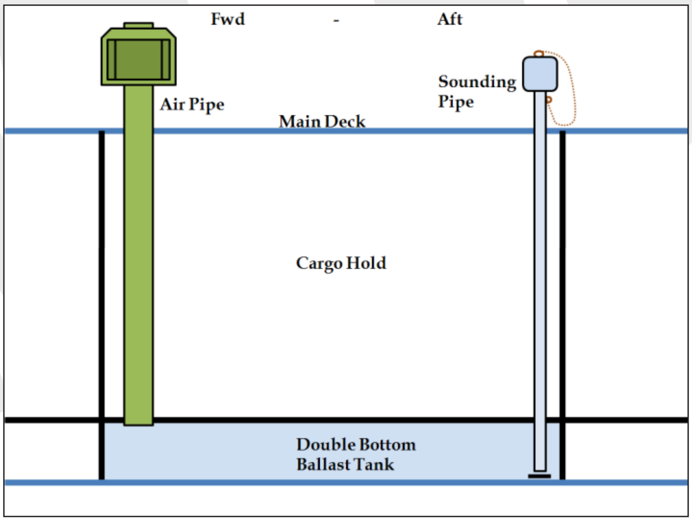
- To understand the construction, purpose and utility of air pipes and sounding pipes on board

**Index**

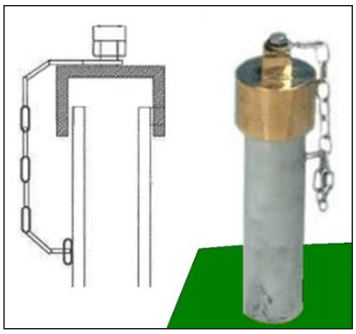
1) Sounding pipes
2) Air pipes

**Description**

**1) Sounding pipes**




- Sounding pipes are fitted in tanks, bilges and compartment likely to have liquids as well as to all compartments which are not readily accessible at all times such as chain lockers etc. These are provided to gauze the depth of accumulated water.
- Sounding pipes are usually straight vertical pipes with as few bends as possible. Bends in such pipes have the least possible curvature to facilitate ready passage of the sounding apparatus. Bent portions of sounding pipes have reinforced thickness and are suitably supported. Sounding pipes are usually fitted in the after part of the compartment, near the suction pipes.



- Sounding pipes, suitably supported by clamps and brackets, lead from the bottom of the tank to above the bulkhead deck or the freeboard deck in easily accessible places. However, in machinery spaces and tunnels, short sounding pipes led to readily accessible positions above the floor and fitted with efficient closing appliances (preferably self-closing type) may be accepted. The openings on deck are fitted with efficient, permanently attached, metallic closing appliances. Closing appliances consist of a metallic screw cap secured to the pipe by means of a chain or a shut-off valve.
- Where sounding pipes are used in flammable (except lubricating) oil systems, they terminate in the open air, where no risk of ignition of spillage from the sounding pipe

might arise. In particular, these are not allowed to terminate in passenger or crew spaces.

- The terminations of sounding pipes terminating in machinery spaces are fitted with self-closing blanking devices and with a small diameter self-closing control cock located below the blanking device for the purpose of ascertaining before the blanking device is opened that fuel oil is not present. Provision is made so as to ensure that any spillage of fuel oil through the control cock involves no ignition hazard. Self-closing appliances are fitted with cylindrical plugs having counterweights such as to ensure automatic closing.

- Doubler/ striker plates are provided under the lower ends of sounding pipes in order to prevent damage to the hull. These are thick steel plates securely fixed below each sounding pipe for the sounding rod to strike upon. Alternatively the sounding pipes may have perforated closed lower ends with reinforced closing plate.

- Sounding pipes are usually located at the after end of tanks because the normal trim for a ship is by the stern. The soundings of tanks while being used in calculations of cargo during draft surveys shall be adequately corrected. Chocked sounding pipes can lead to inaccurate cargo calculations.

- Sounding pipes and their supporting brackets shall be closely inspected for any leaks and corrosion, especially when these pass though cargo holds or other spaces, in order to avoid accidental flow of water or other liquid into cargo spaces causing cargo damage. Sounding pipe caps/plugs shall be kept greased and closed when not in use. During tank entry, the bottom of the sounding pipe and condition of doubler plate shall be checked. Any buildup of mud near the sounding pipe opening shall be cleared.

- Sounding rods shall be lowered gently into the sounding pipes. Sounding rods when dropped uncontrolled form the deck into the sounding pipe is likely part inside the sounding pipe, thus chocking the sounding pipe. Additionally when striking at a high speed, these are likely to generate sparks which may lead to explosion when flammable gas is present in the tank, especially in tankers.

**2) Air pipes**

- In order to allow the passage of air or liquid so as to prevent excessive pressure or vacuum in the tanks or compartments, Air pipes are fitted to all tanks, double bottoms, cofferdams, tunnels and other compartments which are not fitted with alternative ventilation arrangements.

- Air pipes are so arranged to allow free evacuation of air from the tank. These are usually fitted at the highest part of the tank, generally opposite to the filling pipe. Two air pipes are normally required for long tanks. Smaller compartments however may have only one air pipe. The position of air pipes on tanks is advised by the classification society during the design stage of the vessel.

- Air pipes of ballast tanks lead from the top of the tank to above of the freeboard deck. Air pipes of fuel oil tanks are required to lead to open decks above freeboard decks away from sources of ignition. Air pipes of lubricating or hydraulic oil storage tanks not 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. Enclosed super structures enclosing a ballast tank air pipe is required to have scuppers to facilitate suitable drainage. Also the air pipes to oil tanks are so located that any damage to the pipe will not allow the ingress of seawater or rain water into the tank.

- Generally, the height of air pipes, as measured from the upper face of the deck, extending above the freeboard deck or superstructure deck, from the deck to the point where water may have access below, is required to be at least:
  - 760 mm on the freeboard deck, and
  - 450 mm on the superstructure deck.

- In each compartment likely to be pumped up, and where no overflow pipe is provided, the total cross-sectional area of air pipes is required to be at least 1.25 times the cross-sectional area of the corresponding filling pipes. The internal diameter of air pipes is required to be at least 50 mm for all compartments, except for tanks of less than 2 $m^3$ in volume.

- Goose-neck type air pipes are simpler in construction and can be used for small spaces, deep tanks etc. The closing arrangements here are by means of a gasketed flap on hinges with a butterfly nut. Whenever the air pipe serves a fuel oil tank, or other space containing flammable liquids, a spark arrestor will be fitted in addition.

- Closing arrangements may be by way of gasketed flaps with butterfly nuts, or by float type arrangements. The later types are usually fitted to serve ballast tanks and fuel tanks and are capable of high outflow and inflow rates of air. The closing arrangement in the float type arrangements is provided by a buoyant float which lifts and shuts the air pipe as soon as water attempts to enter.

- Automatic closing appliances are permanently attached to air pipes for closing the openings of air pipes in order to prevent the free entry of water into the tank. These closing appliances are designed to allow the passage of air or liquid to prevent excessive pressure or vacuum coming on the tank. These are designed to be effective at angles of heel up to 40°. The clear area through an air pipe closing appliance is kept at least equal to the area of the inlet. Their casings for the float are made of approved metallic materials adequately protected against corrosion. Closures and seats made of non-metallic materials are compatible with the media to be carried in the tank, that is, oil or water, and with sea water at ambient temperatures between -25°C and +85°C. Air pipes of fuel oil tanks are additionally fitted with corrosion resistant wire gauze diaphragms (spark arrestors).


Air pipe head


Air pipe head float assembly


Wasted Air Pipe head

- These air pipe heads containing the closing appliance shall be inspected regularly as per company PMS. Floats, seals and seats shall be checked and renewed as required. Float guides shall be checked to ensure unobstructed operation. Air pipes heads are designed to drain automatically and these draining spaces shall be checked to be clear and not obstructed by rust, rags or other obstructions. The casing shall be checked for corrosion and dents. The dents in the casing may block the free movement of the float within. The fitting nut bolts shall be secure and greased. The spark arrestor mesh in the air pipes for the fuel oil tanks shall be clean.

- The air pipes passing through cargo spaces/ ballast tanks and their supporting brackets shall be carefully checked for corrosion and for any damages after each cargo operation. Any leakage through these pipes is likely to cause water damage to cargo.

- Minimum wall thickness of air pipes to ballast and other tanks above the freeboard deck or superstructure deck is required to be at least 6.0 mm for pipes of 80 mm or smaller external diameter and 8.5 mm for pipes of 165 mm or greater external diameter. The pipes shall be checked for traces of corrosion where the wall thickness appears considerably reduced. Same shall be renewed as required. Pipe supports shall be checked for strength.
- The bending moments and stresses in air pipes are calculated at penetration pieces, at weld or flange connections and at toes of supporting brackets. These points shall be carefully checked for traces of stress and corrosion. Brackets shall be at least 8 mm thick and of minimum length 100 mm. Corrosion shall be checked not to waste the brackets beyond these minimum standards.
- The air pipes and sounding pipes on deck shall be suitably protected from any damage caused by deck cargo.

**Apply Your Knowledge**

1. Draw the cross section of the air pipe for a ballast tank on board your ship.



**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Maintain seaworthiness of the ship

**Task number:** C 2.4

**Sub-task Reference number:** C2.4.23

**Topic:** Seamanship practices

**Task Heading**

- Identify and understand use of purging points provided on hydraulic lines and machinery.

**Objectives**

- Understand the basics of hydraulic principle used in machineries, effect of air in hydraulic system and means of purging the system.

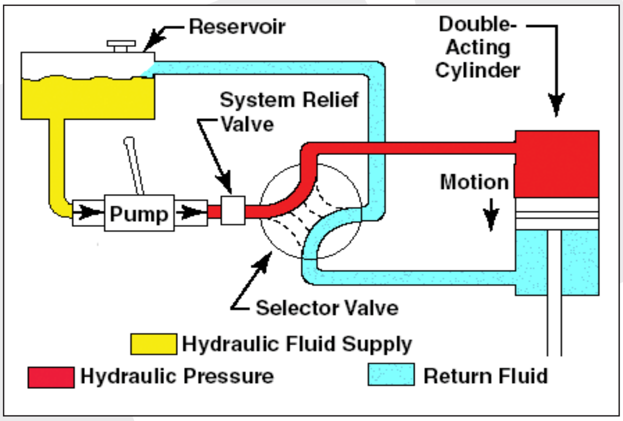
**Index**

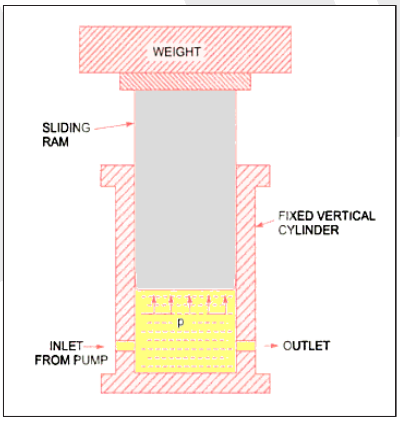
1) Hydraulic systems
2) Air in hydraulic systems

**Description**

**1) Hydraulic systems**

Hydraulic systems enable to accomplish significant works such as lifting heavy loads, turning heavy shafts, operating heavy machineries such as windlass and winches etc. Hydraulic systems work on Pascal's law, which states that pressure applied to a confined fluid at any point is transmitted undiminished throughout the fluid in all directions and acts upon every part of the confining vessel equally upon equal areas. Hydraulic machines use incompressible fluid, a fluid that is at its maximum density. Hydraulic oil is the most commonly used incompressible fluid for hydraulic machines. The major components that make up a hydraulic system are the reservoir, pump, valves and actuators, motor, cylinder, etc.




In a simple hydraulic system, when a piston pushes down on the oil, the oil transmits all of the original force to another piston, which is driven up. A hydraulic pump creates the pressure that moves the pistons. These pistons in return move the machinery working arm such as the jib in the cranes, tiller in the steering gear, hatch cover gypsy etc. Pressure in a hydraulic system is created by positive displacement pumps usually variable-displacement pump or gear pump.

**2) Air in hydraulic systems**

- The hydraulic system can transmit the pressure because the fluid used is incompressible. However the presence of air in the system renders the system ineffective as the air is compressible. Any compression force exerted at the inlet is absorbed by the trapped air which gets compresses. This result in loss of desired movement. In order to remove any air trapped in the system, purge points are provided at suitable location in the system.

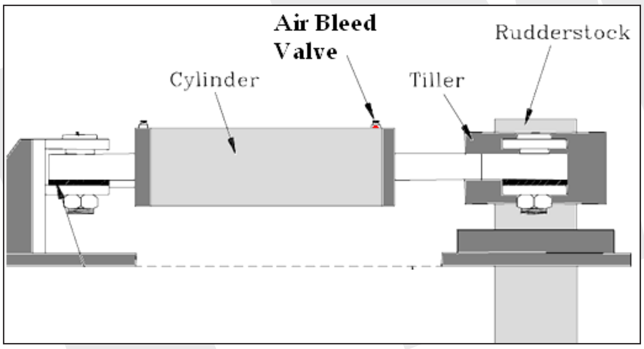
- Fluid aeration can cause numerous problems in a hydraulic system such as unacceptable noise, poor component response due to spongy behavior of aerated fluids, cavitation damage in pumps and severe fluid degradation by accelerated fluid oxidation.

- Air and gas gets into the system through
  - leakage at the suction side of pumps
  - the return line to the reservoir
  - open lubrication locations
  - low filling levels
  - strong turbulences in the reservoir

Aeration in combination with catalytic metal particles in the fluid is likely to cause decomposition of the fluid. Hereby organic acids, Aldehydes, Ketones and Peroxides are likely to form which may lead to further decomposition of the fluid, increase of the total acid number and radical polymerization, leading to formation of high molecular grease, mud or tar formation which can clog valves or block filters.

- A manual air bleed valve, automatic air vent valve, purge relief valve, bubble eliminator or systematic oil treatment system can be used to remove bubbles from fluids.

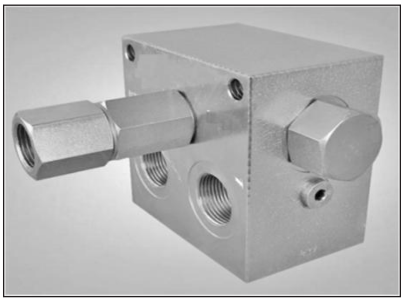
- Air bleed valves are most common and are provided on the individual cylinders gypsies and lines. The valve is opened manually to allow the air in the system to escape out while the chamber is getting filled up with pressurized oil. As soon as the oil is seen coming out, the valve is closed.

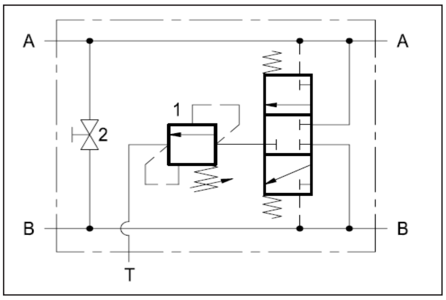



Hydraulic purge valves shall be positively identified and shall not be mistaken for greasing points/ nipple. These valves are likely to project a jet of hydraulic oil at high pressure capable of puncturing the human body part exposed to it. Suitable personal protective gear shall be used such as gloves, goggles etc. to protect the hands, eyes respectively when working on

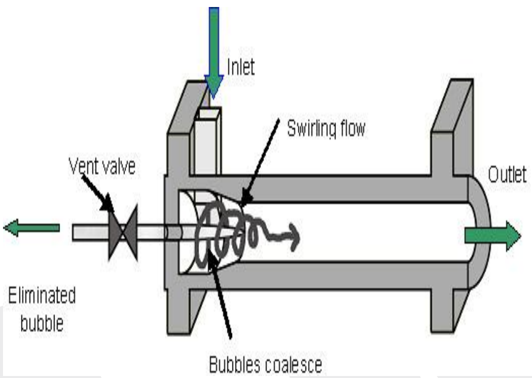
- Automatic air vent valves are mounted on the pressure line as shown in the picture. The valve is set to remain open till the fluid pressure in the line increases to the set limit. As soon as the set pressure is achieved, the valve closes. This facilitates any air trapped in the hydraulic line to leak to the atmosphere. The relief line leads to a separate reservoir where the oil escaped gets collected.

- A purge relief valve, as shown in the picture below, functions as follows. The inlets A-A and B-B are connected to and crossed by the pressure lines of a closed loop hydraulic transmission. As pressure rises in either line, the internally piloted 3-way/3-positions spool opens the lower pressure line to tank through the purge relief valve (1). This allows a portion of the charge pump flow to be exhausted to tank after the oil has done its work and allows an identical volume of fresh oil to get into the closed loop system. When the directional control (and the motion) is reversed, the spool switches in the opposite direction, maintaining hot oil exhaust.






- Bubble eliminator - This device consists of a tapered tube with circular cross-section gradually reducing. It then connects with a cylindrical straight tube chamber. Fluid containing bubbles flows tangentially into the tapered tube from an inlet port and generates a swirling flow that circulates the fluid through the flow passage. The swirling flow accelerates as the radius decreases, reducing the fluid pressure along the central axis as the fluid moves downstream. At the end of the tapered tube, the swirl flow decelerates downstream and the pressure recovers as the fluid moves to the outlet.




There are centrifugal forces created in all parts of the swirl flow, and the bubbles tend to move toward the central axis of the device due to the difference in centrifugal force. Small bubbles are trapped, creating an air column in the vicinity of the central axis of the swirling flow near the area where the pressure is the lowest. When backpressure is applied at the downstream side of the device, the collected bubbles are ejected through the vent port. These eliminators may be fitted in the hydraulic lines, return lines or in a separate relief arm.

- Systematic oil treatment system can be in the form of a separate portable unit or it may be installed with the main hydraulic system.

**Apply Your Knowledge**

1. Check the hydraulic systems for the following gear on board (as applicable) and locate the air purge points.
   - Steering Gear
   - Mooring Winches
   - Hydraulic hatch Covers
   - Hydraulic cargo/ ballast pumps

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Maintain seaworthiness of the ship

**Task number:** C 2.4

**Sub-task Reference number:** C2.4.24

**Topic:** Seamanship practices

**Task Heading**

- Locate the Material Safety Data Sheets (MSDS) for the paints onboard and demonstrate awareness of action to be taken in an emergency.

**Objectives**

- To understand the safe handling procedures for paints with reference to MSDS.

**Index**

1) Material Safety Data Sheets (MSDS)
2) Contents of Material Safety Data Sheets
3) Handling and storage of paints
4) Fire and explosion hazard
5) Toxicity hazards
6) Spillage and disposal

**Description**

**1) Material Safety Data Sheets (MSDS)**

Material Safety Data Sheet (MSDS) is a document that contains information on the potential hazards and how to work safely with the given chemical product. MSDSs are prepared by the manufacturer of the material. The MSDS provides workers and other health and safety representatives with the necessary information to assist in safely managing the risk from hazardous substance exposure. It is important that everyone in the workplace knows how to interpret a MSDS.

**2) Contents of Material Safety Data Sheets**

The Material Safety Data Sheets contain information regarding the products. The information is provided under different sections as mentioned below

- Section 1 – Product identification
- Section 2 – Ingredients of the substance
- Section 3 – Physical data
- Section 4 – Fire and explosion hazard data
- Section 5 – Health hazard information and first aid
- Section 6 – Reactivity data
- Section 7 – Spill, disposal procedures and environmental data
- Section 8 – Special protection information
- Section 9 – Storage and special handling

## MATERIAL SAFETY DATA SHEET

Prepared according to 29 CFR 1910.1200

N/A = Not applicable    Revised 1/15/03

**SECTION 1 - PRODUCT IDENTIFICATION**

**Trade Name: Safecoat Semigloss Enamel**
Product I.D.# & Color: 1512 White
Product Class: Waterborne Polymer Emulsion
Supplier's Name: American Formulating & Manufacturing
Telephone #: (619) 239-0321    Fax # 619-239-0565
Address: 3251 Third Avenue, San Diego, CA 92103
Emergency Phone (MSDS Information): (619) 239-0321 or (562) 693-0872
D.O.T. Emergency Phone Number: (562) 693-0872
US DOT Hazard Shipping Class: Not regulated - aqueous
D.O.T. Labels/Placards Required: No
OSHA Class: 29CFR 1910.1200 Non-hazardous
SARA TITLE III Emergency & Community Right to Know:
Section 311/312 Categorizations (40 CFR 370): Not a hazardous chemical
Section 313 Information (40 CFR 372): This product does not contain a chemical which is listed in Section 313 above de minimis concentrations.

**SECTION 2 – INGREDIENTS**

Modified Acrylic Emulsion    Mixture    Weight Percent: 35 – 40
Water    CAS #: 7732-18-5    Weight Percent: 25 – 30
Titanium Dioxide    CAS #: 13463-67-7    Weight Percent: 20 – 25
Pigment dust when dry or sanded    ACGIH TLV 10 mg/m3 total dust
Aluminum Silicate    CAS #: 1332-58-7    Weight Percent: 0 - 5
Pigment dust when dry or sanded    ACGIH TLV 10 mg/m3 total dust
Propylene Glycol    CAS #: 57-55-6    Weight Percent: <5
Exposure limits: None assigned    Vapor Pressure .22 mm Hg @ 77 F

**Suspected Cancer Agents**: Federal OSHA: No NTP: NO IARC: No    None known.
HMIS Codes: H-1 F-0 R-0 P-B

**SECTION 3 - PHYSICAL DATA**

Physical Description: Viscous liquid, low odor, mildly alkaline, white (when not tinted)

| | |
|---|---|
| Boiling Point | 100 C/212 F |
| Melting Point | N/A |
| Vapor Density | Heavier than air |
| % Volatile by Volume | 65.00 % |
| LBS/GAL Theoretical | 10.48 +or- .15 |
| Solubility in Water | Dilutable |
| Vapor Pressure, mmHg @ 20degC | N/A |
| Evaporation Rate | Slower than ether |
| % Volatile by Weight | 52.31 % |
| Specific Gravity (Water=1) | 1.26 |
| VOC Material | 57 g/l, 0.48 lb./gal |
| VOC Material less H20 | 141 g/l, 1.17 lb./gal |

**SECTION 4 - FIRE & EXPLOSION HAZARD DATA**

**Flash Point**: N/A non-combustible
**Flammable limits in air, volume % - lower LEL**: 2.6 **Upper UEL**: 12.5
**Fire Extinguishing Media**: Water, carbon dioxide, dry chemical
**Personal Protective Equipment**: Self-contained breathing apparatus (pressure-demand MSHA/NIOSH approved or equivalent) and full protective gear may be worn if desired, but not necessary for normal use.
**Autoignition Temp.**: N/A
**Special Fire Fighting Procedures**: Use water (fog) to cool closed containers. Wear self contained breathing apparatus.

**Medical Conditions Generally Aggravated by Exposure**: None known.

**Emergency & First Aid Procedures**:

Inhalation: Remove from exposure. Provide plenty of fresh air.
Splash (eyes): Flush immediately with large amounts of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Take to a physician for medical treatment.
Splash (skin): Remove with soap and water. Remove contaminated clothing. Supply copious amounts of fresh water to the skin areas to rinse material away.
Ingestion (Swallowing): Consult with physician, hospital emergency room, or poison control center immediately. Only if conscious, give 2 glasses of water to drink.
Notes to Physician: Any treatment that might be required for overexposure should be directed at the control of symptoms and the clinical conditions.

**SECTION 6 - REACTIVITY DATA**

**Stability**: Stable, however avoid temperatures above 177°C/350°F, the onset of polymer decomposition.
**Incompatibility (materials to avoid):** Avoid materials that are water reactive, highly alkaline or highly acidic.
**Hazardous Decomposition by-products**: CO, CO2 on combustion
**Hazardous Polymerization**: Will not occur.
**Conditions to Avoid**: Excess heat may cause containers to rupture. Avoid temperatures below 45°F or freezing conditions.

**SECTION 7 - SPILL, DISPOSAL PROCEDURES; ENVIRONMENTAL DATA**

**Steps to be taken in case material is released or spilled**: Confine in small area; contain and remove with inert absorbent (sand, earth, etc.). Place in proper container for proper disposal. CAUTION - Keep out of waterways, drains, sewers by diking. Keep spectators away. Floor may be slippery. Use care to avoid falling.
**Waste Disposal Method**: Place contaminated material in suitable sealed metal containers for disposal. Do not incinerate closed containers. Use non leaking containers, seal tightly and label properly. Do not pour contaminated paint back into unused paint. Do not throw liquid paint into the trash. Where allowed by local laws (check with local regulatory agencies) allow liquid waste materials to dry out before disposing into trash containers. Take all liquid unused paint that cannot be used to approved recycling centers, paint roundups, or county facilities that are approved to take unused paint at collection sites. Contact state, county, city health services or fire departments to find nearest collection centers. Do not dispose of waste into water streams or storm water sewers. Do not mix with other kinds of waste. Dispose all waste in accordance with local, state and federal regulations.
**RCRA Classification**: As produced, this product is not a waste. If discarded as is, it is not classified a "Hazardous" waste under RCRA. This product is not ignitable, corrosive, reactive, or toxic; therefore is not defined as hazardous by the EPA.
**Environmental Hazards**: None known.

**SECTION 8 - SPECIAL PROTECTION INFORMATION**

**Respiratory Protection**: If applied by spraying, use an appropriate, properly fitted NIOSH/MSHA approved respirator to remove spray mist. Good room (mechanical) ventilation should be sufficient protection against vapors from product. If further protection is desired or if persons are sensitive to vapors, use a respirator with a NIOSH/MSHA approval number TC-23C-860 or TC-23C-87 or an equivalent. Refer to OSHA 29 CFR 1910.134, "Respiratory Protection".
**Ventilation:** General (mechanical) room ventilation is expected to be satisfactory.
**Protective Gloves**: None required under most conditions. If protection is desired, plastic, nitrile or latex rubber will provide adequate protection.
**Eye Protection**: Safety glasses or goggles with side shields if splashing may

### 3) Handling and storage of paints

Paints shall be stored in designated paint lockers usually located near the forepeak or aft peak stores. These shall be ventilated spaces free of any sources of ignition and hot surfaces. The drums shall be covered and securely stowed. Any container or pot carrying part of paint shall be well labeled. MSDS sheets shall be read and understood prior using any paint. The in-charge of paint store, the handler and personnel involved in painting operations shall be briefed on the use of various paints and associated hazards. Any paint left over shall be taken back to the paint store and shall not be left here and there.

### 4) Fire and explosion hazard

- Paints contain solvents which when applied in enclosed or confined spaces pose hazards of explosion and toxicity. Precautions must be taken to eliminate them.
- Sufficient ventilation of space must be provided to maintain the ratio of vapour/air at no more than 10% of the lower explosive limit. If the flash point of the solvent is above the working temperature, then an explosion is unlikely. However, ventilation would still be necessary to eliminate toxic hazard. Minimum ventilation air quantity is given in product data sheets.
- This quantity of ventilation air must be maintained throughout the application of the paint and also during the period of evaporation of solvent. The ventilation must be arranged so that all parts of the compartment are properly ventilated. The vapour concentrations in various positions shall be regularly checked. Painting must immediately be stopped if the concentration rises above 10% LEL, until the vapour concentration is reduced to a safe level again. Temperature within compartments, heated up by strong sunlight in summer, may rise well above the flash points of solvents making it essential to continue ventilation. Sparks, hot surfaces, flames and all other sources of ignition must be absolutely isolated from area where painting is in process. Flame proof lighting and electrical equipment, spark proof tools and clothing shall be used within and in adjacent compartments. All equipment, whether electrical or not electrical (e.g. pneumatic pumps, spray tips, etc.) must be adequately earthed to avoid accumulation of static electrical charge.

> The minimum required ventilation air rate in $m^3$ per minute may be calculated from the formula:
>
> $$\frac{(P \times M) + (Q \times N)}{T}$$
>
> P = quantity of paint consumed in litres.
> Q = quantity of thinner consumed in litres.
> M = min. ventilation air quantity needed to reach TLV of 1 litre of paint.
> N = min. ventilation air quantity needed to reach TLV of 1 litre of thinner.
> T = application time in minutes

- Most of the paint solvents have low flash points. Closed paint containers may explode when exposed to extreme heat. Empty or partly filled drums containing residues of solvents can be more dangerous than full drums, as the danger of explosion is greater. Foam, water or fog nozzles are preferable for fighting fire. Lockers having area less than $4m^2$ in deck area are likely to be provided with portable fire extinguishers. Others are required to have a fixed fire extinguishing system installed. The operational readiness of the extinguishers and fixed fire extinguishing system shall be regularly checked.

### 5) Toxicity hazards

Toxic substances can harm the body in three ways.

- ❖ By causing local burns or irritation if they come into contact with skin or eyes
- ❖ By being absorbed into the body and cause internal damage or systemic poisoning
- ❖ By causing an allergic reaction which could be life threatening

> Prior providing first aid to a casualty so affected, it shall be remember that toxins are poisonous to the rescuer as well. All possible precautions shall be taken to protect the casualty as well as self while providing the first aid.

- Toxic substances can enter the body through
- ❖ By inhaling fumes or toxic gases, vapour, gas, mist, spray, dust or fume
- ❖ By swallowing
- ❖ By contact through skin and eyes

> Enclosed spaces or paint store and forepeak store etc. are likely to have accumulated gases and the atmosphere inside may be deficient in oxygen. These spaces shall be well ventilated prior entry and during the periods when personnel are present there in the store. Clear notice shall be posted at the paint locker door stating "Ventilate before entry".

- Repeated and prolonged overexposure to solvents is likely to cause permanent brain and nervous system damage.

- Spray painting operations present both health and physical hazards to the worker. The most common exposure control methods for spray paint operations are the use of spray paint booths or rooms. If not handled properly, spray guns may cause severe injuries to eyes or skin.

- **Inhalation**
  Many chemicals such as chlorine produce fumes which affect the lungs and cause difficulty in breathing. Many gases such as carbon monoxide, carbon dioxide, hydrogen and some refrigerant gases have no odour. The main symptoms of exposure are difficulty in breathing, nausea, headache, dizziness and confusion or even unconsciousness in severe cases. Many solvents used in paint have some degree of toxicity and it is necessary to provide sufficient ventilation air to maintain safe atmosphere below the threshold limit value (TLV). Inhalation of dust and fumes shall be avoided by the use of ventilation or extraction. The enclosed areas shall be ventilated by forced ventilation. A face mask should be worn when spraying, sanding or blast cleaning.

  > Prior entering any enclosed space for rescue enclosed space entry procedure shall be duly followed. Precautions against fire and explosion may be necessary for some gases.

- **Swallowing**
  Many substances will cause chemical burns to the mouth, gullet and stomach if swallowed. These include bleaches and other cleaners and disinfectants, acids and alkalis and corrosives as well as petrochemicals. The ingestion (swallowing) of paint must always be avoided. Food and other eating materials should not be brought into or consumed in the work area where coatings are stored or used. Thorough washing of hands and face is essential after applying paint, particularly before eating or smoking. If paint or thinners should accidently be swallowed, immediate medical attention is required. Pain killers and other medication shall be administered in accordance with radio medical advice and MSDS.

- **Skin contact**
  Absorption through the intact skin may produce general symptoms such as nausea, vomiting, drowsiness and weakness. Substances used in paints may cause irritation after repeated or prolonged contact with the skin and in susceptible cases there is a risk of dermatitis. Personnel with a history of skin sensitivity should not be employed in processes where skin contact can occur. Prolonged or repeated contact of paint with the skin should be avoided by wearing impervious gloves and protective clothing. Barrier cream may be used for protection. Hands shall be cleaned using a proprietary hand cleanser and not with solvent or thinner. The contaminated clothing and shoes should be removed as soon as possible. After completing painting operations, showers should be taken prior to changing into street clothing. For chemicals, the chemical shall be washed off with copious amounts of water for at least 10 minutes or more till there are traces of chemicals on the skin. A chemical burn shall be treated as per the recommended treatment of burn as advised in the MSDS and by radio medical advice.

  > It is recommended to have clean eye wash water kept ready for use in paint store and the areas where the personnel are involved in handling paints &chemicals.

  > Emergency shower is provided on open deck, usually near the paint store. Same shall be checked and tried out regularly and during medical emergency drills for proper

- **Eye contact**
  Many substances, chemical liquids or their fumes produce redness and irritation if the eyes are accidentally splashed or exposed to these. Goggles should be worn for eye protection whenever necessary. The substance shall be washed out of the eye immediately with copious amounts of cold fresh water, keeping the eyelids wide open.

Medication and treatment shall be followed in accordance with MSDS and radio medical advice.

**6) Spillage and disposal**

In case the paint or solvent are spilled all attempts shall be made to avoid escape overboard. On deck and in stores, in case of spill, the area shall be well ventilated and all sources of ignition removed. The spill shall be cleaned with an inert absorbent. The left-over of paints, used drums, brushes etc. shall be incinerated or disposed in accordance with MARPOL garbage disposal regulations.

Tributyltin (TBT) in Antifouling paints has severely harmful effects on the environment and its use is prohibited.
Use of Copper-based antifouling paints, Tin-free anti-fouling paints and Non-stick coatings is recommended as an alternative.

**Apply Your Knowledge**

1. List the contents of material safety data sheets (MSDS) for the paints onboard. Attach a copy of same and highlight the actions to be taken in case of emergency as per the attached MSDS.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Prevent, control and fight fires on board

**Task number:** C 3.1

**Sub-task Reference number:** C3.1.18 (C3.1.18.1- C3.1.18.10)

**Topic:** Operation and maintenance of fire-fighting appliances (FFA)

**Task Heading**

Assist the safety officer with the testing of the following FFA, where fitted:

- Fire detection and alarm systems
- Fixed $CO_2$/DCP extinguishing system
- Fixed steam extinguishing system
- Fixed automatic sprinkler system
- Fixed fire-fighting system in paint room
- Fixed foam extinguishing system
- Fire flaps and dampers
- Foam applicators
- Automatic and manual fire doors
- Emergency shut off valves, pump stops and main engine stops.

**Objectives**

- Understand procedures for testing and inspection of various fixed fire fighting appliances.

**Index**



**Description**

**1) Testing of fire fighting installations**

SOLAS chapter II/2, regulation 14 requires fire protection systems and fire-fighting systems and appliances to be properly tested and inspected in order that they are maintained in a state ready for use at all times while the ship is in service. If a fire protection system is under repair, then suitable arrangements should be made to ensure safety is not diminished.

A planned maintenance schedule, developed in accordance with IMO and flag state guidelines, is available on board the ship for the required maintenance of FFA. The maintenance manual is divided in two parts, namely, “Fire Equipment Maintenance Plan” and “Fire Equipment Maintenance Record”.

The fire equipment maintenance plan provides a complete checklist of all fire-fighting equipment on board, their particulars, their location, and detailed maintenance instructions. The details of the FFA including make, type, serial number and maintenance instructions are mentioned for all FFA provided on board.

In the manual, fire extinguishers, fire hoses, fire detectors, ventilators, etc. is assigned a unique number. Numbering is continuous, starting from monkey island, going down to the engine room, followed by main deck. The numbering on the main deck is from forward to aft. The numbering of ventilators is such that all ventilators serving the same fire zone are grouped together.

Part II of the manual is the maintenance record which provides a complete record of inspection, maintenance, any non-conformities noted, action taken and completion dates. The record also lists the details of the spares carried on board. An inventory check of all spare parts must be taken once in 3 months.

Prior testing various fire-fighting systems, the crew shall be suitably advised not to be mistaken by any of the alarms. Once the tests are completed, suitable announcement shall be made. Critical Tests other than routine inspection shall be carried out only in consultation with the Master when the ship is in open sea, anchorage or alongside ONLY after having determined if safe to do so.

### 2) Fire detection systems

Following items are checked in fire detection systems.

a) Self-tests are carried out as per manufacturer's instructions.
b) Fire alarm is tested for operation.
c) Zone indicator bulbs are checked for proper functioning.
d) Power failure alarm is checked for proper functioning.
e) If operation of fire alarm activates any tripping of fire doors, ventilator fans, pumps etc., then it should also be verified whether the trip has actually operated.

Inspection of emergency alarm switches

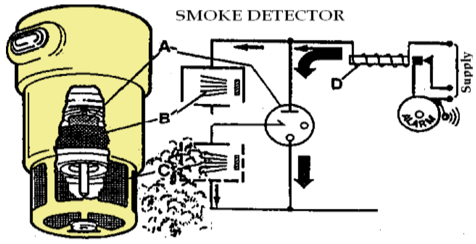
a) Check that the serial number of the switch / Push Button is marked near the respective alarm bell or switch.
b) Location of all alarm switches / push buttons should be clearly marked in the safety plan.
c) Ensure that no switch is bypassed or inoperative.

Inspection of sensors

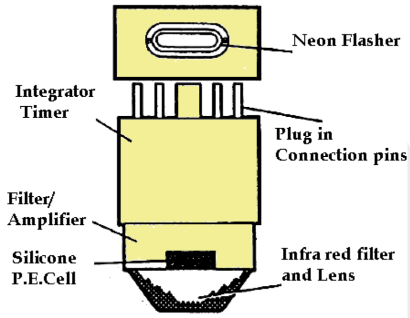
a) Check that the serial number of the sensor is marked near the sensor.
b) Check that the direction of rotation to open the sensor, if applicable, is marked.
c) Ensure that no sensor is bypassed or covered. If a smoke sensor near a steam leak is getting activated repeatedly, then it is preferable to put a shield to prevent direct attack of steam on the sensor, rather than bypassing or covering the sensor.

Testing of sensors and switches / push buttons

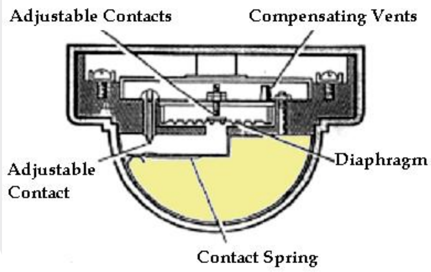
a) All fire detecting sensors and switches / push buttons must be tested within a six month period. A batch of sensors from various zones must be tested every week with at least one sensor from each zone covered every month and no more than 6 months between testing of each sensor.
b) All tests must be carried out as per manufacturer's instructions.
c) Smoke sensors are usually tested by manufacturer's recommended activating agent in spray cans.




d) Heat sensors should NEVER be activated by naked flames as it damages its sensitive plastic heads. Usually a hot air blower is sufficient to activate the heat sensors. Check manufacturer's instructions on testing.



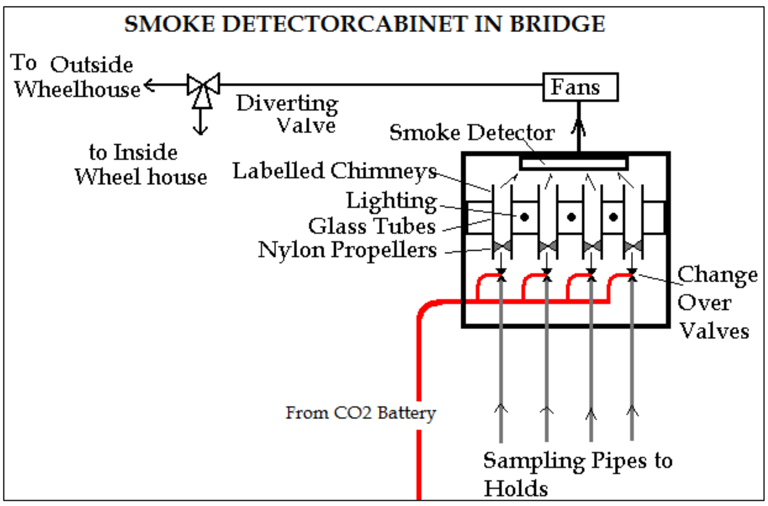

e) Some flame detectors are specially designed not to react to a flashing torch across their lenses. The best way of testing these types of detector is to use a test device specifically designed for the purpose.




### 3) Sample extraction smoke detection systems

Inspection of unit

a) The unit shall be kept on at all times, irrespective whether vessel is at sea or in port.
b) The detection cabinet has two exhaust motors which shall be interchanged on a daily basis.
c) Check that air is being extracted from all compartments.
d) Carry out self-checks and try out the audible alarm on the panel.
e) Ensure that the areas to be kept isolated are isolated.



Smoke activation test

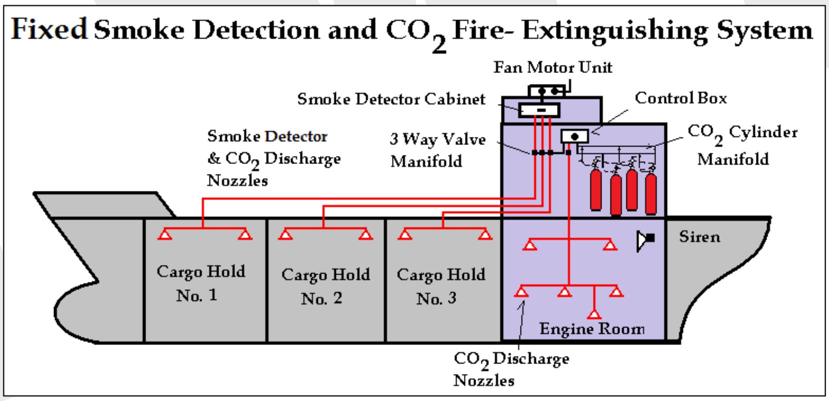
a) The automatic detection and activation of alarm function of the system can be checked by generating smoke near the suction in the hold or area covered. Usually smoke bombs are used to activate the alarm.
b) Alternatively, below the display unit of the system, an inlet with plug is provided for the test. This plug is opened and smoke induced to test the unit.
c) When carrying out the test, it must be ensured that compartment is correctly identified.
d) Test for blowing the lines is covered under fixed gas extinguishing systems.

### 4) Fixed gas fire smothering system

$CO_2$ / Halon room & operating controls

Fire-extinguishing systems using Halon 1211, 1301, and 2402 and perfluorocarbons are prohibited. New installations of Halon systems are further prohibited.

a) Ensure that all access to $CO_2$ / halon rooms and control panel are kept locked. The keys should be in a glass fronted box, adjacent to the compartment.
b) Check the $CO_2$/ halon room for signs of any leaks, damage or missing / damaged equipment.
c) The instructions for operating the installation should be displayed in the $CO_2$/ halon room and near all control stations. Such instructions must state that when remote controls are used, the $CO_2$/ halon room must be checked to ensure that the medium has been released.
d) When installation is used to protect a pump room or cargo tank, a notice should be displayed stating that $CO_2$/ halon cannot be used for inerting purpose as its injection may generate a static charge capable of igniting.
e) Ensure that fans and light in $CO_2$/ halon room can be operated from outside the room. The $CO_2$/ halon room vent should be clearly marked.
f) Temperature in $CO_2$/ halon room should never exceed 60° C.




Cylinders

a) Check all cylinders are firmly and correctly clamped.
b) Ensure stop valves are in closed position.
c) Ensure none of the cylinders have twisted out of alignment due to vibration etc.
d) Visually inspect all control valves, to ensure they are in proper position and readily accessible for immediate use.
e) Ensure all discharge piping and pneumatic tubing is intact and has not been damaged.


Additionally, on low pressure systems the inspections should verify that

a) the pressure gauge is reading in the normal range
b) the liquid level indicator is reading within the proper level
c) the manually operated storage tank main service valve is secured in the open position

d) the vapour supply line valve is secured in the open position

Alarms

a) Check that each alarm is numbered in a serial order.
b) Ensure warning is posted at each alarm $CO_2$/ halon Alarm. “Vacate this compartment immediately as $CO_2$/ halon is being released”.
c) Test each alarm from remote and local position. Ensure all personnel witness the test so that sound of alarm is easily recognized.
d) Where mechanical ventilation is shut down automatically, test to ensure that the ventilation is shutting down on activation.

$CO_2$/ halon line into engine room

a) Blow compressed air into the line to ensure that line is clear.
b) Check that air is coming out of every nozzle in E/R.
c) Ensure all pipe clamps are secured tightly.

$CO_2$ / halon line into hold or paint room etc.

a) Compressed air is usually connected to the $CO_2$ / halon line and three way valves of individual holds are operated in a sequence.
b) Each ejector in every hold is checked to ensure that air has a clear passage and there is no leak in the line.
c) If ejector is unapproachable, thin strips of polythene are tied at a pole’s end which is kept near the ejector to check emission of air from the ejector.
d) Ensure all pipe clamps are secured tightly.

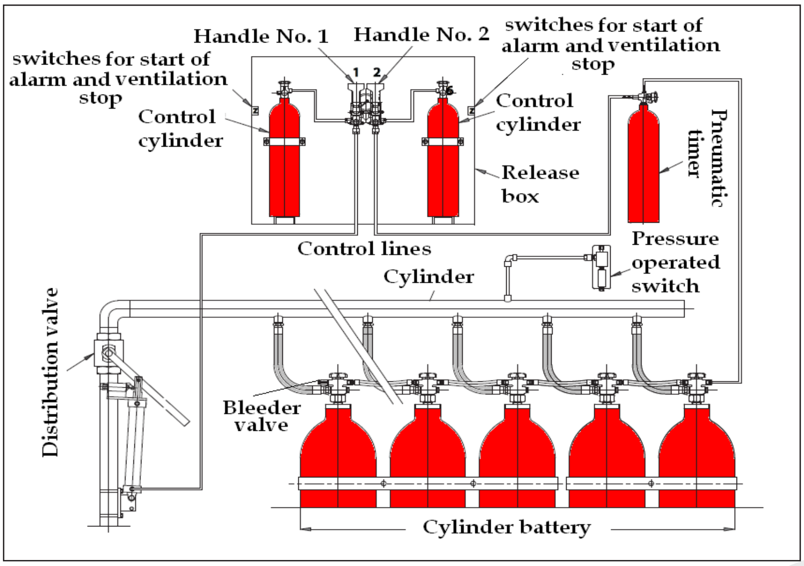
System check

a) The boundaries of the protected space should be visually inspected to confirm that no modifications have been made to the enclosures that have created un-closeable openings that would render the system ineffective.
b) All storage containers should be visually inspected for any signs of damage, rust or loose mounting hardware. Cylinders that are leaking, corroded, dented or bulging should be hydrostatically retested or replaced.
c) System piping should be visually inspected to check for damage, loose supports and corrosion. Nozzles should be inspected to ensure they have not been obstructed by the storage of spare parts or a new installation of structure or machinery.
d) The manifold should be inspected to verify that all flexible discharge hoses and fittings are properly tightened.
e) All entrance doors to the protected space should close properly and should have warning signs, which indicate that the space is protected by a fixed carbon dioxide system and that personnel should evacuate immediately if the alarms sound. All remote releasing controls should be checked for clear operating instructions and indication as to the space served.

$CO_2$ / halon bottles weighing / level checking

At each intermediate, periodical or renewal survey in cargo ships, the following maintenance should be carried out

a) All high pressure cylinders and pilot cylinders should be weighed or have their contents verified by other reliable means to confirm that the available charge in each is above 90% of the nominal charge. Cylinders containing less than 90% of the nominal charge should be refilled. The liquid level of low pressure storage tanks should be checked to verify that the required amount of carbon dioxide to protect the largest hazard is available.
b) The hydrostatic test date of all storage containers should be checked.
c) The discharge piping and nozzles should be tested to verify that they are not blocked. The test should be performed by isolating the discharge piping from the system and flowing dry air or nitrogen from test cylinders or suitable means through the piping.




System check and pressure test

At each renewal survey (usually every 5 years) in cargo ships, the following maintenance should be carried out by service technicians/specialists trained to standards accepted by the administration.

a) Where possible, all activating heads should be removed from the cylinder valves and tested for correct functioning by applying full working pressure through the pilot lines. In cases where this is not possible, pilot lines should be disconnected from the cylinder valves and blanked off or connected together and tested with full working pressure from the release station and checked for leakage. In both cases this should be carried out from one or more release stations when installed. If manual pull cables operate the remote release controls, they should be checked to verify the cables and corner pulleys are in good condition and freely move and do not require an excessive amount of travel to activate the system.
b) All cable components should be cleaned and adjusted as necessary, and the cable connectors should be properly tightened. If the remote release controls are operated by pneumatic pressure, the tubing should be checked for leakage, and the proper charge of the remote releasing station pilot gas cylinders should be verified. All controls and warning devices should function normally, and the time delay, if fitted should prevent the discharge of gas for the required time period.
c) After completion of the work, the system should be returned to service. All releasing controls should be verified in the proper position and connected to the correct control valves. All pressure switch interlocks should be reset and returned to service. All stop valves should be in the closed position.

$CO_2$ / halon bottles hydraulic pressure testing.

a) The hydrostatic test date of all storage containers should be checked. High pressure cylinders should be subjected to periodical tests at intervals not exceeding 10 years. At the 10-year inspection, at least 10% of the total number provided should be subjected to an internal inspection and hydrostatic test. If one or more cylinders fail, a total of 50% of the onboard cylinders should be tested. If further cylinders fail, all cylinders should be tested. Flexible hoses should be replaced at the intervals recommended by the manufacturer and not exceeding every 10 years.
b) If flag state requirements are more stringent, then they should be followed.

**5) Fixed dry powder system**

DCP monitors

a) Grease and oil the monitors. Swing through the limit of elevation and rotation.
b) Ensure that the monitor’s sea going securing arrangements are well greased and can be freed easily by hand.

c) Ensure that valve of monitor is in the open position.
d) Ensure that monitor nozzle is directed to the area to be protected.
e) Paint the monitor, if required.

Hand hoses stations

Hose must be stretched and condition of hose and nozzle checked.

Actuator box

a) Ensure that the actuator box is free from obstruction and in good condition and can be opened easily.
b) Ensure pilot bottle is properly secured.
c) Ensure pilot bottle safety clip is in position.

DCP unit

a) Ensure that the instructions for operating the monitor and hand held hoses are posted.
b) Check the unit for signs of leakage, missing or damaged equipment.
c) Ensure quantity of dry powder in container is sufficient.
d) Ensure propellant bottles are properly secured.
e) Inspect all control valves, relief valves and associated pipe work connected to the pilot cylinders.

Dry chemical powder

Rotate or blow nitrogen as applicable into the DCP container to loosen any caked powder.

System check

a) Propellants and pilot bottles to be checked to ensure that they are fully charged.
b) Flexible hoses are subjected to a pressure test at least equal to their working pressure.
c) All actuator, selector and other control valves to be tried out.
d) DCP container checked.

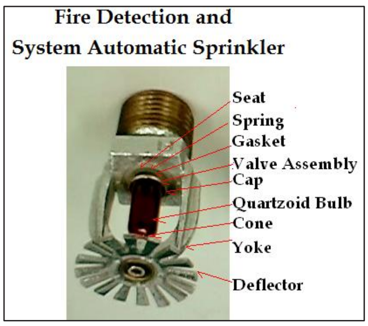
**6) Fixed steam smothering systems**

In general, the use of steam as a fire-extinguishing medium in fixed fire-extinguishing systems is not permitted. In exceptional cases, the use of steam may be permitted in restricted areas as an addition to the required fire-extinguishing medium providing that the boiler or boilers available for supplying steam have an evaporation of at least 1.0 kg (2.2 lb) of steam per hour for each 0.75 $m^3$ (27 $ft^3$) of the gross volume of the largest space so protected.

**7) Fixed water spray system/ automatic sprinklers/ paint room sprinklers**

Inspection of controls

a) Ensure that operating instructions and valves are clearly displayed.
b) For automatic sprinkler systems, ensure instructions for carrying out periodic tests is prominently displayed at the control station.
c) Automatic system must be in a state of readiness at all times. The pressure and water in the tank is maintained.
d) Check the valves of the control system for free operation. Grease them if required.
e) Operate the pump to check the discharge pressure.
f) Check electrical circuit and switching arrangement is operational.
g) It should be clearly mentioned which space is protected by the water spray system.




Inspection of sprinkler system

a) Check the pipelines for mechanical damage or corrosion.
b) Check the condition of all spray heads or sprinklers.
c) Damaged bulbs inside the sprinkler heads should be replaced immediately.
d) All automatic alarms for the sprinkler systems are tested using test valves for each section.
e) Perforated pipes in lieu of spray heads are not acceptable even for manual release sprinkler system.

Testing of the entire system
a) A sprinkler should be activated. In an automatic system, ensure that water level in the tank is brought up to original level automatically by the pump and all electrical controls are operational.
b) A manual control system should be testing by running water through the sprinklers. If water activation is to be avoided, blow through with compressed air to ensure that the pipelines are clear.

**8) Foam monitors and fixed foam installations**

Foam monitors

a) Ensure Instructions for use are posted at each control station.
b) Grease and oil the monitors. Swing through the limit of elevation and rotation.
c) Ensure that the monitor’s sea going securing arrangements are well greased and can be freed easily by hand.
d) Ensure all system stop valves are in proper open or closed position.
e) Paint the monitor, if required.
f) All the foam valves, including isolation valve from fire main should be painted yellow.

Foam tank
a) Check foam liquid in tank is up to the required level.
b) Inspect foam tank for signs of damage or corrosion.
c) Ensure all valve related to foam tank are painted yellow.
d) Check foam concentrate container to ensure marking includes
   i. name and address of manufacturer
   ii. product designation
   iii. type of foam (synthetic, protein-based, etc.)
   iv. intended use (regular or alcohol-resistant)
   v. batch number and reference to batch certificate
   vi. date of manufacture
   vii. expiry date
   viii. reference to test standard and approvals
   ix. recommended usage concentration
   x. indication if seawater compatible
   xi. maximum and minimum storage temperature
   xii. required onboard storage tank materials (steel, stainless steel, FRP, etc.)
   xiii. quantity of foam concentrate
   xiv. indication of film forming capability
   xv. safety, health and environmental information

Testing of foam monitors
a) Foam monitors should be tested under full pressure. Ensure the supply valve can be opened easily by hand.
b) Ensure the monitor can cover the required surface area.

Testing of eductor type foam installation
a) This installation should not be started with foam isolation valve open as the there is a possibility of water contamination into foam storage tank.

b) For testing, the foam isolation valve should be shut tightly, water inlet from fire main opened to the foam monitors and then foam valves opened.

Testing of foam pump

a) Operate the system using the independent foam pump, for duration of at least half minute.
b) Ensure adequate foam is produced at the foam monitor or applicator.
c) Flush the system on completion of test and top up the tank.

Testing of foam making liquid

a) Quality of foam held in the foam tanks should be tested by a laboratory acceptable to the administration after a period of three years and, after that, every year.
b) If foam proves to be below specification then the shipping company shall be informed immediately.

**9) Portable foam making equipment**

Inspection of portable foam applicator and hose


a) Foam applicator should be capable of being connected to the fire main, using a fire hose.
b) Check the moving parts of the foam applicator for ease of movement. Grease, if required.
c) Check the coupling of foam applicator is in good condition for connection. Grease the edges.
d) Check the eductor side of applicator is clear.
e) Check the applicator for corrosion or any other apparent damage
f) Range out the fire hose and check for any apparent damage.

Inspection of foam making liquid

a) Check that at least 20 litres and a spare tank of foam making liquid is kept with the applicator.
b) Check foam concentrate container to ensure marking includes
   i. name and address of manufacturer
   ii. product designation
   iii. type of foam (synthetic, protein-based, etc.)
   iv. intended use (regular or alcohol-resistant)
   v. batch number and reference to batch certificate
   vi. date of manufacture
   vii. expiry date
   viii. reference to test standard and approvals
   ix. recommended usage concentration
   x. indication if seawater compatible
   xi. maximum and minimum storage temperature
   xii. required onboard storage tank materials (steel, stainless steel, FRP, etc.)
   xiii. quantity of foam concentrate
   xiv. indication of film forming capability
   xv. safety, health and environmental information

Testing of foam concentrate

a) Quality of foam held in the foam tanks should be tested by a laboratory acceptable to the administration not more than 3 years after being supplied to the ship, and after that, every 1 year.
b) If foam proves to be below specification then company should be informed immediately.

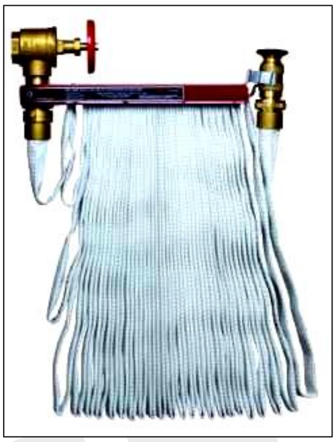
**10) Testing of foam applicator**

Important to note:

a) Rig the foam applicator and test the same with foam making liquid.

b) Fire hoses must be pressure tested for any leaks. Hoses are pressurized to full pressure of the fire line by opening the hydrant and shutting of the nozzle slowly. Hoses must be dry and coiled before they are placed back in their respective boxes. A condemned hose should be destroyed and disposed of ashore.

**11) Fire hydrants, fire hoses & hose boxes**



Inspection of fire hose boxes:

a) Each hose box must be clearly marked 'Fire Hose' or the appropriate IMO symbol.
b) Each hose box must be marked with stowage number. The numbering must be common for all deck and engine room hoses.
c) Check that hose box is firmly secured and is not damaged.
d) Check if hinges and fastenings are in good condition. No rope etc. must be used to fasten the hose box.
e) Check the contents of the hose box are in good order. Each hose box must contain hose, nozzle (and coupling spanner if applicable).
f) Paint the hose box 'red', if required.

Inspection of fire hydrants

a) Test all fire hydrants valves for ease of operations, if required grease/oil lightly.
b) Ensure hydrant is not leaking. Lapping of the surface of the valve seat should be carried out to stop leaks from the hydrant.
c) Check that hydrant washer is placed correctly. Replace the worn out / hardened or missing washer.
d) Check that hydrant cap is in place and the drain hole of the cap is clear. Hydrant cap should be secured to the hydrant preferably with a light chain.
e) The fire hydrants should be painted 'red'. Repaint it whenever necessary.

Inspection of fire hose


a) Range out the fire hoses and check for any apparent damage.
b) Check the couplings are attached firmly to the fire hoses by copper seizing wire. Jubilee clips should not be used to fasten the coupling. Fastening should be renewed if same is damaged or corroded.
c) Check and grease edges and moving parts of the coupling.
d) Ensure washers are fitted correctly inside the couplings. Replace the worn out / hardened or missing washer.
e) Ensure that fire hoses are not dragged, have kinks, passed over sharp edges or kept on hot surface.
f) If hoses are dirty, wash them with soap and fresh water.
g) Hoses must be dry and coiled before they are placed back in their respective boxes.
h) Hoses in machinery places should preferably be left connected to the hydrant.
i) Ensure that fire hose are not used for deck or engine room bilges washing. Old hoses must be kept for this purpose.

Inspection of fire nozzles

a) For ship's whose keel were laid after 01 Jul 1986, all nozzles should be dual purpose shut off type.
b) Diameter of nozzles used in accommodation spaces should not exceed 12 mm
c) Check the nozzles carefully for any damage.
d) Test the nozzle for free movement. Lightly grease the moving parts.
e) Test the nozzle under operating condition.

Testing of fire hydrants

a) Water must be run through each hydrant to ensure that the fire line leading up to the hydrant is clear.
b) Running of water is very important in case of dormant hydrants e.g. inside the accommodation and engine room

Testing of fire hose

a) Fire hoses must be pressure tested for any leaks.
b) Hoses can be attached to each other and laid straight on deck. One end is sealed using a attaching a shut off type nozzle and other is attached to the hydrant.
c) Hoses are pressurized to full pressure of the fire line by opening the hydrant and shutting of the nozzle slowly. If hydrant is opened suddenly, when nozzle is shut it will cause hammering damage to the hose.
d) Any leaks near the couplings should be rectified or hose should be renewed.
e) Hoses must be dry and coiled before they are placed back in their respective boxes
f) A condemned hose should be destroyed and disposed of ashore.

NOTE:

a) The fresh water hose and deck washing hose with nozzle should be separate from the fire hoses & nozzles.
b) Under no circumstances, an operational fire hose should be used for any other purpose. Crew must be instructed accordingly.



**12) International shore connection**

Location

Sight that international shore connection is kept in its designated location with required 4 bolts, washers and gasket.

Marking

Ensure that the location of the ISC is clearly marked.

Condition

a) Check that the securing nuts and bolts are free and the threads are lightly greased.
b) Check that the gasket is in good condition.

**13) Fire dampers, flaps and ventilators**

Operation test

E/R blower flaps, funnel flaps and skylights to be operated.

Markings

a) Check the following markings near the closing appliance / operating lever:
    - ❖ Serial number
    - ❖ Compartment served
    - ❖ ‘Open’ and ‘Close’ position along with direction of rotation.
    - ❖ If a fire damper is behind a ceiling or panel it should be clearly marked in red ‘FIRE DAMPER No. …’ .
b) Check operation handles are painted RED.
c) Check the inner surface of hinged flaps is painted RED.

Operation test and inspection

a) Ensure that all fire dampers, flaps & ventilators except tank ventilators, have a positive means of closing. It should be possible to close / isolate any compartment on board, in case of fire.
b) Operate every month, all fire dampers, flaps & ventilators throughout the ship. Ensure that they shut correctly and completely. When remote means are used to close the appliance, it must be physically checked that the fire dampers are closing properly and fully, e.g. funnel flaps.
c) Check that locking pins are in position.
d) Check for any apparent damage to the damper or its closing mechanism. Check flame gauge and filters of vents / flaps. The damage flame gauges should be replaced.
e) Inspect seals / packing material of flaps & ventilators. Seals should not be painted over, brittle or missing. All faults must be rectified immediately.
f) Grease or Oil the operating mechanism. It must be well lubricated and operate easily without use of any tools, at all times.

Inspection and thorough examination of fire dampers

a) Check the condition of remote operating wires for corrosion, damage, especially at the bends. The operating wires should not have a fibre core, as same may get damaged during fire. Apply grease on the wires, sheaves etc., as required.
b) Check condition of spindles and connecting sockets of a remote damper such as funnel flaps. Grease, as required.
c) Check condition of connections, springs and fusible links of automatic fire dampers.
d) Check condition of pneumatic closing system, as per manufacturer's instructions.

Inspection and thorough examination of flaps & ventilators

a) Check the fire flaps / ventilators for corrosion or other damages. De-scale the flaps as required. A holed or thinned down flap should be repaired immediately. No temporary repairs are permitted.
b) Chalk test or hose test will be required for the flap type vents. The procedure for carrying out chalk test is, as follows:
   - ❖ Chalk should be applied on the compression bar of the vent
   - ❖ Close the vent fully with its closing means.
   - ❖ Open the vent and check if the impression of chalk is firm and continuous on the rubber packing.
c) All faults must be rectified immediately.

Inspection and thorough examination of fire dampers

Check the flaps or dampers fitted inside a ventilator trunking physically, to ensure that they are not missing or holed.

- ❖ From the inspection cover where provided – yearly
- ❖ Where no inspection cover is provided, by opening the trunking – when suspected or every 2 ½ years


**14) Fire doors**

Marking for fire doors

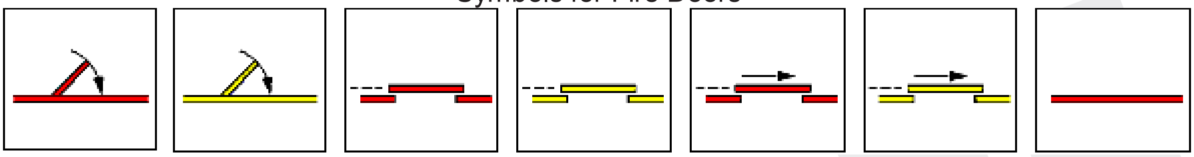
Check the following markings on each fire door:

a) ID number

b) Compartment served
c) Fire doors are clearly marked 'Fire Door'

Inspection of fire doors
a) Check condition of door for corrosion, buckling or any other damage.
b) Check hinges of the doors to ensure same are not damaged or bent.
c) Ensure doors are not blocked.
d) Ensure that fire doors (except self-closing doors) are never kept permanently open and there is no permanent arrangement to keep the door permanently open. All holdbacks must be removed.
e) Check operation of the self-closing device.
f) Ensure that all doors can be closed efficiently and correctly.
g) Grease all closing mechanism and hinges of the doors if required
h) Rectify all defects immediately.

Symbols for Fire Doors



| | | | | | | |
|---|---|---|---|---|---|---|
| A Class Fire Door Self Closing | B Class Fire Door Self Closing | A Class Fire Door | B Class Fire Door | A Class Fire Door Self Closing | B Class Fire Door Self Closing | A Class Division |

**15) All emergency trip switches**

Markings and instructions
a) Following should be marked clearly near the trip switch :
❖ The serial number
❖ Function of the emergency trip
b) All officers and petty officers on board should be familiar with use and procedure to use the relevant Emergency trips and stops.
c) The location of trips for pumps having discharges above light water line and under boat embarkation position should be known to all deck officers also.
d) The fuel trips must be tested only in port, unless in an emergency.
e) All trip switches must be operated within a period of three months.
f) Ensure that all valves and associated equipment have been reset after completion of test.

Testing of wire type trips
a) Check the condition of wire and the associated sheaves. Apply grease on wire and sheaves as required.
b) Wire must be renewed if found damaged or corroded. The wire used for engine room trips should be made of steel without the fibre core. Wire may stretch unduly in a fire.
c) Activate the wire pulls and check that all valves have closed.
d) Reset the valves.

Testing of air trips
a) Check that emergency air control bottle is fully pressurized.
b) Open air to quick closing valves.
c) Check that valves have closed.
d) Reset the valves.

Testing of electrical trips
a) Operate the trip.
b) Check that relevant valves / fans / pumps have stopped.

c) Reset the switch.

**16) Fire wallets and fire plan holders**

Location

a) Fire control plans should be prominently displayed with in the accommodation area.
b) A duplicate set of fire control plan should be kept outside the accommodation in water tight container.
c) Fire plan holders should be preferably located on both sides, near the entrance to accommodation on main deck.

Container & markings

a) Ensure that containers located on external deck are water tight & well secured.
b) Check the container for any damage, corrosion or wear & tear.
c) Grease the hinges / threads of the cap etc.
d) Fire wallet / fire plan holder should be painted RED and marked clearly ‘FIRE WALLET’ or ‘FIRE PLAN’, as applicable.
e) If Fire Wallet is not kept adjacent to entrance to accommodation / near the gangway, then its location should be clearly marked at these positions on both sides of the vessel.

Contents of fire wallet

a) Check that all contents of fire wallet are kept updated at all times, especially the cargo plans, IMDG plans & manifest, crew list etc.
b) Check that all contents are dry, in good condition and legible.

**17) Fire blankets**


Container for fire blankets

a) Ensure that blanket is kept in the container.
b) Check that the container is clearly marked ‘FIRE BLANKET’.
c) Instructions to use the blanket must be posted on the container.
d) The container should be firmly secured.

Condition of fire blankets

a) Ensure the fire blankets are in clean and good condition.
b) The blankets should be free of any oil or paint.
c) Blankets should be stowed correctly and ready for immediate use.

**18) Fire bucket/ sand boxes**

Sand

a) Check that level of sand inside the box has not reduced. Replenish the sand, if required.
b) Ensure that sand is dry inside the box and is ready for use.
c) Remove any foreign material from the sand.

Sand box

a) Ensure that the box is not blocked or covered with other equipment.
b) Check sand box for signs of corrosion or damage.
c) Ensure that sand box is painted RED and ‘FIRE’ and ‘SAND’ are marked clearly on the box.

Fire buckets, scoops

a) Check that scoop and fire bucket are kept in vicinity of the sand box.
b) Ensure that fire bucket is painted RED and ‘FIRE’ is clearly marked on the bucket.
c) Ensure that at least one scoop is kept inside the box.
d) Check condition of scoop and bucket for corrosion or damage.

**Apply Your Knowledge**

1. Check the vessel’s firefighting equipment maintenance manual and assist in inspections and tests of various FFA.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Prevent, control and fight fires on board

**Task number:** C 3.1

**Sub-task Reference number:** C3.1.19

**Topic:** Operation and maintenance of fire-fighting appliances (FFA)

**Task Heading**

- Under supervision, operate the breathing apparatus (BA) air compressor and assist with charging of BA air bottles.

**Objectives**

- Learn the use of breathing apparatus air bottle compressor

**Index**

1) Self-contained breathing apparatus air cylinders and compressor

**Description**

**1) Self-contained breathing apparatus air cylinders and compressor**

- SOLAS requires that two spare charges shall be provided for each breathing apparatus. Passenger ships carrying more than 36 passengers constructed on or after 1 July 2010 shall be fitted with a suitably located means for fully recharging breathing air cylinders, free from contamination. The means for recharging can be either:
  - breathing air compressors supplied from the main and emergency switchboard, or independently driven, with a minimum capacity of 60 litres/min per required breathing apparatus, not to exceed 420 litres/min; or
  - self-contained high-pressure storage systems of suitable pressure to recharge the breathing apparatus used on board, with a capacity of at least 1,200 litres per required breathing apparatus, not to exceed 50,000 litres of free air.
- A breathing air compressor should be installed in an enclosed compartment which in any case should have little or no fire risk, with sufficient space on all sides to ensure good ventilation. The area should be as cool as possible but places where freezing is possible should be avoided and the air intake should be located in open air and away from potential contaminant release points.
- The refilling of cylinders shall be carried out by the responsible person who is competent and trained for it.
- The label on the cylinder shall display vital safety information and should be clearly legible. The working pressure shall be clearly marked on the cylinder.
- The quality of the air produced by any high-pressure storage system or breathing air compressor should be tested annually by a national accredited laboratory, in accordance with national standards.
- Breathing air compressors are used to recharge the air cylinders used with SCBA sets. These have air delivery rates of around 100 litres/ minute and operate on ship's power supply. The air bottles are charged to a pressure of around 200 bars.
- Common checks prior recharging air bottles
  - The compressor shall be placed in open, well ventilated, cool space away from air areas of exhausts, smoke, rain, icing etc.
  - The condition of the air filter shall be checked clean and drained.
  - The pressure gauze shall be checked for functioning.

- ❖ All sealing gaskets shall be checked to ensure air-tightness while the bottles are being charged.
- ❖ The air bottles generally heat up during charging and hence these shall be kept in cool surroundings or in a tub of cold water.
- ❖ The pressure shall be continuously monitored while charging the bottle. Bottles are usually charged to a pressure of around 200 Bar.
- ❖ Manufacturer's instructions shall be followed for the system check.

**Apply Your Knowledge**

1. Do you have a BA charging compressor on board? Assist the safety officer in charging an SCBA air cylinder and describe in detail what precautions you will take during the charging process.
2. Discuss the reason of air bottles getting heated up while recharging.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Prevent, control and fight fires on board

**Task number:** C 3.2

**Sub-task Reference number:** C3.2.4

**Topic:** Fire fighting

**Task Heading**

- ➢ Lead a fire party during a drill.

**Objectives**

- ➢ Understand the role of the team leader in case of emergencies.

**Index**

1) Leadership

**Description**

**1) Leadership**

- ➢ For the team to perform effectively, each team is assigned a leader. A competent officer is designated as the leader of each team. Leaders are nominated on the basis of their knowledge, experience and work field on board; for example, the chief officer will be assigned to lead a team assigned to deal with an emergency of cargo hold fire.

The roles of the team leader in an emergency situation can be written as follows:

- ❖ Act as the communication channel between the central command and the team
- ❖ Being on scene, he shall be able to assess the situation of emergency and report the same
- ❖ Shall be able to evaluate the hazards and required measures to control the same; and foresee the conditions likely to develop in due course; further, being able to evaluate when the situation becomes incurable
- ❖ Shall be able to assign duties to various team mates, considering their abilities and limitations
- ❖ Shall be able to keep a check on the condition and morale of the team mates
- ❖ Shall be able to advise on the necessary support and/ or equipment as required or as need to be replenished in due time
- ❖ Time being most vital, shall be able to manage tasks without undue delay and without compromising on any safety parameter

- ➢ Duties while leading an emergency team during fire emergency
- ❖ Be present on the muster station at the earliest without delay
- ❖ Take headcount and report; also report if some team member is found missing
- ❖ Check if the team is suitably dressed and equipped with all necessary gear such as walkie talkies, SCBA, fireman's outfit etc.
- ❖ Communicate clearly with the command
- ❖ Reach the site of fire emergency as directed by the command
- ❖ Assess the fire situation and report
- ❖ Assess if any additional gear/ manpower is required
- ❖ Assign duties to team members considering their abilities and limitations
- ❖ Keep a check on the condition of team members, attend if someone requires medical aid
- ❖ Brief the fire fighters prior they enter a fire compartment
- ❖ Keep a check on the activities and personnel entering the fire compartment for fire fighting or rescue
- ❖ Ensure all duties are effectively carried out as required by command
- ❖ Monitor the site and situation and keep the command appraised on latest developments

**Apply Your Knowledge**

1. Observe the team leader during a fire drill. Discuss the issues that need to be dealt with when leading a team of multilingual crew.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Prevent, control and fight fires on board

**Task number:** C 3.2

**Sub-task Reference number:** C3.2.5

**Topic:** Fire fighting

**Task Heading**

- Perform fire rounds.

**Objectives**

- Understanding the importance of fire patrol rounds and the likely sources of ignition.

**Index**

1) Fire patrol rounds

**Description**

**1) Fire patrol rounds**

- Precaution is better than cure. The aim of fire patrol rounds is to check that necessary precautions for fire prevention are being observed; and to detect any signs of fire in early stages so that it can be controlled well in time before it becomes incurable.
- Fire patrolling rounds are taken by designated officers or crew member at regular intervals, while the ship is navigating, while at anchorages and while the ship is at berth. The frequency of rounds is increased depending on the likelihood of fire. The sites more prone to fire are suitably equipped, monitored and manned if required.
- The fire patrol rounds shall be carried out across all decks looking for sources of ignition and potential fire hazards all around. The likely sources of ignition are
  - Smoking
  - Hot work
  - Spontaneous combustion
  - Overheated/ faulty/ unauthorized electrical appliances
  - Overloaded electrical circuits, improper wiring, damaged cargo clusters and lose electrical connections
  - Inappropriate storage/ use of oxygen and acetylene bottles
  - Sparks coming out from funnel including sparks coming out from funnels of nearby ships
  - Improper housekeeping and inappropriate waste disposal
  - Ship's antennae such as RADAR or telex antennae transmitting at high voltages
  - Static electricity and sparks
- Locations on board prone to fire hazard
  - Paint Stores
  - Engine room spaces
  - Compartments/ holds carrying flammable goods and cargo, spontaneously combustible goods
  - Deck areas where any repair works are in progress
  - Deck and engine room workshops
  - Cargo pump room, cargo manifolds and main deck on tankers
  - Accommodation spaces and unauthorized smoke rooms
  - Galley
- While carrying out fire patrolling, above mentioned sources of ignition shall be taken into consideration. Necessary precautions shall be taken as required.

- Additional precautions as required on tankers, gas carriers, ships loading/ discharging dangerous/flammable cargoes, or for specific operations such as gas freeing shall be taken as applicable.
- Locations where any hot work is being carried out, the situation assessment shall be repeated at regular intervals as mentioned in the hot work permit. The repair team shall be briefed on the procedures to follow. Further they shall be advised regarding the ship's contact point in case of emergency.
- Smoking rules shall be strictly observed and 'No Smoking' board and signs shall be prominently displayed wherever required.
- Company specific SMS procedures shall be followed for fire rounds and precautions.
- Suitable entries shall be made in the logs as and when fire rounds are taken and about any specific observations if relevant along with the necessary follow up.
- Vessels have systems set up to ensure that the person taking the fire round visits all the spaces identified for inspection. The system could be in form of alarms which sound if it is not reset within specified period, or a simple arrangement of signing with time, a paper or register kept at the place. Some vessels have a swipe system which has print out options with time and location thus giving a positive confirmation of rounds been taken.

**Apply Your Knowledge**

1. Locate the designated smoke rooms on board your vessel. Discuss the SMS procedures for controlling fire risk from smoking.
2. With regards to the safety and fire protection, discuss the safe work procedures for renewing a damaged hydraulic line for gangway motor while the ship is at berth working cargo.

**Competence:** Prevent, control and fight fires on board

**Task number:** C 3.2

**Sub-task Reference number:** C3.2.6

**Topic:** Fire fighting

**Task Heading**

- Participate and understudy the team leaders in a search and rescue drill for an enclosed space.

**Objectives**

- To understand the search and rescue procedure for evacuating a casualty from an enclosed space.

Please read this task in conjunction with task C7.1.2.1

**Index**

1) Rescue from an enclosed space
2) Rescue procedure

**Description**

**1) Rescue from an enclosed space**

- In case a person within an enclosed compartment is observed not responding to the attendant at the entrance, for scheduled call he might be in need of immediate evacuation.
- Prior entering the space rescuers should first ensure that they themselves are not put to risk.
- Time is vital. Hence all evacuation gear shall be ready near the enclosed space entrance prior entering such space.
- In addition to suitable working gear including personal protective aids, additional instruments required for rescue are
  - SCBA sets
  - Stretcher
  - Hand held torches
  - ELSA kit/ EEBD/ oxygen resuscitator kit
  - Ropes, tackles, harness etc.
  - Warm clothing if necessary

> Anybody entering the compartment for rescue shall remember that the person inside has fallen unconscious only because there is something wrong in his vicinity within the space. The hazards remain the same for the rescuer

> Whenever a person has collapsed or fallen unconscious in an enclosed space, the person stationed at the entrance shall NOT proceed to rescue the injured. Rather, he should immediately raise alarm and inform Bridge, giving his name and location of incident to the Duty Officer.

**2) Rescue procedure**

- Duty officer having received the information shall inform master, raise the emergency alarm (internal & external) and announce on public address system (nature & location of emergency).
- The teams shall proceed for their duties as specified in the emergency procedures. The duties in general will be as follows:
- **Command team/ bridge team**
  - Take charge of bridge and navigation.
  - Coordinate the rescue process.

- Prepare for radio medical advice.
- Keep a record of all the activities.

- **Emergency team**
- At least 3 persons working as a team will be required to rescue the victim.
- Chief officer/ 2nd engineer, bosun/ fitter and oiler/ ab don self-contained breathing apparatus(SCBA) (Note down pressure and carry out other safety checks)
- Rescue team suitably dressed with PPE enters the space with harness, safety line, SCBA / ELSA / oxygen resuscitator for the victim and hand held torches.
- Air or oxygen shall be administered to the victim as soon as possible.
- The victim, if mobile, shall be guided to the escape route. Else he shall be evacuated using a stretcher. Within the space he shall be moved depending upon the availability of working space. Care shall be taken not to cause further injuries such as by dragging.

- **Medical team**
- Shall arrange the stretcher, first aid kit, ELSA/ EEBD, oxygen resuscitator kit and warm clothing to the location of emergency
- Help emergency team to remove victim to a safe place.
- Prepare to provide first aid to the victim as soon as he is out into open space.

- **Support team**
- Bring rescue rig equipment consisting of ropes, tackles, harness etc. to entrance of the compartment.
- Make arrangement for additional ventilation to the affected area.
- Prepare for evacuation by helicopter, if applicable

- **Engine team**
- To take charge of ECR and assist as required.
- Arrange for providing additional ventilation, lighting etc. in the rescue area.

- Having evacuated the casualty, depending on his medical condition, following shall be considered as applicable:
- Monitor casualty's condition continuously.
- If casualty has been exposed to a hazardous chemical, he should be given rest and observed for at least 24 hrs.
- In accordance with radio medical advice and medical condition of the casualty, consider
    - ✓ deviating to nearest port of refuge
    - ✓ seeking helicopter assistance to land casualty ashore
    - ✓ If at anchorage or in port call an ambulance

**Apply Your Knowledge**

1. One of the AB seamen slipped on the rungs of a vertical ladder and fell down in an empty cargo hold. List the action required in rescuing him from the hold.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Operate lifesaving appliances

**Task number:** C 4.1

**Sub-task Reference number:** C4.1.14, C4.1.16, C4.1.17

**Topic:** Lifesaving appliances (LSA)

**Task Heading**

- Assist crew in preparing and lowering of lifeboats.
- Participate in routine lowering and maneuvering of a lifeboat, clear the ship and cox the boat away from the ship under supervision.
- Demonstrate understanding of the procedure for recovering a rescue boat in rough weather.

**Objectives**

- Understand the procedures and safety precautions related to recovery of lifeboats and rescue boats. Also understand the additional procedures for lowering the lifeboat in heavy weather.

Please read this task in conjunction with task C4.1.6

**Index**

1. Preparing and lowering lifeboats
2. Additional precautions during abandon ship drills
3. Clearing off from the ship after launching
4. Boat rowing
5. Recovering of the rescue boat and life boat
6. Recovering lifeboats are fitted with recovery arrangements
7. Recovery of a free-fall lifeboat by hydraulic winches
8. Launching/ recovering the lifeboat/ rescue boat in an emergency in heavy weather

**Description**

**1. Preparing and lowering lifeboats**

Preparing and lowering of lifeboats open, enclosed and free-fall has been covered in task C4.1.6. This task shall be read in continuation to task C4.1.6.

**2. Additional precautions during abandon ship drills**

- Drills shall, as far as practicable, be conducted as if there were an actual emergency. Elements of the drill that may involve unnecessary risks shall be given special attention or may be excluded from the drill. The lowering of a boat with its full complement of persons is an example of an element of a drill that may, depending on the circumstances, involve unnecessary risk. Such drills should only be carried out only when special precautions are observed.
- Procedures for holding safe drills are provided in the Safety Management System (SMS) of shipping companies.

Before placing persons onboard a lifeboat during drill, it is recommended that the boat first be lowered and recovered without persons on board to ascertain that the arrangement functions correctly. The boat should then be lowered into the water with only the number of persons on board necessary to operate the boat. The correct operation of ‘limit switch’ shall be checked and verified while hoisting the empty boat.

- During drills, those responsible should be alert for potentially dangerous conditions and situations and should bring them to the attention of the responsible person for appropriate action.

- The monthly drills with free-fall lifeboats should be carried out according to the manufacturer's instructions, so that the persons who are to enter the boat in an emergency are trained to embark the boat, to take their seats in a correct way and to use the safety belts and also are instructed on how to act during launching into the sea.

- When the lifeboat is free-fall launched as part of a drill, this should be carried out with the minimum personnel required to maneuver the boat in the water and to recover it. The recovery operation should be carried out with special attention, bearing in mind the high risk level of this operation.

**3. Clearing off from the ship after launching**

- The free-fall boats are positioned at the stern of the vessel and when launched these are already clear off the vessel in the astern direction.

- Clearing off the lifeboats lowered alongside the vessel
  - The coxswain should ship the tiller and put the helm towards the ship's side whilst the bowman bears off forward with a boat hook.
  - The engine should then be put ahead and then painter let go to clear the boat from the ship's side. The intention is to keep boat propeller and rudder away from the so as not to bang the shipside avoiding damage.
  - A lowered boat on a stopped vessel may be cleared by bearing off and hauling aft on the painter before rowing clear. Care shall be taken not to run the boat into the stern under the transom.
  - When a vessel has headway on, boats could be cleared one at a time starting from aft.
  - Get well clear of the sinking vessel and wreckage. Sea anchor shall be used to heave to the wind in order to head into the sea waves avoiding dangerous rolls.
  - All survival crafts shall be assembled close to each other to facilitate detection.

> The most common reasons for accident involving lifeboats are
> - failure of on-load release mechanism
> - inadvertent operation of on-load release mechanism
> - inadequate maintenance of lifeboats, davits and launching equipment
> - communication failures
> - lack of familiarity with lifeboats, davits, equipment and associated controls
> - unsafe practices during lifeboat drills and inspections
> - design faults other than on-load release mechanisms

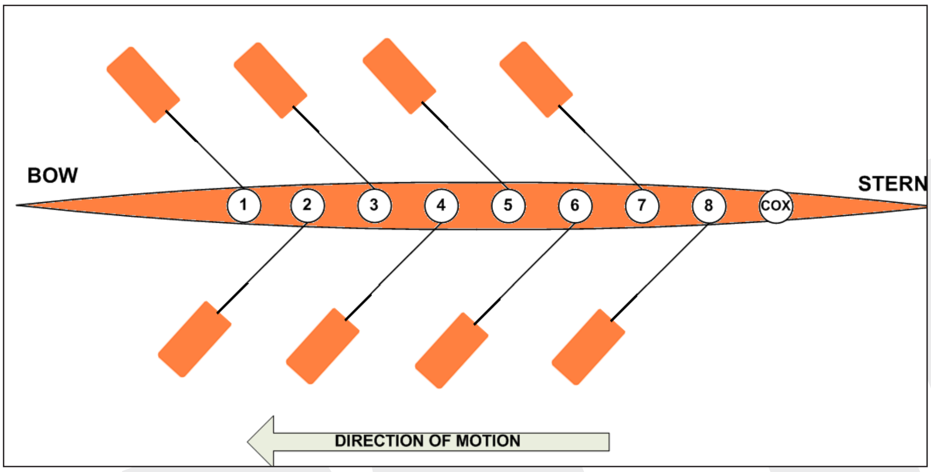
**4. Boat rowing**

- In boat rowing, each rower is numbered by boat position in ascending order from the bow to the stern. The person who is seated on the first seat is always the 'bowman'; the closest to the stern is commonly referred to as the 'stroke'.

- Coxswain (cox)
  The role of a coxswain is to
  - Steer the boat
  - Provide motivation and encouragement to the crew
  - Inform the crew of where they are in relation to other crews and the finish line
  - Make any necessary race tactic calls

- The "stroke" is the rower closest to the stern of the boat. Everyone else follows the stroke's timing - placing their blades in and out of the water at the same time as stroke. The stroke-man can communicate with the coxswain to give feedback on how the boat feels. It is the stroke's responsibility to establish the crew's rate (number of strokes per minute) and rhythm. The rower in the stroke seat will usually be one of the most technically sound members of the boat.

- The rowers in the middle of the boat do not have to be as technically sound or reactive to the movements of the boat, and can focus more on pulling as hard as they can. It is common practice among crews to put the most technically proficient rowers at the bow and stern and the physically strongest and heaviest rowers in the centre.
- The bowman is responsible for giving calls to the crew. The bow pair of bow and "two", who are the two rowers closest to the boat's bow, are more responsible for the stability and the direction of the boat than any other pair of rowers, and are often very technical rowers.
- The steersman is chosen according to experience and the nature of the course on which the boat is rowing.




## 5. Recovering of the rescue boat and life boat

- The boat is manoeuvred under the hooks/blocks. Two men must be ready to catch the hooks and prevent anybody from being hurt by the blocks.
- The boat is connected to the falls, fore and aft, simultaneously.
- Hoisting of the boat is started immediately after the boat has been connected.
- The engine is stopped.
- Once partial weight of the boat is taken by the floating blocks, hoisting is stopped. The swivels are turned to remove any twists in the falls.
- Once the crew is properly seated in the boat holding on to the lifeline, hoisting is resumed.
- The boat is hoisted to the yard arm of the davits and the tricing pendants are fastened.
- The boat is lowered until it levels with and is pulled tight to the boat deck.
- The crew and possible passengers leave the boat.
- The boat is hoisted into its stowed position and secured. The boat must rest on the chocks and the weight to be taken up by the hooks on the davit head.
- The drain plugs are removed and the equipment is cleared up and properly stowed.
- It may not be possible to hoist a fully laden life boat other than a rescue boat as the hoisting winch may not be designed for this purpose.

(Normally the life boat recovery appliance winch motor is designed to raise the boat from the water with its complement. For the rescue boat this is the weight of boat + weight of 6 persons but for a Life boat this is the weight of boat + weight of 2 persons. Refer to davit manufacturer's manual for exact details on winch motor)

## 6. Recovering lifeboats are fitted with recovery arrangements

- On return of the boat to the falls the boat is positioned beneath the falls.
- A seaman should be detailed to connect to recovery pennants at each end of the boat. This operation is carried out by grasping the bight on either side and placing it in the hook.
- In the case of releasing types of hook, these must be thoroughly checked prior to this operation to ensure that they are correctly set in readiness for taking weight. Persons making this check must be fully conversant with the settings of the releasing gear.

- When the boat has been connected preparations are made for hoisting.
- When the coxswain is assured that both ends of the boat are satisfactorily connected the signal should be passed to the responsible person on deck to commence hoisting. During the hoisting operation, all occupants should be seated in the boat and, where provided, seat belts should be fastened.
- Boats which are fitted with on-load release gear will suspend the hoisting operation as soon as the boat comes clear of the water. A thorough check of all hooks and associated gear will be conducted to ensure the boat is properly connected. Once verified the hoisting can continue.

- It may not be possible to hoist a fully laden life boat other than a rescue boat, as the hoisting winch may not be designed for this purpose.
  (Normally the life boat recovery appliance winch motor is designed to raise the boat from the water with its complement. For the rescue boat this is the weight of boat + weight of 6 persons but for a Life boat this is the weight of boat + weight of 2 persons. Refer to davit manufacturer's manual for exact details on winch motor).

- Once the falls are hoisted “two blocks” to the davits the effect on continued hoisting will be to luff the davits inboard. This swings the boat alongside the deck where occupants can be disembarked.

- **Re-stowing procedure**

- Hanging-off
  - ✓ After disembarking all occupants the boat is ready for hanging off.
  - ✓ The boat is lowered back to a position where the hanging-off wires can be attached. The wires, having been released from their stowage, are connected to the hanging-off lugs at each end of the boat. The weight of the boat is then transferred from the falls to the wires.

- Re-stowing
  - ✓ The nylon recovery pennants are taken off the lifting hooks. The falls are lowered back and the chains connected. Care must be taken when lowering or overhauling falls without load to avoid riding turns on the stowage drum. When taking up on the wires care must be taken to ensure they are correctly aligned on the drum for even positioning between forward and after falls. This operation is best done by manual winding.
  - ✓ After re-connecting and transferring the weight of the boat back to the falls, the hanging-off wires should be disconnected from the boat and re-secured in their stowage positions.
  - ✓ The boat is re-stowed in the davits and the gripes applied and tightened. Care should be taken to ensure that the boat is correctly stowed against any chocks designed to prevent movement in a seaway and that the hull of the boat is not likely to sustain damage from incorrect alignment of gripes.

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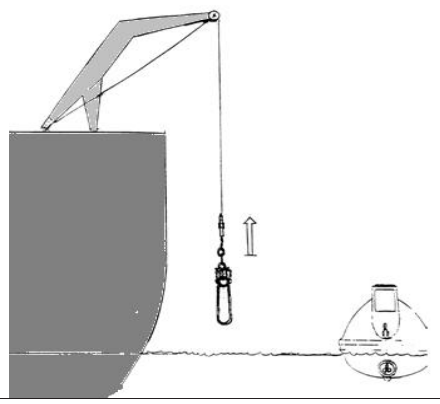
|---|---|
|  | Boat released<br>Falls heaved up to place recovery pennants in position for boat’s return. |

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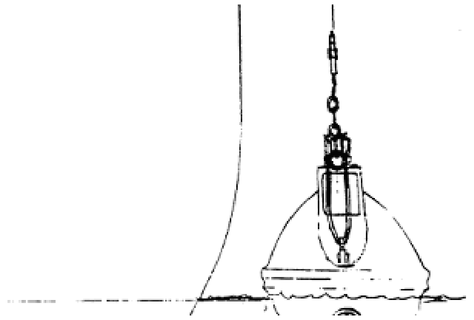
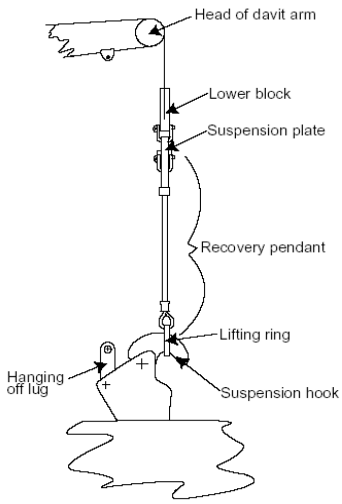
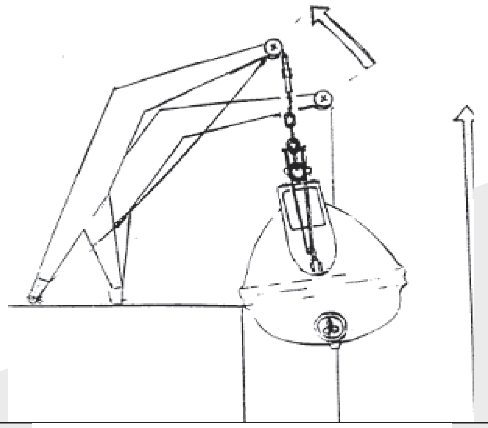
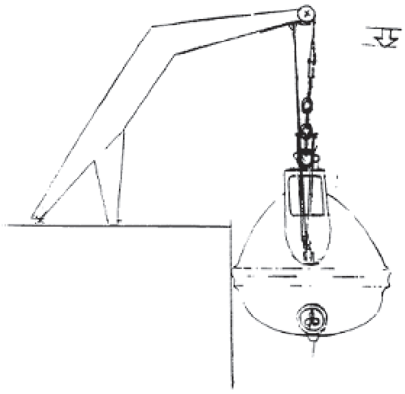
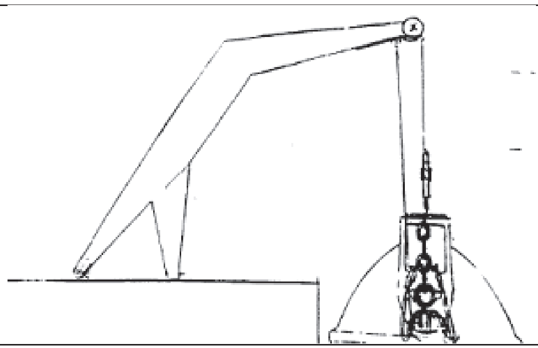
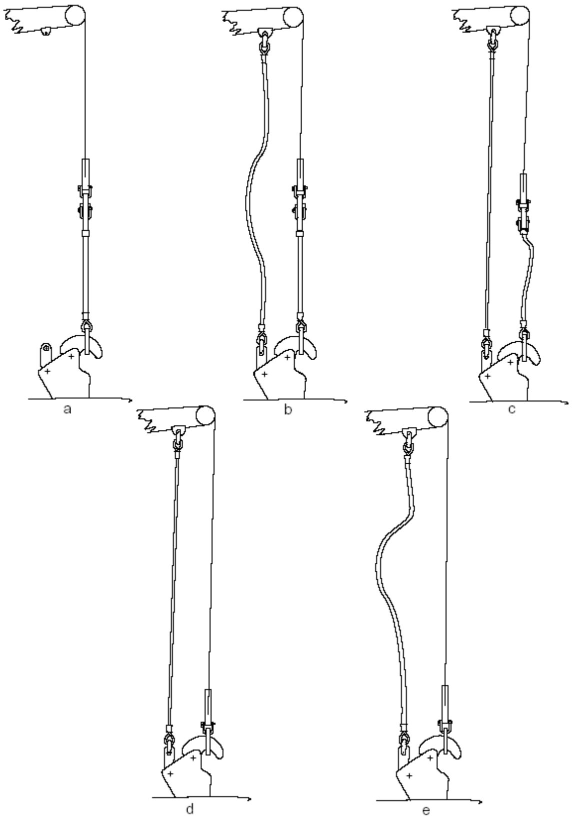
|  Boat returns. Connects to recovery pennants (in hook) |   |
|  | Boat hauled up to Blocks. Davits luffed inboard to place boat alongside deck for disembarkation |
|  | Hanging off strops connected, boat lowered back so as to transfer weight from falls |
|  | Recovery pennants disconnected, falls lowered to re-engage chains. Boat re-housed on embarkation / stowage position |

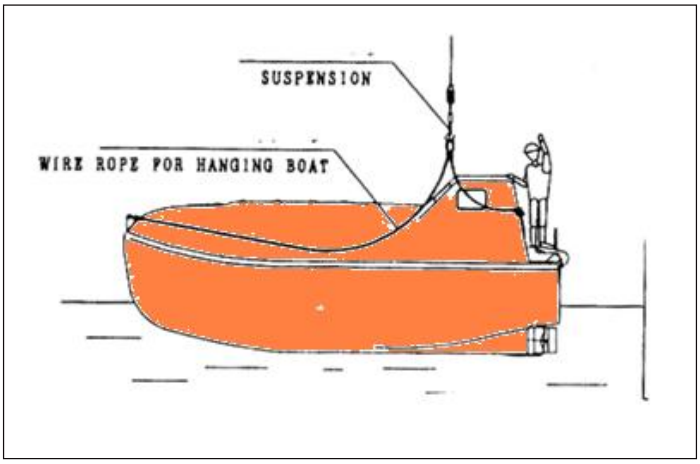



Sequence for transferring load from recovery pendants to lower blocks

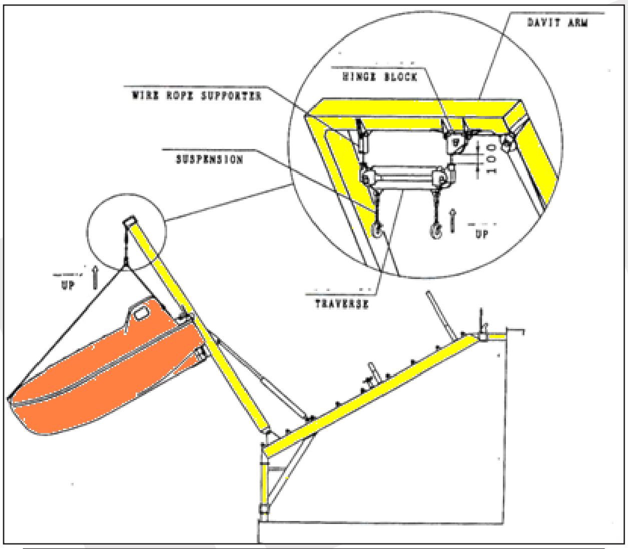
## 7. Recovery of a free-fall lifeboat by hydraulic winches

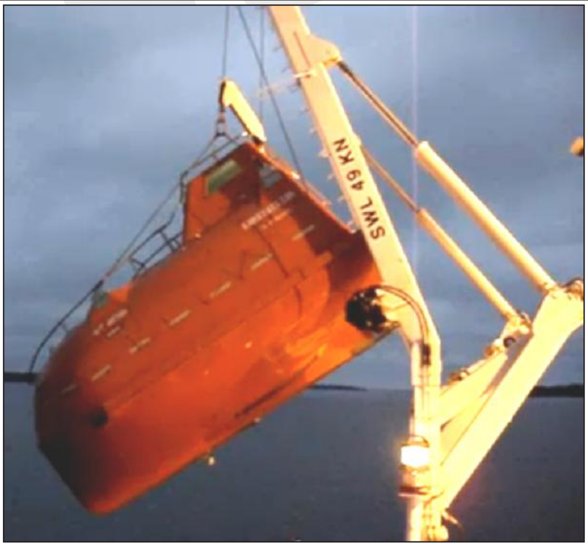
General recovery procedure is as follows. This may vary as per manufacturer's instructions.

- Turn the main power "ON". (The lamp will light.) Push the "ON" button switch (Green)
- The operator operates the control lever to move the davit arms outboard to the boat lowering position.
- The operator operates the control lever to lower the suspension to a position which allows the wire rope for hanging boat to be set.
  **Caution:** when hoisting the suspension, follow the signal given by the operator in the boat.
- The operator in the boat sets the wire rope for hanging boat to the suspension. After giving a signal to the operator on the depot ship, the operator in the boat takes a seat in the control compartment and wears a seat belt. Stop the engine in accordance with the boat operation manual.

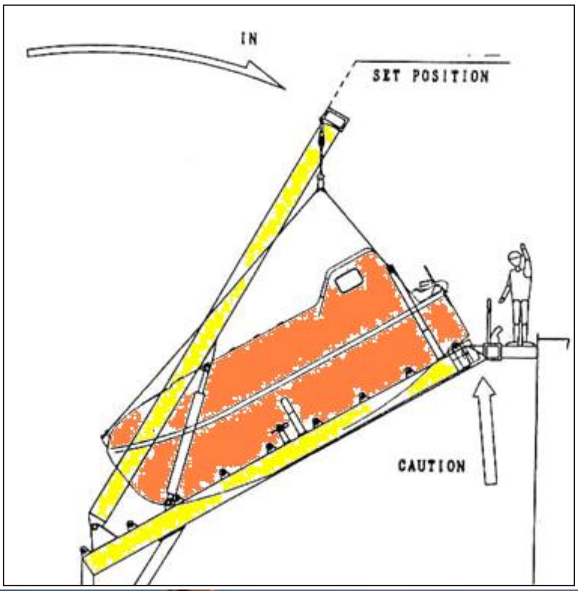


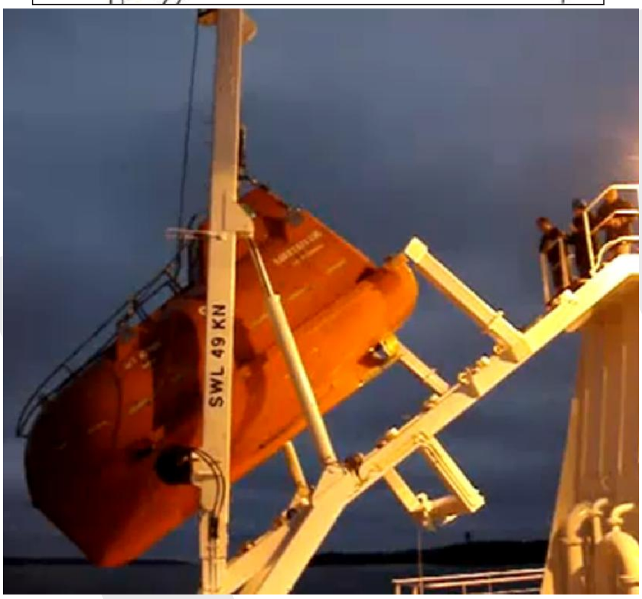

- The operator hoists the boat after ensuring that the engine of the boat has come to a stop. Stop the hoisting 100MM before the position where the traverse will hit against the hinge block and the wire rope supporter.



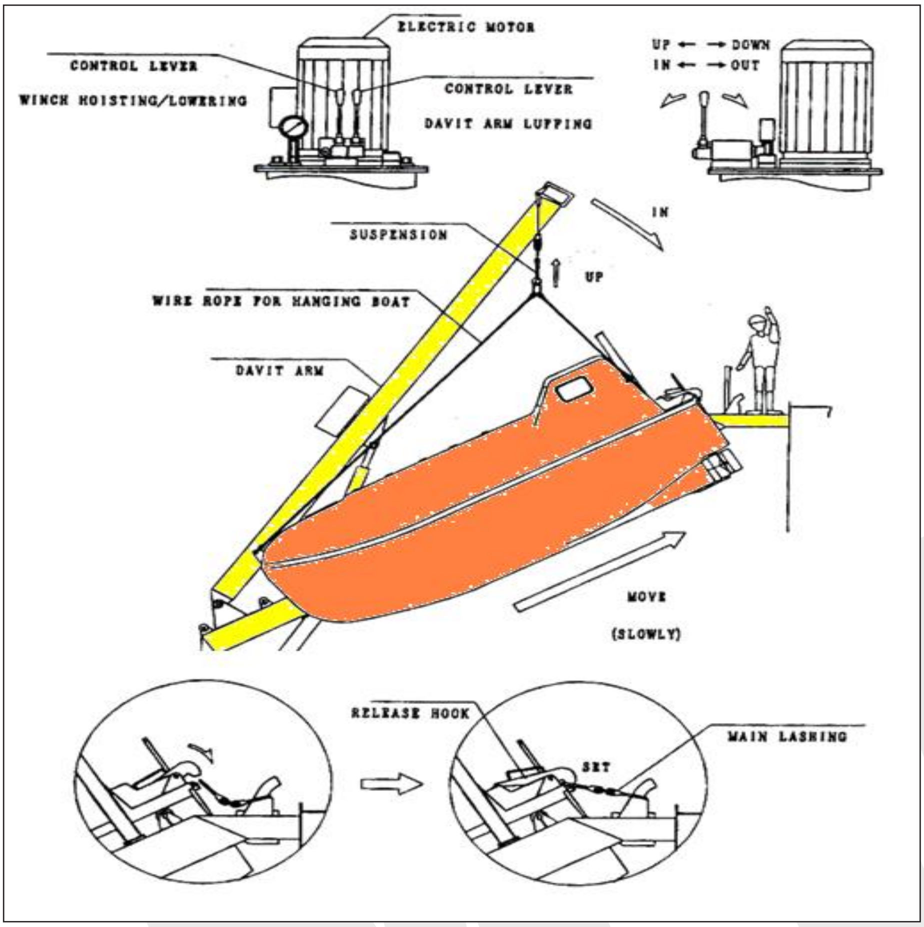




- The operator operates the control lever to store the davit arms in the boat set position. Assign the operator to the platform and stop the boat in a position where the boat will not touch the davit rear span.

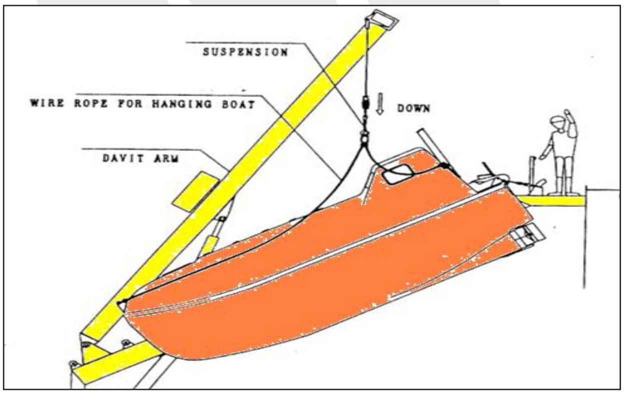


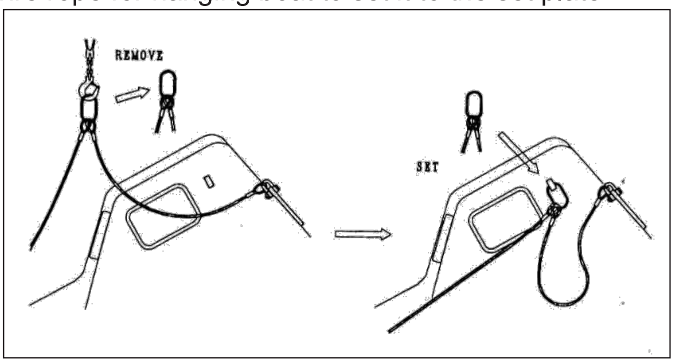

- The operator operates the control lever to lower the boat until it mounts the roller. Assign the operator to the platform so that the wire rope is not let out more than necessary.
- The operator operates the control lever to repeat operation of storing and hoisting. The boat will be moved to a position which allows the boat to be set to the main lashing.
  **Caution:** Assign the operator to the platform and operate the boat slowly in accordance with the signal. Never operate the boat abruptly.
- Set the main lashing in accordance with the boat operation manual. The operator checks to ensure that the main lashing have been set.



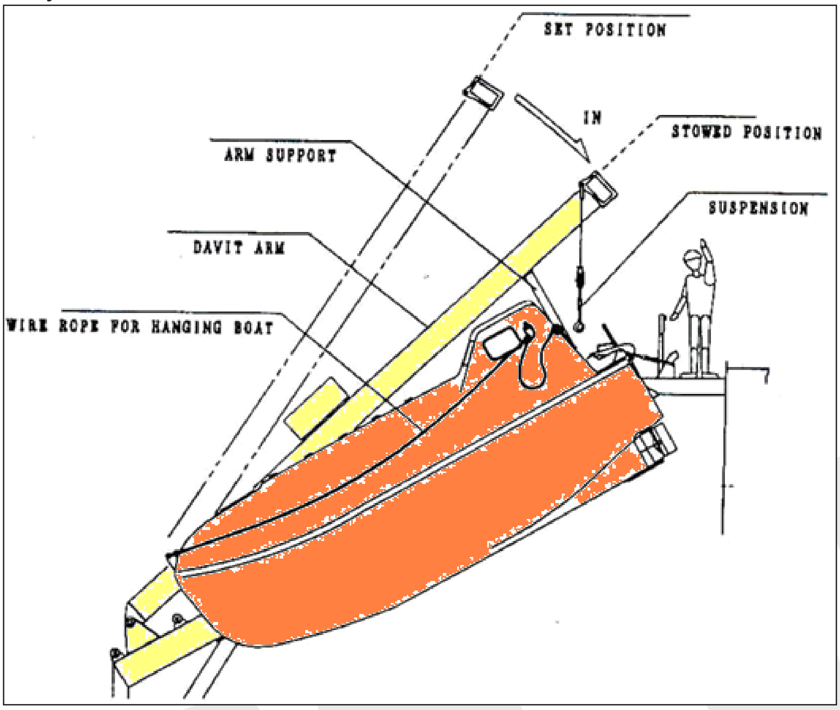

- The crew members board from the boat to the depot ship from the rear hatch. Lower the suspension until the wire rope for hanging boat comes fully loose.



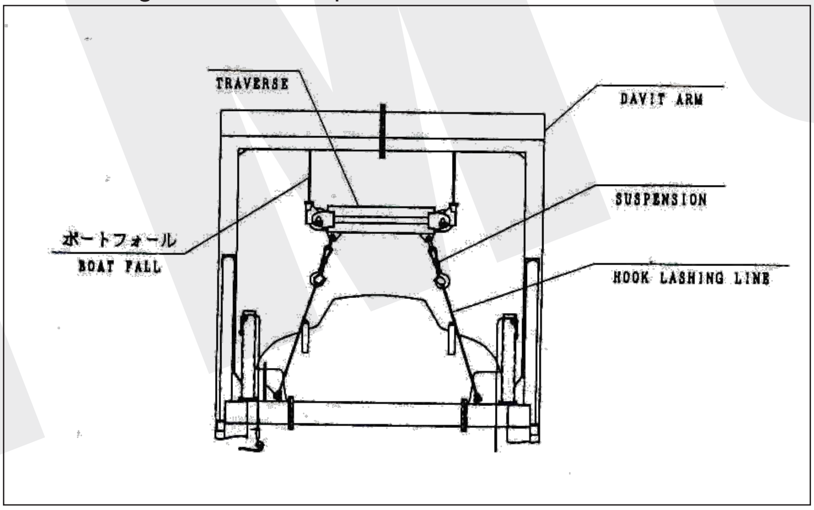

- Release the wire rope for hanging boat to set it to the set plate.



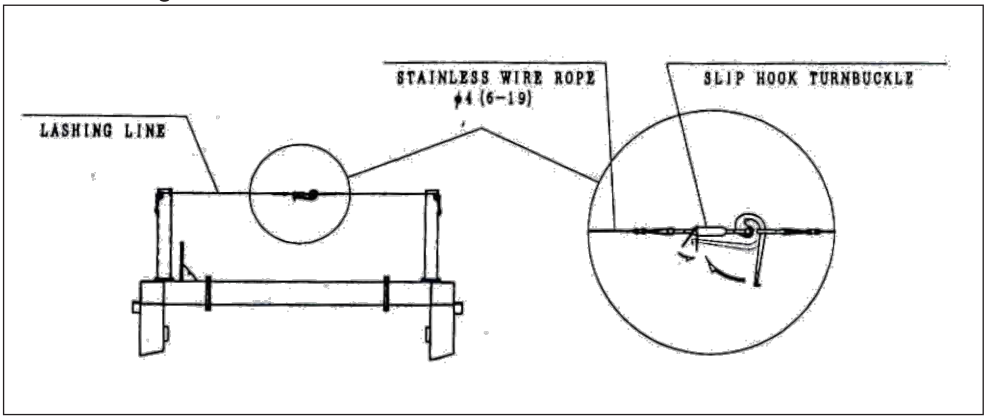
- The operator operates the control lever to move the davit arm to the stowed position. The davit arms will hit against the arm support and stop automatically, but ensure to operate the lever by visual check.




- Set the hook lashing line to the suspension.




- Set the lashing line.



- Set of the lashing plate to the lashing lines allows the automatic setting. The main power of the power pack is turned “OFF” (The lamp is turned off.)

## 8. Launching/ recovering the lifeboat/ rescue boat in an emergency in heavy weather

- When the ship is abandoned in heavy weather, additional precautions will be required while lowering the lifeboat. These are as follows:

- Boats on the leeward side can be launched more conveniently as compared to the one on windward side. For recovery suitable lee shall be provided to the rescue boat.
- Fenders shall be rigged, both on the parent ship and on the boat, to protect the boat against damage as it is lowered/ heaved. Mooring hawsers or mattresses may turn useful as fenders.
- The painters shall be rigged at both forward and aft end of the boats and these shall be tendered/ heaved as the boat is lowered/ heaved. This is to restrict the boat movement in rolling.
- Fibre or synthetic ropes may be passed around the boat falls and a stanchion aboard the parent ship in order to reduce the amount of swinging experienced by the boat if the vessel is rolling.
- Heaving lines may be attached to the lower fall blocks so that these can be hauled clear of the lifeboat when released to avoid banging on the boat.
- Persons not engaged in launching should be seated as low down as possible and warned not to put their hands and arms outboard.
- The boat should be launched onto a wave crest and with a downward roll of the ship if she is rolling. The winch brake should then be kept in the off position so that the falls will be slackened as the lifeboat moves into the trough of the next wave, or as the parent vessel rolls in the opposite direction. This will then ensure that the boat’s crew will be able to let go the falls whilst they are still slack. This is essential – if one of the falls cannot be released because it has tightened the lifeboat could slew round in the next wave and broach to perhaps even capsizing in the process.
- The boat may have to be fended off the ship’s side after lowering using boathooks or oars.
- The engines shall be started prior to lowering in the water. The gear should be engaged as soon as the lifeboat is in the water.
- Recovery strops provided in rescue boats eliminate the danger of occupant being hit by the fall blocks. These shall be used as appropriate.

**Apply Your Knowledge**

1. Read the launching and recovery procedure for the lifeboats and rescue boat provided on your vessel and discuss the salient features with Shipboard Training Officer.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Operate lifesaving appliances

**Task number:** C 4.1

**Sub-task Reference number:** C4.1.15

**Topic:** Lifesaving appliances (LSA)

**Task Heading**

- Check the statutory equipment required to be carried in a survival craft (lifeboat, rescue boat, life raft). Recognize minimum food and water requirements for survival craft occupants.

**Objectives**

- To know the equipment and fittings of the lifeboats, liferafts and rescue boats

Please read this task in conjunction with tasks C4.1.13 and C4.1.19

**Index**



**Description**

**1) Lifeboat equipment and fittings**

a) **Lifeboat equipment**

Each lifeboat shall be provided with the following equipments.

- One radar reflector
- One boarding ladder
- Oars and crutches (except for free-fall lifeboats) (usually 6)
- One steering oar and a steering oar grommet
- Two boat hooks
- One bailer
- Two buckets
- One survival manual
- One compass in binnacle with suitable means of illumination
- One sea anchor
- Two painters - length equal to not less than twice the distance from the stowage position of the lifeboat to the waterline in the lightest seagoing condition or 15 m, whichever is the greater, strength sufficient allowing the boat to be towed at 5 knots in calm seas
- Two hatchets
- One rustproof dipper c/w lanyard
- One rustproof graduated drinking vessel
- Locker for small gear (marked)
- 4 parachute signals
- 6 hand flares

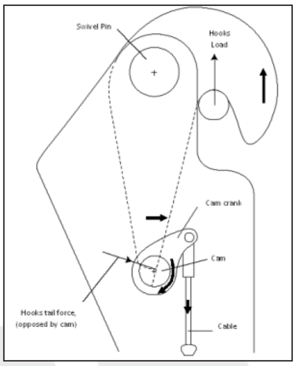
- ❖ 2 smoke floats
- ❖ One waterproof electric torch with one set spare batteries and one spare bulb
- ❖ One daylight signaling mirror
- ❖ One life saving signals table
- ❖ One whistle
- ❖ One first aid kit
- ❖ One x seasick bag per person and 6 x anti seasick tabs/person
- ❖ One jack knife
- ❖ Three tin openers
- ❖ Two rescue quoits & 30m line
- ❖ One manual pump
- ❖ One fishing tackle set
- ❖ One engine tool box
- ❖ One fire extinguisher for extinguishing oil fires
- ❖ One searchlight with a horizontal and vertical sector of at least 6° and a measured luminous intensity of 2500 cd which can work continuously for not less than 3 h
- ❖ TPAs for 10% of boat capacity


**b) Lifeboat fittings**

- ❖ Suitable handholds or becketed buoyant lifeline all around the boat, except in the vicinity of the rudder and propeller
- ❖ Mast & galvanized stays
- ❖ Embarkation ladder
- ❖ Plugs (2 per hole secured to boat); every drain point of the life-boat should be fitted with a ‘cap’ or ‘plug’ for closing from inside if required. Such caps/ plugs shall be attached to the boat by small lanyard or chain so that they are not misplaced.
- ❖ Tricing pendants forward and aft to facilitate the boat come alongside at boarding stations while lowering.
- ❖ ‘Hanging off pendants’ are provided to facilitate testing and maintenance of hook release mechanism. ‘Hanging off pendants’ usually has a factor of safety of at least 6 based upon the breaking strength of the wire.
- ❖ At least one drain valve fitted near the lowest point in the hull, which shall automatically open to drain water from the hull when the lifeboat is not water-borne and shall automatically close to prevent entry of water when the lifeboat is waterborne.
- ❖ Seat belt to hold each person, designed to hold a person with a mass of 100 kg securely in place with the boat in a capsized condition

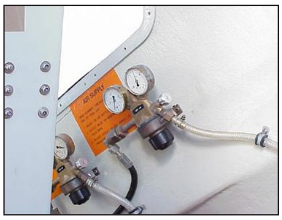
- ❖ Lifeboats have a compression ignition engine operating with fuel of flashpoint of more than 43°C (closed cup test).The engine is provided with either a manual starting system, or a power starting system with two independent rechargeable energy sources along with necessary starting aids. The engine is capable of operating for at least 5 min after starting from cold with the lifeboat out of the water. Suitable arrangements are provided for ahead and astern propulsion. The engine is powered to move the lifeboat when proceeding ahead in calm water at speed of at least 6 knots, when loaded with its full complement of persons and equipment. Further it is able to tow a 25-person loaded liferaft at 2 knots. Fuel is provided for continuous operation of engine for at least 24 hours.
- ❖ A rudder and removable tiller securely stowed near the rudder stock

- ❖ Watertight lockers or compartments to provide for the storage of the small items of equipment, water and provisions
- ❖ Means for the storage of collected rainwater
- ❖ Release mechanism for hooks on load and off-load
    - ✓ In free-fall lifeboats and other lifeboats, instructions for correct use of 'On-load/ off-load release mechanism' should to be posted inside boats. Danger signs should be provided which makes it apparent to the crew when boat release hooks are secured improperly.
- ❖ Release device –toggle for forward painter to be released when under tension; Release mechanism of toggle-painter is fitted allowing for operating from inside the boat.




- ❖ A permanently installed earth connection for portable radio apparatus antenna
- ❖ Skates and fenders to facilitate launching and prevent damage to the lifeboat (excluding free fall lifeboats)
- ❖ A manually controlled lamp visibility at least two miles lasting for duration of at least 12 hours. If the light is a flashing light, it initially flashes at a rate of not less than 50 flashes per minute over the first two hours of operation of the 12 hours operating period.
- ❖ A lamp or source of light for inside the lifeboat lasting at least 12 hours (oil lamps are not permitted)
- ❖ Adequate view forward, aft and to both side is provide from the control and steering position


- ❖ Partially enclosed lifeboats are provided with permanently attached rigid covers extending over at least 20% of the length of the lifeboat from the stem and 20% of the length of the lifeboat from the aftermost part of the lifeboat. The lifeboats are fitted with a permanently attached foldable canopy which together with the rigid covers completely encloses the occupants of the lifeboat in a weatherproof shelter and protects them from exposure. The entrances in the canopy are provided with efficient adjustable closing arrangements which can be easily and quickly opened and closed from inside or outside so as to permit ventilation but exclude seawater, wind and cold.
- ❖ Passenger ship motor lifeboats – 'radio' lifeboats carry a fixed radiotelegraph installation in a cabin large enough to take the set and an opera. A battery is provided to supply power for the radio and an engine drive dynamo capable of recharging it and other batteries in the boat. A searchlight which will operate for at least 3 hours continuously and effectively for a total of 6 hours. A spare bulb must be carried.



- ❖ On chemical tankers and gas carriers carrying cargoes emitting toxic vapours or gases, lifeboat with a self-contained air support system are provided. These are so arranged that, when proceeding with all entrances and openings closed, the air in the lifeboat remains safe and breathable and the engine runs normally for a period of not less than 10 min. visual indicators are provided to indicate the pressure of the air supply at all times.

- ❖ A fire-protected lifeboat is provided with systems such as sprinkler system which comes in operation when waterborne. System can protect from a continuous oil fire that envelops the lifeboat for a period of not less than 8 min.
- ❖ Free-fall lifeboats are fitted with a release system which has two independent activation systems for the release mechanisms which may only be operated from inside the lifeboat. These are marked in a colour that contrasts with its surroundings.

- Recovery strops are required for rescue boats or lifeboat cum rescue boats

Additionally few equipment and fittings may be found on open lifeboats of older vessels (whose keels were laid before 1 July, 1986). These include

- Bilge keel grab lines
- Oil lamp with sufficient oil for 12 hours
- 'Safety matches' in watertight container
- Storm oil 4,5 litres(1 gallon)
- Oil bag, for attaching to sea anchor
- 'Bowsing in tackle' to hold boat against ship's side
- steering oar with blade painted white

**c) Lifeboat rations and drinking water**

- **Quantity**

✓ **Fresh Water**
3 litres per person, out of which

- 1litre may be provided by using the de-sailing apparatus has the capacity to produce ½ litre per person per day OR
- 2 litres per person may be replaced by a manually powered reverse osmosis de-salinator capable of producing an equal amount of fresh water in 2 days

✓ **Rations -**10,000 Kilo Joules per person to be provided, in the form of biscuits etc.

- **Storage and labeling of food**
All emergency rations are required to be packed in airtight bags or containers. Storage tanks or compartments are required to be watertight. Covers of containers shall be such that these can be easily opened without requiring special tools. Screwed covers are not recommended in circumstances where they could become seized. All packages of food must be labeled to indicate the contents and the applicable expiry date. The packaging and stowage arrangements of provisions and water should not be affected by any of the prototype tests carried out on the survival craft in which they are stowed.


- **Drinking water**
Water in sachets or bottles has a given storage life which should be marked on the container. If the date of manufacture only is given the product should be replaced after 3 years. Water stored in sealed cans may be assumed to have an indefinite life provided the vacuum is maintained. Water held in larger containers or in built-in or loose tanks should be sampled for taste at each survey and should be changed if the surveyor is not satisfied with the quality.


- **Reverse osmosis desalination pumps**
Where reverse osmosis desalination pumps are provided in the survival craft, they are to be fixed if this is motor driven. In either case they should be fixed/ stowed in such a manner that they are protected from damage or contamination by oil which could render them unserviceable. In the case of fixed installations, clear operating instructions should be attached to the structure of the survival craft adjacent to the pump. These instructions should not become illegible through exposure to the environment. In the case of hand operated pumps, water resistant instructions should be stowed with the pump. A suitable container should be provided for the collection and storage of the water that is produced.

**2) Liferaft equipment and fittings**

a) **Liferaft equipment**

## SOLAS Pack A

The items provided in liferafts carried aboard vessels engaged on long international voyages

- ❖ One buoyant rescue quoit, attached to buoyant line of at least 30m length
- ❖ One knife of the non-folding type having a buoyant handle and lanyard attached. The knife is stowed in a pocket on the exterior of the canopy near the point at which the painter is attached to the liferaft. A liferaft permitted to accommodate13 persons or more are provided with a second knife which need not be of the non-folding type.
- ❖ Buoyant bailers – one in liferaft with capacity 12 persons, two in liferafts with capacity13 persons or more
- ❖ Two sponges
- ❖ Two sea-anchors each with a shock resistant hawser and tripping line
- ❖ Two buoyant paddles
- ❖ Three tin-openers and a pair of scissors. Safety knives containing special tin-opener blades are satisfactory for this requirement;
- ❖ One first-aid outfit in a waterproof case capable of being closed tightly after use
- ❖ One whistle
- ❖ Four rocket parachute flares
- ❖ Six hand flares
- ❖ Two buoyant smoke signals
- ❖ One waterproof electric torch with one spare set of batteries and one spare bulb in a waterproof container
- ❖ A radar reflector
- ❖ One daylight signaling mirror with instructions on its use
- ❖ One copy of the life-saving signals on a waterproof card
- ❖ One set of fishing tackle
- ❖ One rustproof graduated drinking vessel
- ❖ Anti-seasickness medicine sufficient for at least 48 h
- ❖ One seasickness bag for each person of liferaft
- ❖ Instructions on how to survive and instructions for immediate action
- ❖ Thermal protective aids sufficient for 10%of the number of persons the liferaft is permitted to accommodate or two, whichever is the greater
- ❖ One topping-up pump or bellows(only in inflatable liferafts)
- ❖ One repair outfit for repairing punctures in buoyancy compartments (only in inflatable liferafts)

- ➢ **Liferaft ration**
- ❖ A food ration of at least 10,000 kJ for each person of liferaft kept in airtight packaging and stowed in a watertight container
- ❖ Fresh water 1.5 litre for each person the liferaft in watertight receptacles of which either 0.5 litre per person may be replaced by a de-salting apparatus capable of producing an equal amount of fresh water in 2 days or 1 litre per person may be replaced by a manually powered reverse osmosis de-salinator capable of producing an equal amount of fresh water in 2 days.

## SOLAS Pack B

The items provided in liferafts carried aboard passenger ships engaged on short international voyages

- ❖ One buoyant rescue quoit, attached to buoyant line of at least 30m length
- ❖ One knife of the non-folding type having a buoyant handle and lanyard attached. The knife is stowed in a pocket on the exterior of the canopy near the point at which the painter is attached to the liferaft. A liferaft permitted to accommodate 13 persons or more are provided with a second knife which need not be of the non-folding type.

- ❖ Buoyant bailers – one in liferaft with capacity 12 persons, two in liferafts with capacity13 persons or more
- ❖ Two sponges
- ❖ Two sea-anchors each with a shock resistant hawser and tripping line
- ❖ Two buoyant paddles
- ❖ One first-aid outfit in a waterproof case capable of being closed tightly after use
- ❖ One whistle
- ❖ Two rocket parachute flares
- ❖ Three hand flares
- ❖ One buoyant smoke signals
- ❖ One waterproof electric torch with one spare set of batteries and one spare bulb in a waterproof container
- ❖ A radar reflector
- ❖ One daylight signaling mirror with instructions on its use
- ❖ One copy of the life-saving signals on a waterproof card
- ❖ Anti-seasickness medicine sufficient for at least 48 h
- ❖ One seasickness bag for each person of liferaft
- ❖ Instructions on how to survive and instructions for immediate action
- ❖ Thermal protective aids sufficient for 10% of the number of persons the liferaft is permitted to accommodate or two, whichever is the greater
- ❖ One topping-up pump or bellows(only in inflatable liferafts)
- ❖ One repair outfit for repairing punctures in buoyancy compartments (only in inflatable liferafts)

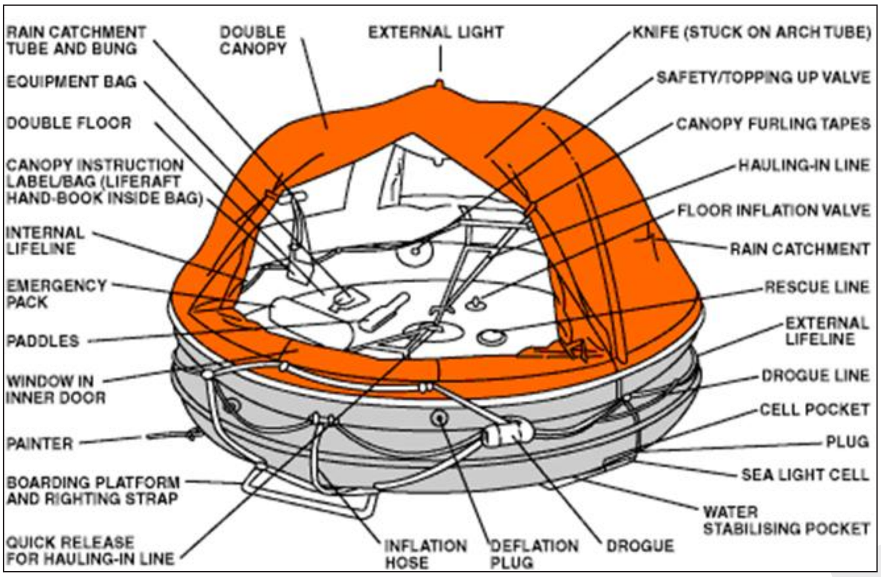
> There is no food ration or drinking water in SOLAS B pack liferafts. Also the distress pyrotechnics are half in number.

**b) Liferaft fittings**

Liferaft are so constructed as to be capable of withstanding exposure for 30 days afloat in all sea conditions.

The fittings:

- ❖ At least one viewing port
- ❖ Means for collecting rain water
- ❖ Means to mount a survival craft radar transponder at a height of at least 1 m above the sea
- ❖ Lifelines securely becketed around the inside and outside of the liferaft
- ❖ painter of length 15 m or more,  breaking strength15.0 kN for liferaft  of 25 persons or more, 10.0 kN for liferafts of 9 to 25 persons and not less than 7.5 kN for any other liferaft
- ❖ A manually controlled white light lamp fitted to the top of the liferaft canopy (switching on automatically) operating continuously for at least 12 hours with a luminous intensity of at least 4.3 cd, in case of a flashing light – flashing  at least 50 flashes or more
- ❖ A davit launched liferaft is provided with means for bringing the liferaft alongside the embarkation deck and holding it securely during embarkation.




- In inflatable liferafts, the main buoyancy chamber is divided into two separate compartments inflated through a non-return inflation valve. Each individual chamber is made capable of supporting the entire load of liferaft when fully laden.
- At least one entrance shall be fitted with a semi-rigid boarding ramp
- Water pockets in the underwater portion to provide stability
- Inherently buoyant containers for stowing the inflatable liferafts so constructed as to withstand conditions encountered at sea

**3) Rescue boat equipment and fittings**

a) **Rescue boat equipment**

All items of rescue boat equipment (except boat-hooks) shall be kept secured within the rescue boat by lashings, storage in lockers or compartments, storage in brackets or similar mounting arrangements not interfering with any launching or recovery procedures. All items of rescue boat equipment shall be as small and of as little mass as possible and shall be packed in suitable and compact form.

Normal equipment of every rescue boat consist of

- Sufficient buoyant oars with thole pins, crutches or paddles to make headway in calm seas. Thole pins or crutches shall be attached to the boat by lanyards or chains.
- A buoyant bailer
- A binnacle containing an efficient compass with suitable means of illumination
- A sea-anchor and tripping line of at least10 m in length
- A painter of length 15 m and securing device and strength sufficient allowing the boat to be towed at 5 knots in calm seas
- One buoyant line at least 50 m in length, of sufficient strength to tow the laden liferaft(largest carried on the vessel) at speed of at least 2 knots
- One waterproof electric torch suitable for morse signaling, together with one spare set of batteries and one spare bulb in a waterproof container
- One whistle
- A first-aid outfit in a waterproof case capable of being closed tightly after use
- Two buoyant rescue quoits, attached to buoyant line of at least 30 m length
- A searchlight with a horizontal and vertical sector of at least 6° and a measured luminous intensity of 2500 cd which can work continuously for not less than 3 h
- A radar reflector
- Thermal protective aids sufficient for 10%of the number of persons the rescue boat is permitted carry or two, whichever is the greater
- Portable fire-extinguishing equipment of an approved type suitable for extinguishing oil
- Fires

- Every rigid rescue boat shall additionally carry
  - A boat-hook
  - A bucket
  - A knife or hatchet

- Every inflated rescue boat shall in addition carry
  - A buoyant safety knife
  - Two sponges
  - An efficient manually operated bellows or pump
  - A repair kit in a suitable container for repairing punctures
  - A safety boat-hook

**b) Rescue boat fittings**

- At least one automatic drain valve
- A rudder and a tiller
- Suitable A buoyant lifeline becketed around the outside of the boat
- A release device to enable the painter to be released when under tension
- Effective means of bailing
- Skates and / or fenders
- Recovery strops made of nylon or other suitable material, having a factor of safety of at least 6 based upon the breaking strength of the strop.
- Rescue boats are designed to be capable of maneuvering at a speed of at least 6 knots and fuel is provided for maintaining that speed for a period of at least 4 h. The boat may have an inboard engine or outboard motor. In case of an outboard motor, the rudder and tiller may form part of the engine. Petrol-driven outboard engines with an approved fuel system may be fitted in rescue boats provided the fuel tanks are specially protected against fire and explosion.
- The buoyancy of an inflated rescue boat is provided by either a single tube subdivided into at least five separate compartments of approximately equal volume or two separate tubes neither exceeding 60% of the total volume.
- A lifeboat may be accepted as a rescue boat if it satisfies the criteria for rescue boats.

**Apply Your Knowledge**

1. Check the inventory of lifeboat, liferaft and rescue boat equipment on your vessel. Discuss the procedures for checking and maintenance of the same.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Operate lifesaving appliances

**Task number:** C 4.1

**Sub-task Reference number:** C4.1.18

**Topic:** Lifesaving appliances (LSA)

**Task Heading**

- Check the securing arrangements of a life raft (including life raft stowed away from accommodation) and recognize the function of the hydrostatic release unit (HRU) and weak link.

**Objectives**

- Understand the securing arrangements of a life raft.

**Index**

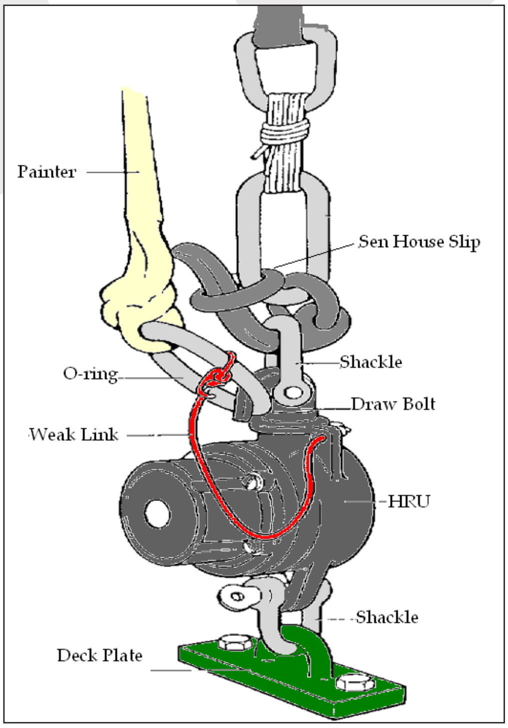
1) Float free arrangement for liferafts
2) Securing arrangements of the liferaft
3) Installation of 'Hammar' HRU

**Description**

**1) Float free arrangement for liferafts**

The float free arrangements for liferafts are provided by installing hydrostatic release units (HRU). The installation and release mechanism of HRUs are discussed under task C4.1.7 in detail which shall be referred.

- **Weak link**
The weak link used in the float-free is made from a corrosion resistant material which is and not affected by seawater, oil or detergent. These are either made of cordage, have the ends either whipped or heat treated OR from flexible wire, having each end looped around a thimble and secured with a locking ferrule. The breaking strength of the weak link under a tensile force is between 1.8 and 2.6 kilo-Newton. Within this range, the weak link is able to pull the painter out of the liferaft container and operate the liferaft inflation system. Weak link is used in the float-free arrangement is required not be broken by the force required to pull the painter from the liferaft container.




**2) Securing arrangements of the liferaft**

- The liferafts are stowed on the designated cradles and are secured usually with a strap which is further attached to the deck through a piece of rope, a sen-house slip and a HRU as shown in picture. While the HRU facilitates automatic release of liferaft in case the ship sinks, the sen-house slip and rope provide for quick manual release in case of emergency.

- While checking the stowage, check that the liferaft is tightly secured on the cradle. Check painter is secured properly to the hydrostatic release, in the following manner:

- ✓ Ensure that the painter will remain attached to vessel, if life raft is released manually.
- ✓ The painter may get released with liferaft, if liferaft is released automatically by HRU. But ensure that weak link painter will remain attached to the vessel in this case.
- ✓ Under no circumstances painter must be drawn from the container to shorten it or to tie off to a strong point.

❖ The liferaft cradle and the securing eye on deck shall be maintained in satisfactory condition, checked for wear, tear and rust. The sen-house slip shall be checked and greased as appropriate.

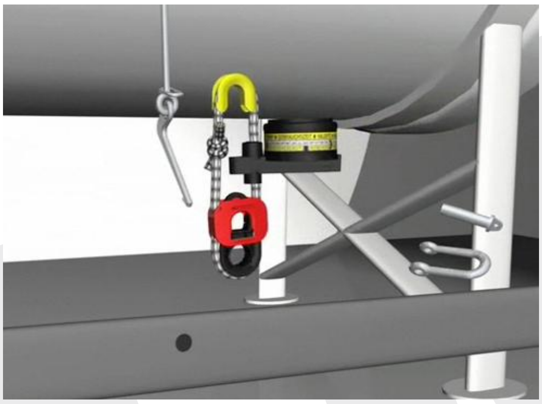
❖ If life raft has two separate lines as liferaft operating cord and painter, then they should be identified clearly.

❖ HRU shall never be painted over. Disposable HRU are usually maintenance free, where the expiry date shall be checked. The drain holes of HRU shall be checked clear and water has not accumulated inside the HRU.

➢ **Instructions and information**

The training manual contains general description of the HRU, installation instructions, any on-board maintenance and servicing requirements.

**3) Installation of Hammar HRU**



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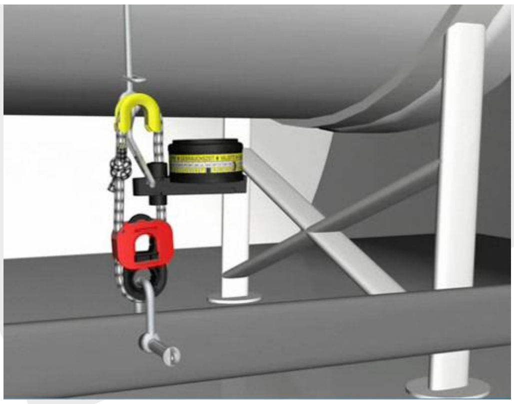

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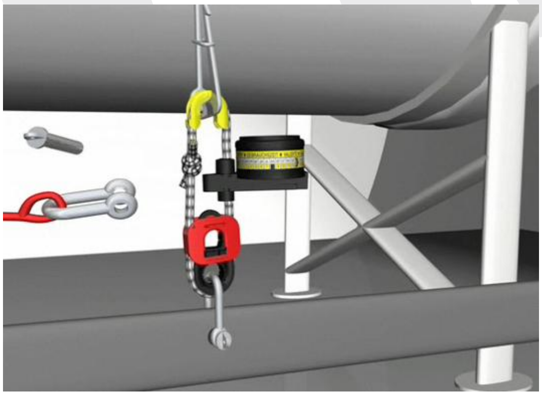

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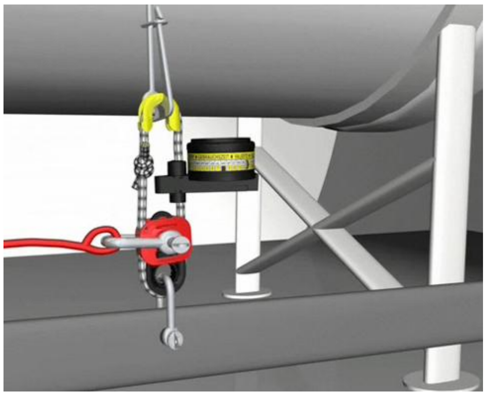

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**Apply Your Knowledge**

1. Locate the liferaft placed near the forward or aft extremity of your vessel and check its stowage and securing arrangement.
2. Mention the make of HRU used on liferafts and last service/ renewal date.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Operate lifesaving appliances

**Task number:** C 4.1

**Sub-task Reference number:** C4.1.19, C4.1.20

**Topic:** Lifesaving appliances (LSA)

**Task Heading**

- Check lifesaving equipment as per planned maintenance system and maintain readiness at all times.
- Demonstrate understanding of the regulations concerning annual and other servicing and testing requirements of life rafts, lifeboats and launching and recovery arrangements.

**Objectives**

- To understand the testing and maintenance requirements of lifeboats, rescue boats and launching gear

Please read this task in conjunction with tasks C4.1.9 to C4.1.14, C4.1.16 and C4.1.17

**Index**

1) Planned maintenance system for LSA
2) Testing standards for liferafts and lifeboats
   a) Liferafts
   b) Lifeboats
   c) Launching and embarkation appliances
3) Annual thorough examination of lifeboats, rescue boats and launching gear
   a) Lifeboat on/ off-load release gear
   b) Davit
   c) Winch
   d) Boat falls
   e) Annual servicing of liferafts

**Description**

**1) Planned maintenance system for LSA**

- SOLAS chapter III – regulation 20 emphasizes on operational readiness, maintenance and inspections of LSA and regulation 36 provide instructions in general for onboard maintenance procedures. The responsibility of required servicing and maintenance of the LSA on board lies with the company which in turn establishes the planned maintenance system specifying various schedules and procedures of maintenance. These procedures include procedures for on board maintenance and the procedures where the shore based serving/ testing etc. is required.

- The planned maintenance schedule specifies the procedures to be followed for onboard testing and maintenance along with the schedule as and when due, to ensure the operational readiness. It further specifies the person in-charge on board for carrying out such maintenance.

- Only authorized Service providers are permitted to carry out the thorough examination, operational testing, repair and overhaul of lifeboats, launching appliances and on-load release gear. Weekly and monthly inspections, and routine maintenance as specified in the equipment maintenance manuals and shipboard PMS is done by ship's crew under direct supervision of a ship's officer assigned in accordance with the PMS. All other inspections, servicing and repair is done by the manufacturer's representative or other person from authorized Service providers appropriately trained and certified for the work to be done.

- Records of inspections, servicing, repairs and maintenance are updated and filed on board the ship. When repairs, thorough examinations and annual servicing are completed, a statement confirming that the lifeboat arrangements remain fit for purpose is issued by the service provider who performed the work. These reports and checklists are signed by the person who carries out the inspection and maintenance work and are countersigned by the company's representative or the ship's master.
- A full set of maintenance manuals and associated technical documentation is required to be kept on board for use in all operations involved in the inspection, maintenance, adjustment and re-setting of the lifeboat and associated equipment, such as davits and release gear.
- The procedures for planned maintenance of various LSA are covered under tasks C4.1.9 – C4.1.13.

**2) Testing standards for liferafts and lifeboats**

**a) Liferafts**

- **General**
  - ✓ Liferafts both of inflatable and rigid types are tested to be damage proof for two drops from a height of stowage or 18 m whichever is greater. Following the test the liferaft shall be left floating for 30 minutes.
  - ✓ Liferafts both of inflatable and rigid types are tested to be damage proof for consecutive jumps of person weighing 75 kgs or more from a height of 4.5m for x number of times where x is the authorized carrying capacity of the liferaft.
  - ✓ The liferaft along with its container shall weigh not more than 185kgs.
  - ✓ The liferafts are tested for towing using the rope provided in the raft across a distance of at least 1km at up to 3knots in calm water.
  - ✓ The liferafts are tested for remaining afloat for 30 days loaded with weight of its full complement. The inflatable liferafts are permitted to be topped up for air pressure once a day using manual pump.
  - ✓ The inflatable liferafts are required to have a freeboard of at least 300mm when fully loaded and floor not inflated.
  - ✓ Liferafts undergo boarding tests where two persons at the entrance of empty liferaft pick up a person from water, without capsizing the liferaft.
  - ✓ Liferafts are provided with paddles using which it shall be possible to propel the fully laden raft at least by 25 metres in calm waters.
  - ✓ Liferafts are further tested to support its full complement when swamped with at least 10 waves of height 90 cms.
  - ✓ The liferaft' s canopy is tested for closure not allowing any significant accumulation of water inside the raft by a hose test pouring 2300ltrs of water per minute through a 63.5mm hose from 3.5m away for period of 5 minutes.
  - ✓ The breaking strength of the painter system including its means of attachment to the liferaft should be as follows:
    - not less than 7.5 kN for liferafts accommodating up to 8 persons;
    - not less than 10.0 kN for liferafts accommodating 9 to 25 persons;
    - not less than 15.0 kN for liferafts accommodating more than 25 persons.
- Davit launched liferafts are further tested for impact test to a rigid vertical surface at speed 3.5m/s and drop test from a height of 3m in fully loaded condition.

- Inflatable liferafts are further tested for supporting the entire weight with one of its buoyancy chambers un-inflated or damaged.
- The inflatable liferafts are required to be capable of being turned upright by one person.
- Each inflatable liferaft is required of being able to be inflated at an ambient temperature of 18 to 20 degree celsius in not more than 1 minute. The inflated compartments are tested for pressure 3 times the working pressure.
- Davit-launched inflatable liferafts are tested for strength by being hung fully laden for at least 5 minutes at temperature 20+3°C. It is also demonstrated, after a period of 6 h in a chamber at a temperature of -30°C, that the liferaft will support a load of 1.1 times the number of persons for which it is to be approved and its equipment with all relief valves operative. The liferaft is lowered for a distance of at least 4.5 m in continuous contact against a structure erected to represent the side of a ship having a 20° adverse list and checked after its completion not to sustain damage or distortion, or assume a position which would render it unsuitable for its intended purpose.
- The tensile strength of the fabric is checked to be a minimum of 2255 N/50 mm width for warp and weft. Maximum elongation, for the above should be 30% over a 200 mm gauge length; the elongation should be expressed as a percentage of the initial test length between the jaws. Where two layers of floor fabric are provided to form an inflatable floor the main floor should be as specified. The inner/outer layer may have a minimum tensile strength of 1470 N/50 mm widths in warp and weft direction.

**b) Lifeboats**

- The material used to construct lifeboat and its canopy is tested in flame for burning time and for inherent buoyancy. The buoyancy is further checked for continuous immersion of 14 days in crude oil, fuel oil, diesel and spirit at 18°C for buoyancy not reducing by more than 5%.
- The fully laden lifeboat is tested to be launched while the ship is moving at least 5 knots.
- Davit-launched lifeboats are tested for deflection and residual deflection longitudinally and athwartship when hung in light and fully loaded conditions. The keel deflection and change in breadth should not exceed 1/400 of the lifeboat's length when the lifeboat is subjected to 25% overload. If the lifeboat is made of GRP, such measurements are taken after a lapse of time approximately 18 hours.
- Free-fall lifeboats are tested for any damages when launched fully laden from a height of 1.3 times the height for which it is to be approved. The lifeboat is further required to make positive headway immediately after water entry.
- Davit launched lifeboats are further tested for impact test to a rigid vertical surface at speed 3.5m/s and drop test from a height of 3m in fully loaded condition. Following the impact and drop test operational test are carried out which include unloading, cleaning and careful examination to detect the position and extent of damage.
- Lifeboat seating strength is checked to support a weight of a person weighing 100 kgs. Also the seating space is checked to be adequate for accommodating persons of average mass of 75 kg wearing lifejacket and any other essential equipment and be able to be seated within 3 minutes. The lifeboat is also maneuvered and all equipment on board checked for being operated without difficulty and without interference with the occupants.
- The lifeboat is checked to have positive stability when filled with water to represent flooding which would occur when the lifeboat is holed in any one location below the waterline assuming no loss of buoyancy material and no other damage.

- The minimum required freeboard of the lifeboat on the lower side is 100mm or 1.5% of the lifeboat's length (whichever is less) when loaded with its full equipment and half the number of persons, seated on one side.
- The on load release mechanism of the davit launched lifeboat is tested for simultaneously releasing the boat with the boat held just above water, when laden to the total mass equals 1.1 times the mass of the fully laden lifeboat, boat being towed at 5 knots, with the hooks inclined in the lengthwise direction of the boat at an angle of 45° to the vertical and also in the athwartship direction at an angle of 20° to the vertical.
- Free-fall release mechanism for a free-fall lifeboat is checked to operate effectively when loaded with a force equal to at least 200% of the normal laden load.
- Laden Lifeboat is tested to be safely towed at a speed of not less than 5 knots in calm water and on an even keel. The painter release system is checked if it can be operated while being towed at 5 knots.
- Totally enclosed lifeboats are tested for automatic self-righting when
- ✓ fully laden with the occupant of average weight 75 kgs each are seated in their positions secured by seatbelts.
- ✓ In light condition.
- Totally enclosed lifeboats are further tested to allow open escape route to occupant when flooded and capsized.
- The engine of totally enclosed lifeboat is tested by engine inversion test whereby it is rotated, started and stopped frequently a number of times. During these tests, the engine should not overheat, fail to operate, or leak more than 250 ml of oil during any one inversion. When examined after being dismantled the engine should show no evidence of overheating or excessive wear.
- Lifeboats with a self-contained air support system are tested that with all entrances and openings of the lifeboat closed and the engine run at full speed for a period of 10 min the internal air pressure should never fall below the outside atmospheric pressure nor should it exceed outside atmospheric pressure by more than 20 mbar during the test.
- Fire-protected lifeboats are tested when enclosed in a fire of kerosene continuously for 8 minutes. The analysis should indicate that there is sufficient oxygen and no dangerous levels of toxic or injurious gases or substances and a positive pressure is being maintained inside the lifeboat. Water spray system is then put in operation the delivery rate of water or the thickness of the sprayed water film at the external surface of the lifeboat is checked. The spray system is checked for satisfactory operation with the boat listed and or trimmed by 5°.

**c) Launching and embarkation appliances**

This section is covered under tasks header C4.1.14/16/17.

**3) Annual thorough examination of lifeboats, rescue boats and launching gear**

- Annual thorough examination of lifeboats, rescue boats and launching gear includes the following.
- condition of lifeboat structure including fixed and loose equipment
- engine and propulsion system
- sprinkler system, where fitted
- air supply system, where fitted
- maneuvering system
- power supply system
- bailing system

**a) Lifeboat on/ off – load release gear**

- The testing of the release gear involves the following:

- ✓ operation of devices for activation of release gear
- ✓ excessive free play (tolerances)
- ✓ hydrostatic interlock system, where fitted
- ✓ cables for control and release
- ✓ hook fastening

- ❖ The release gear is to be examined prior to its operational test. The release gear is re-examined after its operational test and the dynamic winch brake test. Special consideration is given to ensure that no damage has occurred during the winch brake test, especially the hook fastening.

- ❖ Operational test of free-fall lifeboat release function
- ✓ The simulated launching arrangements as specified in the manufacturer's operating instructions are engaged.
- ✓ The operator is properly seated and secured in the seat location from which the release mechanism is to be operated.
- ✓ The release mechanism to release the lifeboat is then operated.
- ✓ The lifeboat is then reset in the stowed configuration.
- ✓ The above are repeated using the back-up release mechanism, when applicable.
- ✓ Having completed the test, the simulated launching arrangements are removed and the lifeboat is checked to be ready to launch stowed configuration.

- ❖ Overhaul of on-load release gear
  The procedure includes
- ✓ Dismantling of hook release units
- ✓ Examination with regard to tolerances and design requirements
- ✓ Adjustment of release gear system after assembly
- ✓ Examination of vital parts with regard to defects and cracks using non-destructive examination techniques, such as dye penetration

**b) Davit**

The following items are examined for satisfactory condition and operation

- ❖ davit structure, in particular with regard to corrosion, misalignments, deformations and excessive free play
- ❖ wires and sheaves, possible damages such as kinks and corrosion
- ❖ lubrication of wires, sheaves and moving parts
- ❖ functioning of limit switches
- ❖ stored power systems
- ❖ hydraulic systems

**c) Winch**

- ❖ The following items are examined for satisfactory condition and operation
- ✓ open and inspect brake mechanism
- ✓ replace brake pads, if necessary
- ✓ remote control system
- ✓ power supply system
- ✓ winch foundation

- ❖ Dynamic winch brake test
- ✓ Annual operational testing is done by lowering preferably empty boat. When the boat has reached its maximum lowering speed and before the boat enters the water, the brake is abruptly applied.

- ✓ The five-year operational test is done by lowering the boat loaded to a proof load equal to 1.1 times the weight of the survival craft or rescue boat and its full complement of persons and equipment, or equivalent load. When the boat has reached its maximum lowering speed and before the boat enters the water, the brake is abruptly applied.

- ✓ In loading the boat for this test, precautions are taken to ensure that the stability of the boat is not adversely affected by free surface effects or the raising of the centre of gravity.
- ✓ Following these tests, the brake pads and stressed structural parts are re-inspected.

**d) Boat falls**

- ❖ Fall wires used in launching are required to be turned end for end at intervals of not more than 30 months and renewed when necessary due to deterioration of the falls or at intervals of not more than five years, whichever is the earlier.

**e) Annual servicing of liferafts**

- ❖ Every inflatable liferaft shall be serviced at intervals not exceeding 12 months, provided where in any case this is impracticable; this may be extended to a period to 17 months.

**Apply Your Knowledge**

1. Participate in the planned maintenance of lifeboats, liferafts and launching & recovery appliances.
2. Check the salient items checked during Safety Equipment Surveys with respect to lifeboats, liferafts and launching & recovery appliances.
3. While referring to the SOLAS Training manual, explain the procedure for on-load release of lifeboat hooks on your ship. Under which circumstances would you need to release the hooks when on-load?
4. Check the records to be maintained with regards to maintenance of lifeboats and liferafts and launching/ recovery gear.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Operate lifesaving appliances

**Task number:** C 4.1

**Sub-task Reference number:** C4.1.21

**Topic:** Lifesaving appliances (LSA)

**Task Heading**

- Assist engineers with the routine maintenance of a lifeboat and rescue boat engine.

**Objectives**

- To learn the maintenance procedures for lifeboat engines

Please read this task in conjunction with tasks C4.1.1

**Index**



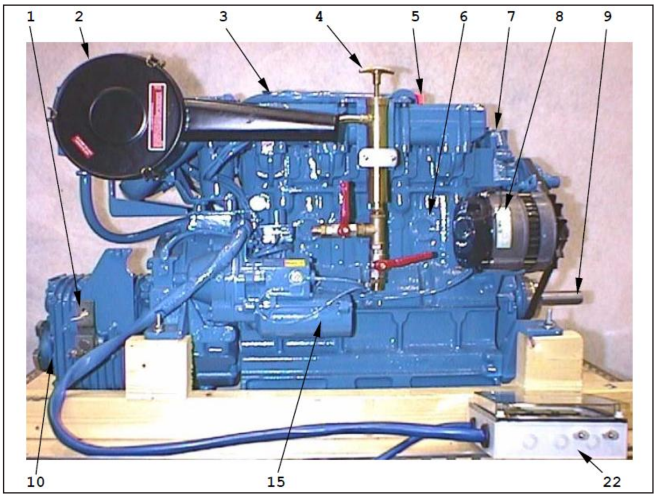
**Description**

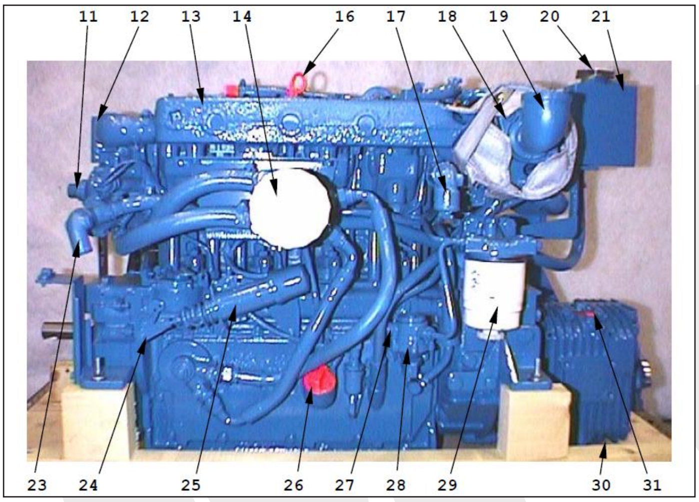
**1) Description of lifeboat engine**

Lifeboats have a compression ignition engine operating with fuel of flashpoint of more than 43°C (closed cup test). The engine is provided with either a manual starting system, or a power starting system with two independent rechargeable energy sources along with necessary starting aids. The engine is capable of operating for at least 5 min after starting from cold with the lifeboat out of the water. Suitable arrangements are provided for ahead and astern propulsion. The engine is powered to move the lifeboat when proceeding ahead in calm water at a speed of at least 6 knots, when loaded with its full complement of persons and equipment. Further it is able to tow a 25-person loaded liferaft at 2 knots. Fuel is provided for continuous operation of engine for at least 24 hours.

**2) Parts of engine**

| | |
|---|---|
| 1. Gearbox Lever | 17. Coolant Outlet |
| 2. Air Inlet Damper | 18. Exhaust Outlet |
| 3. Heater plug | 19. Turbocharger |
| 4. Sump Oil Drain Pump | 20. Coolant Filler Cap |
| 5. Oil Filler Cap, Valve Cover | 21. Header Tank |
| 6. Jacket Heater Mounting | 22. Relay box |
| 7. Fuel Return to Tank | 23. Coolant Inlet |
| 8. Alternator | 24. Stop Lever |
| 9. Shaft Extension | 25. Stop Solenoid |
| 10. Gearbox | 26. Oil Filler Cap, Crankcase Door |
| 11. Fresh Water Pump | 27. Fuel supply |
| 12. Thermostat housing | 28. Fuel Lift Pump |
| 13. Exhaust manifold | 29. Fuel Filter |
| 14. Lubricating Oil Filter | 30. Gearbox Oil Drain Plug |
| 15. Starter Motor | 31. Gearbox |
| 16. Dipstick | |




### 3) General precautions related to engine operation

- ❖ Ensure that the engine is securely mounted.
- ❖ Ensure that the ventilation and combustion air ducts are not obstructed.
- ❖ Keep the engine and surrounding areas clean.
- ❖ Avoid contact with exhaust pipe when the engine is, or has recently been running. These parts can be very hot and can cause severe burns.
- ❖ Isolate the battery when working on the engine.
- ❖ All drive belts must receive regular attention.
- ❖ Keep electrical contacts free from corrosion etc. by smearing them with petroleum jelly.
- ❖ Batteries under charge release explosive gases, therefore the battery compartment must be well ventilated at all times. Never allow any smoking, sparks or flames near the batteries.
- ❖ Wear protective goggles when handling liquids which are harmful to the eyes, for ex. battery acid. If any of these substances are splashed in the eyes, wash out thoroughly with clean water.
- ❖ Never allow any part of the body to come into contact with high pressure fuel oil when testing injection equipment.
- ❖ Rectify all fuel, water and oil leaks as soon as possible.

### 4) General maintenance requirements

- ❖ Life boat engines maintenance schedule given in manufacturer's instruction manual should be followed and if required it should be modified to time bound schedule.

- ❖ Check and tighten all hose clamps and unions, paying particular attention to the fuel system. Check and tighten all external nuts and bolts, particularly mounting bolts, shaft coupling bolts and exhaust manifold bolts and nuts.
- ❖ Poor engine idling is often due to the engine being left on tick over or low revolutions for too long, thus oiling up the plugs. If it is not possible to increase revolutions, occasionally the gear shall be changed to neutral and ‘revolutions up’ to prevent oiling.
- ❖ The lifeboat engine starting procedure is to be posted clearly next to the engine. The requirements demand the engine should be capable of starting at an ambient temperature of $-15^{o}$C within 2 min of commencing the start procedure. Same is to be tested for starting every week. Especially designed ceramic or fire proof heater may be used to keep engine warm in cold climate.
- ❖ SOLAS requires: “the engine should be run weekly ahead and astern for a total period of not less than 3 min provided the ambient temperature is above the minimum temperature required for starting the engine”.
- ❖ If provided with sea water cooling arrangement the engine should not be run outside the water for very long. If fitted with fresh water cooling system then antifreeze levels are to be maintained at the correct levels during cold weather periods.
- ❖ Short movements may be given to check propeller movement in ahead and astern direction. Too long movements outside water must be avoided as these may damage the shaft bush.
- ❖ The fuel tank must always be kept topped up. SOLAS requires “Sufficient fuel, suitable for use throughout the temperature range expected in the area in which the ship operates, shall be provided to run the fully loaded lifeboat at 6 knots for a period of not less than 24hrs”. Additional fuel in portable cans must be kept handy at a suitable place (safe from fire hazard) and carried to the boat in emergency.
- ❖ While topping up engine fuel tank MDO supplied as diesel bunkers should not be used. Only HSD capable of cold start must be used. Vessels trading in cold weather conditions shall use only ‘Winter Grade Gas Oil’. As an alternative, vessels may carry a low temperature fuel additive which can be added to HSD. Tests carried out on board should determine temperature when waxing occurs.
- ❖ Where battery start is provided, the alternative source of starting is to be tested at least once a month. The battery, starter / dynamo, and the charger are to be maintained in good working order at all times. The battery log is to be maintained for charge and density of the electrolyte.
- ❖ Always maintain sufficient spares for the lifeboat engine, i.e. valve, piston, rings and bearings etc.

**5) Weekly checks and maintenance**

> The lubrication oil level should always be checked before starting. The level should never be allowed to fall below lower mark. Note that the marks indicate correct level when the engine has approximate horizontal position. The marks should be corrected according to

- ❖ Check coolant level.
- ❖ Check / top-up fuel oil tank
- ❖ Check / top-up crank case oil.
- ❖ Check / top-up gear box oil
- ❖ Drain water and contaminants from water separator.
- ❖ Check the condition of propeller. Look for dents on the blades.
- ❖ Check the condition of the fuel tank and supply line for corrosion. Special attention must be paid to the underside of the tank.
- ❖ Run lifeboat engines and rescue boat engines ahead and astern for a period of not less than 3 minutes. The engine should be capable of working for at least 5 minutes when boat is outside the water. The running should be limited to 5 minutes at idle speed. The water temperature alarm should be watched.

### 6) Quarterly checks and maintenance

- Engines must be tried for operation when boats are lowered into water, at least once every 3 months. The following must be checked:
  - Ensure that Pump of a water cooled engine, is working when LB is in water.
  - Check the Fuel Filter is clean and not damaged.
  - There are no exhaust system leaks (especially in enclosed lifeboats).
  - The exhaust pipe has means of preventing ingress of water.
  - The exhaust and its lagging runs clear of the bilge water area. Exhaust lagging should be clean, dry and provide suitable protection.
  - Bilges are kept dry and clear of oil. Rectify all oil or diesel leaks immediately.
  - Check V belt, dynamo and Starter motor.
- Check gearbox oil level.
- Check battery condition.
- Check condition of stern gland and propeller shaft bearings. Apply grease as required.
- Any starting trouble or any other malfunction in the engines should be rectified immediately.
- Check that any paint used on engines, manifold and exhaust does not give off fumes when it is heated.

### 7) Annual checks and maintenance

- Following Annual maintenance is recommended:
  - Renew engine oil and the Fuel Filters.
  - Check the valve clearance.
  - Check injectors of the LB engines.
  - Renew Engine crankcase oil and propeller shaft gear case oil
- Grease remote control parts.
- Check alternator belt tension.
- Check block heater and manifold heater plug.
- Check electrical connections for tightness and corrosion.

### 8) Some common maintenance procedures

Listed below are the common maintenance procedures related to the lifeboat engines of a typical make. The specific user's manual shall be followed for boat specific engine make.

- Changing lubrication oil
- Gearbox oil check and change
- Coolant level check
- Changing fuel oil filter
- Fuel water separator
- Priming the fuel system
- Battery check

### 9) Troubleshooting in specific situations

- The engine shall start easily at -15°C, and an engine block heater is usually a part of the equipment. The engine heater should always be energised in environments where the temperature is -15°C or lower. Engine manual shall be referred for troubleshooting in cases of experiencing difficulty in starting or in case of observing excessive carbon deposits, frequent engine stops, loss of engine power, over-heating, or when engine fails to be stopped.

### 10) Engines on rescue boats and fast rescue boats

- Fast rescue boats may be fitted with inboard diesel engine or outboard petrol engine. Sufficient fuel should be provided in fully loaded rescue boats for at least 4 hours running at 6 knots. In the case of high speed rescue boats, sufficient fuel should be provided to meet the increased consumption associated with the higher speeds involved.

- When a petrol driven outboard motor is fitted, it should be of an approved type. The motor is fitted with the usual controls for hand starting, stopping, regulating speed and going astern. It is made spray proof and as far as practicable waterproof. The motor exhaust is kept below the water line. Primary hand starting is either manual automatic rewind system or a pull cord round the top flywheel of the motor.
- Where an outboard motor is fitted, a small quantity of spare petrol, about 100 litres, may be carried if it is stored in suitable containers in a specially constructed, well ventilated compartment situated in a safe place sited whenever possible on the open deck. Warning notices should clearly indicate the contents of the compartment and smoking should not be permitted in the vicinity. The warning notice may contain instructions to jettison the petrol containers overboard in case of shipboard fire in the vicinity of the store.
- Any petrol fuel tank shall be checked adequately protected against fire and explosion and separate from the engine. Provision made for sealing the air vent when the tank is not in use shall be checked to prevent spillage of fuel.
- The fuel pipe is made of suitable non-metallic material and its end connections are self-sealing. Provision is made for shutting off the fuel at the engine. Completed fuel tanks and their connections are designed capable of withstanding hydraulic pressure corresponding to a head of at least 4.5 metres above the top of the tank.
- A kit of spare parts and tools shall be provided and checked. Water resistant instructions for starting and operating the engine should be provided and mounted in a conspicuous place near the engine starting controls.

**Apply Your Knowledge**

1. Identify various parts of the engine and checks prior starting the engines.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Operate lifesaving appliances

**Task number:** C 4.1

**Sub-task Reference number:** C4.1.22

**Topic:** Lifesaving appliances (LSA)

**Task Heading**

- Assist the crew with inspection and overhaul of a davit winch.

**Objectives**

- To understand the procedures for carrying out maintenance and inspection of survival craft davit winches.

**Index**

1) Davit winches
2) General requirements regarding survival craft winches
3) General precautions while carrying out winch inspection and maintenance
4) Winch inspections and maintenance
5) Winch inspection/ maintenance - process
6) Winch brake mechanism
7) Winch gear mechanism

**Description**

**1) Davit winches**

- The lifeboats davits are designed to launch the lifeboat by gravity, without requiring any connection with the ship's power supply. However to operate in the recovery mode to pick up the lifeboat/ rescue boat these are provided with winches which operate pneumatically or electrically. For lowering the lifeboat, usually a brake handle is provided which when lifted releases the brake holding the winch drums where the fall wires are rove.

- Each lifeboat winch consists of:
- ❖ drums for coiling the fall wire ropes in two layers
- ❖ gearbox for transferring the load to motor and brake and connection to the foundation
- ❖ centrifugal brakes
- ❖ holding brake
- ❖ full set of limit switches
- ❖ crank handle for manual operation
- ❖ hydraulic/pneumatic or electric motor

**2) General requirements regarding survival craft winches**

- In the case of a multiple drum winch, unless an efficient compensatory device is fitted, the falls are so arranged to wind off the drums at the same rate when lowering, and to wind on the drums evenly at the same angle when hoisting. The lead blocks are arranged to give a fleet angle or angle of lead of not more than 5° for grooved drums and 3° for un-grooved drums. In the case of mechanically controlled single-arm davits, the lead of the wire rope fall shall be such that the fall winds evenly on the drum.

- Winch brakes are required to be of robust construction and be capable of controlling and limiting the speed a boat is lowered. The hand brake is so arranged that it is normally in the "ON" position and returns to the "ON" position when the control handle is not being operated.

- The mass of the brake lever is made sufficient to operate the brake effectively without additional pressure. The winch brakes are made of sufficient strength to withstand –

- ❖ a static test with a proof load of not less than 1.5 times the maximum working load
- ❖ a dynamic test with a proof load of not less than 1.1 times the maximum working load at maximum lowering speed

- The brake gear of the winch includes the means for automatically controlling the speed of lowering. A ratchet gear may be incorporated in these winches.
- Hand gear handles are required to be non-rotating by moving parts of the winch when the lifeboat or rescue boat is being lowered or when it is being hoisted by power. Provision is made to allow the falls to be manually unwound.
- The launching mechanism is so arranged that it may be actuated by one person from a position on the ship's deck and, except for secondary launching appliances for free-fall lifeboats, from a position within the survival craft or rescue boat. When launched by a person on the deck, the launching and recovery arrangements are such that the winch operator on the ship's deck is able to observe the craft at all times during launching and recovery.

**3) General precautions while carrying out winch inspection and maintenance**

- The setting and maintenance of release gear are critical operations with regard to maintaining the safe operation of the lifeboat and the safety of personnel in the lifeboat. All inspection and maintenance operations on this equipment should therefore be carried out with the utmost care. No maintenance or adjustment of the release gear should be undertaken while the hooks are under load.
- Risk assessment may be required as per company SMS procedures prior carrying out any such operations.
- The release gear is to be examined prior to its operational test. The release gear is to be re-examined after its operational test and the dynamic winch brake test.
- Special consideration should be given to ensure that no damage has occurred during the winch brake test, especially to the hook closure and its fastening.
- Hanging-off pennants may be used for this purpose but should not remain connected at other times, such as when the lifeboat is normally stowed and during training exercises.
- The boat/ craft shall be adequately secured along with the davits prior undertaking maintenance and overhaul of the winch.
- Any inspection, servicing and repair should be carried out according to the system for inspection and services developed by the manufacturer.
- A full set of maintenance manuals and associated documentation issued by the manufacturer is available on board for use in all operations involved in the inspection, maintenance, adjustment and re-setting of the lifeboat and associated equipment, such as davits and release gear.

### 4) Winch inspections and maintenance

- Survival craft winch inspections and maintenance shall be carried out as follows:
  - As per manufacturer's recommendations - maintained in accordance with instructions for on-board maintenance - conducted by ships personnel
  - Annual thorough examination - conducted by manufacturers representative or person trained & certified by the manufacturer
  - Annual dynamic test of winch brake - Conducted by manufacturers representative or person trained & certified by the manufacturer.
  - Five yearly dynamic test of winch brake - Conducted by manufacturers representative or person trained & certified by the manufacturer and witnessed by class surveyor.

- Winch inspection and maintenance involves inspection and maintenance of following items:
  - Winch brake mechanism
  - Winch gear mechanism
  - Winch gear box oil change
  - Winch foundation
  - Winch crank handle interlocks
  - Remote control system
  - Power supply system
  - Angles / clearances of "dead mans" brake levers to be checked upon reassembly

- On completion of an inspection or overhaul, a dynamic winch brake test is conducted - with or without load - to ensure operational readiness. Classification surveyors, ship's officers and crew are assured that this system fully complies with manufacturer's recommendations and operating parameters. An official checklist and certification is issued after supervised testing is completed.

### 5) Winch inspection/ maintenance process

- Prior carrying out any winch maintenance the lifeboat and davit is safely secured in position as discussed above. It shall be ensured that there is no load on the boat falls. Winch brake system is then inspected by opening brake removing the brake case. The tolerances, damages and cracks in brake discs are checked.

- Gearbox oil is checked for oil quantity, any discoloration, presence of moisture etc. The casing is checked for any leakages and damages. The gear oil usually replaced once a year. Drain plug is provided usually under the winch gear box for drawing the gear oil.

- Inside the gear box, the gear teeth state is checked along with the bush, bearing and the oil seal. Checks are made for any signs of cracking or damages.

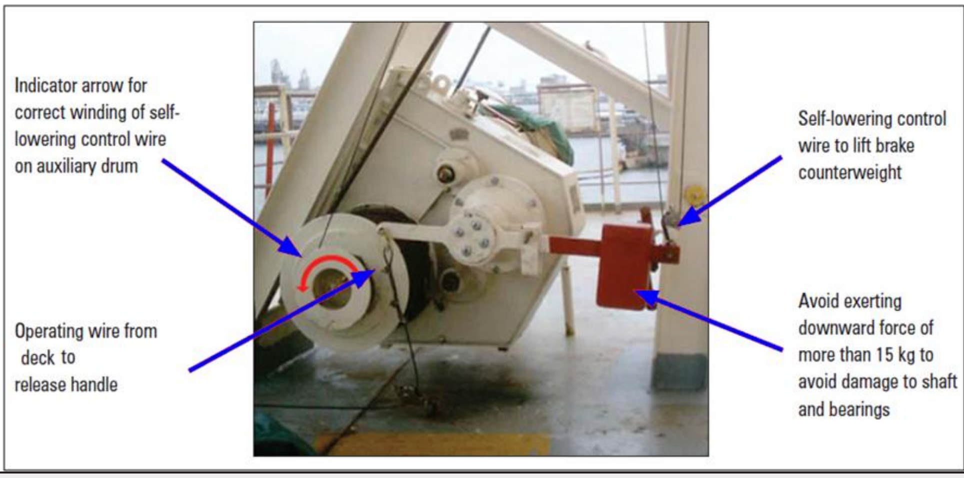
- Additionally the hand cranking lever and cranking over-locks are tested and checked for the operation of winch. Crank handle cut out switch shall also be checked for operation.

- The release system of wire and pulleys for releasing the boat from within the boat is also checked and greased as required. The wire shall be in sound condition, of suitable length, correctly rove and shall have smooth operation.

- The general condition of the winch and the foundation is checked for any signs of corrosion etc.

- Having completed above checks and procedures, the brakes and other fittings are re-assembled. Davit brake function is then tested by lowering the empty boat. Before and during this process the limit switches are tried out. The boat is subsequently heaved back and boat and davit safely secured.

- Brake is opened again then and checked for damage. Overall condition of davit is checked again for stress damages

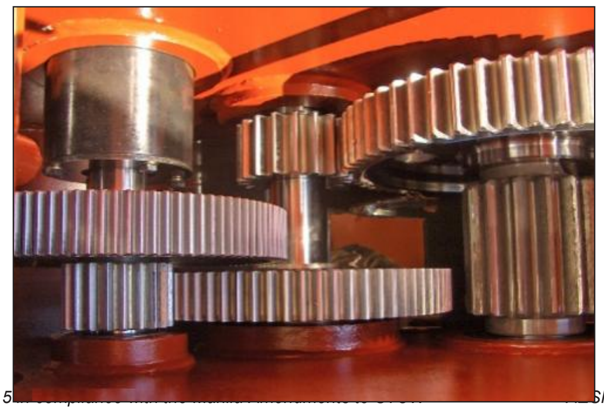



**Dynamic Winch Brake Test**

- ❖ Annual operational testing is done by lowering the empty boat.
- ❖ When the boat has reached its maximum lowering speed and before the boat enters the water, the brake is abruptly applied.
- ❖ The five-year operational test is done by lowering the boat loaded to a proof load equal to 1.1 times the weight of the survival craft or rescue boat and its full complement of persons and equipment, or equivalent load. When the boat has reached its maximum lowering speed and before the boat enters the water, the brake is abruptly applied.
- ❖ Following these tests, the brake pads and stressed structural parts should be re-inspected.
- ❖ In loading the boat for this test, precautions should be taken to ensure that the stability of the boat is not adversely affected by free surface effects or the raising of the centre of gravity.
- ❖ Every free-fall lifeboat is free-fall launched every 5 years loaded to a proof load equal to 1.1 times the weight of the free-fall boat and its full complement of persons and equipment.
- ❖ If the boat is launched unmanned without use of its own release system, the release system has to be load- tested separately.

### 6) Winch brake mechanism

- ➢ Two brakes are fitted on the winch. Both brakes act on the same shaft, which is also the shaft on which the hand cranking lever is fitted for manual operation. The shaft is geared to the main wire drum and rotates when this drum moves, both when hoisting and lowering. Both brakes are enclosed in a common housing.
- ➢ One brake is of centrifugal type which automatically limits the lowering speed of the winch. The brakes' shaft also rotates when hoisting but, because this happens at a much lower speed than when lowering, the centrifugal brake does not influence the process.
- ➢ The second brake is normally referred to as a gravity brake, largely because it's external operating lever is fitted with a heavy weight having the effect of applying the brake by gravity. This brake is released by raising the lever, so allowing the winch to lower the boat under gravity, with the speed of lowering controlled by the centrifugal brake. Releasing this lever at any stage while the winch is lowering will normally stop the operation. Braking forces are generated between the external surface of the brake drum and the friction lining of the brake shoe of the gravity brake. This lining is on the inner curved surface of the shoe.



### 7) Winch gear mechanism

- The winch operates with a system of gears which relay the power from the motor (pneumatic/ electric) to the winch. The gear mechanism requires periodic lubrication to maintain proper function. It is important to use premium grade 2 lithium based bearing grease with moly-disulfide. The grease fitting is usually located on the back of the gear housing and mates with a standard adapter on a grease gun. The grease shall be injected until it comes out either the main shaft bushing or the input hex drive shaft bushing.
- Additionally the gear assembly will normally be operating in a sealed box fitted with lubricating oil, in which case the quantity and the quality of gear oil is checked.

### Apply Your Knowledge

1. Read the user's manual for the lifeboat and rescue boat davit winches and discuss the maintenance and overhaul procedures.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Apply medical first aid on board ship

**Task number:** C 5.2

**Sub-task Reference number:** C5.2.1, C5.2.2, C5.2.3, C5.2.4, C5.2.5, C5.2.6, C5.2.7, C5.2.8

**Topic:** Basic understanding of first aid principles and treatment for burns, scalds, fractures, shock, heat stroke and hypothermia.

**Task Heading**

- Participate in a first aid drill
- Demonstrate knowledge of first aid procedures for arresting the bleeding of a casualty, cardiopulmonary resuscitation, and treatment of suffocation and drowning
- Demonstrate procedures for treatment of burns and scalds
- Demonstrate procedures for treatment of minor fractures
- Demonstrate handling a casualty in shock
- Demonstrate procedures for dealing with a casualty from electric shock
- Demonstrate procedures for dealing with heat stroke
- Demonstrate procedures for treating casualty with hypothermia including placing the casualty in recovery position

**Objectives**

- Understand the objectives and procedures of administering first aid in case of medical emergencies on board

**Index**

1) First aid drill
2) General principles of first aid
3) Cardio Pulmonary Resuscitation (CPR)
4) Bleeding
5) Suffocation (Asphyxia)
6) Drowning
7) Shock
8) Electrocution and electrical burns
9) Wounds
10) Burns and scalds
11) Fractures
12) Effects of high temperatures
13) Effects of low temperatures

**Description**

**1) First aid drill**

First aid drills shall be conducted on board at regular intervals as per company SMS procedures. The drill involves practicing procedures for dealing with a medical casualty, defining teams and individual roles, procedures of providing first aid and medical care, seeking radio medical advice, record keeping, reporting and evidence collection. All members on board shall be aware of the basic first aid procedures.

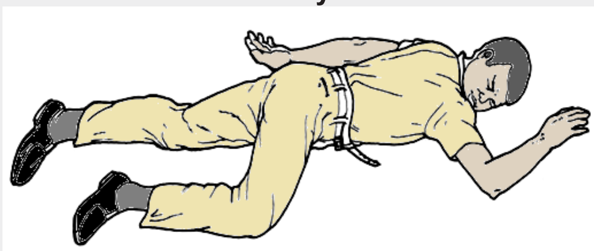
**2) General principles of first aid**

- A rapid examination of the patient shall be done to assess responsiveness and the extent of the injury. Once it has been established that there is no immediate threat to life there will be time to take stock of the situation. Reassurance and quick and effective attention to injuries and compassionate treatment of the injured person will alleviate his condition. A calm and systematic approach should be adopted. The casualty shall be protected from heat or cold.

➢ The following signs indicate serious injuries and shall be carefully and promptly attended to.
- ❖ unconsciousness
- ❖ suspected internal bleeding
- ❖ possible fractures
- ❖ stab or puncture wounds
- ❖ wounds near joints
- ❖ eye injuries

➢ Check for ABC – Airway, Breathing, Circulation (pulse)
- ❖ if breathing has stopped, artificial respiration needs to be given
- ❖ if the heart has stopped, cardiac compression and artificial respiration shall be followed
- ❖ any serious bleeding shall be immediately arrested

**The Recovery Position**



Unconscious patients who are breathing and whose heart is beating should be placed in the Recovery Position. It ensures open airway, avoiding falling back of tongue. Further, in this position, head and neck remain extended so air passage becomes widened and any vomit or fluid in the casualty's mouth drains clearly.
- ✓ Place the casualty in the unconscious or recovery position as shown in figure above. No pillows should be used under the head.
- ✓ Pull up the leg and the arm on the side to which the head is facing, pull up the chin.
- ✓ Stretch other arm out as above.

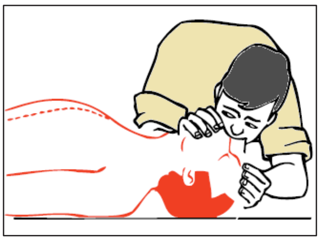
➢ The patient shall be handled gently and moved as little and as possible so as to prevent further injuries and shock. Bleeding should be arrested, fractures immobilized and shock treated. Shock can be a great danger to life and all attempts shall be made to prevent this. Splints, bandages etc. may need to be improvised for immediate use. The patient shall be put in the most comfortable position possible and any tight clothing loosened to facilitate breathing. Any clothing covering the injured part shall be removed gently or cut. However, clothing involved in burn shall not be removed. The casualty shall be not be surrounded by crowd. Liquor in any form shall never be rendered to the casualty. Necessary manpower and equipment shall be used for transporting the casualty.

**3) Cardio – Pulmonary Resuscitation (CPR)**

➢ The first step when a person falls unconscious is checking whether the person is breathing and if there is pulse. Any of the two missing is followed by the other. In case of such an observation where the pulse or breathing is found to be missing, following procedure for first aid shall be followed:

It takes just 4 to 6 minutes for a person to die when the heart has stopped pumping and the blood circulation to the brain is lost.

- ❖ Check for signs of breathing visually (movements of the chest and abdomen), by listening (ear over the mouth and nose) or feeling.
- ❖ Note the colour of face and lips if normal or blue/grey tinge.
- ❖ If the casualty is observed to be breathing, place the casualty in the unconscious or recovery position.
- ❖ If the casualty is observed not breathing, lay the casualty flat on his back. Open the airway by making sure that the head is tilted back whilst lifting the chin upwards and forwards which will move the tongue forward and clear the airway.



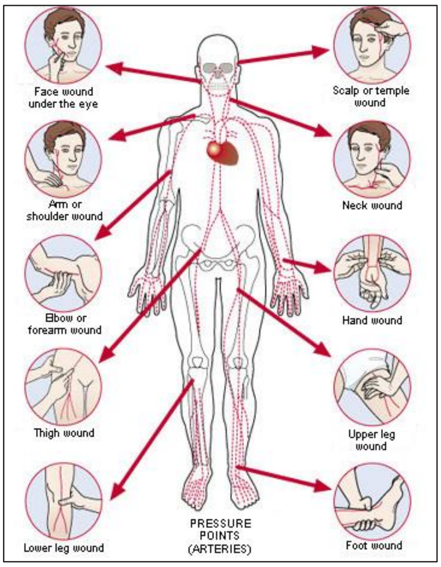
- ❖ Open the mouth and mop out any obvious obstructions such as vomit etc. using a clean piece of cloth or fingers. Remove the broken or displaced dentures if worn.
- ❖ Following above, the casualty may gasp and start to breathe

naturally. If still no breathing is observed artificial respiration shall be started. This can be done by mouth to mouth, mouth to nose or by artificial respirator. Air shall be blown into his mouth until the chest is seen rising. This takes about 2 seconds for full inflation. Having given two to four effective quick inflations, the colour of the face and lips shall be checked if improving. The normal respiratory rate is 14 – 18 / min. Artificial ventilation should be given so as to achieve the same rate. Rise of the chest may not be seen and indicates obstructed airway, Improper sealing of mouth, improper / inadequate exhalation of air into the lungs or improper position of the patient. If there is improvement artificial respiration shall be continued at a rate of about a dozen inflations each minute.

- ❖ If there is no improvement pulse and heart beat shall be checked. If no heart beat is felt, the heart has stopped. A trained first-aider shall administer chest compression then. Casualty shall be laid on his back on a hard surface. The hands are placed on the chest as shown in the picture and compressions of half second duration shall be applied firmly, around 100 times a minute. The compressions shall be applied on the middle of the lower half of the breastbone sufficient to produce a downward movement of about 4 cm.
- ❖ Artificial respiration shall be combined with heart compressions giving heart compression, compressing 15 times and then filling the lungs with air twice. When two people are available the combination shall be one giving heart compression and the other giving artificial respiration, at a ratio of 5 chest compressions to 1 lung inflation.
- ❖ Heart compression shall be stopped as soon as the heart beat/ pulse is felt but artificial respiration shall be continued until natural breathing is restored. Once the person is observed breathing naturally, he shall be transferred to the stretcher in the recovery position and moved to ship's hospital for further nursing care.

**4) Bleeding**

- ➢ Uncontrolled escape of blood form blood vessels in the body is called bleeding. Bleeding occurs whenever a blood vessel is cut, crushed or torn. This can take place within the body when any of the internal organs are affected or through an external wound or cut. Internal bleeding is considered more dangerous as it may go unnoticed for a long period without showing any prominent signs. Excessive bleeding is followed by fall in blood pressure, weak pulse, blurring vision, clouding of consciousness, fainting, shock and subsequent death. Bleeding can be of three types –




- ❖ Arterial Bleeding – bright red blood at pressure
- ❖ Bleeding from veins – dark red colour blood gushing out
- ❖ Capillary bleeding – blood oozing out at comparatively lesser pressure

- ➢ Seeing **external bleeding**, the first aid involves immediate measures to arrest the bleeding. This is achieved by applying direct pressure on the cut or wound for around 10 minutes. In case of large incision wounds, the sides of the wounds shall be squeezed together. The effected part shall further be raised to reduce the pressure of blood flowing out. This facilitates clotting of blood in the wound area. Once the bleeding is stopped, the wound shall be cleaned with antiseptic solutions and suitable dressing applied as required.

- **Arterial bleeding** cannot be arrested by applying pressure and requires and indirect pressure whereby the pressure is applied at appropriate pressure points. An artery is compressed at appropriate pressure points against an underlying bone. This will stop the blood flow in the artery beyond this point. The indirect pressure blocks the blood flow and hence cannot be continued for a long duration as the organ beyond the pressure point might be affected. Hence this indirect pressure shall be released intermittently after around every 5 minutes. For applying indirect pressure, tourniquets may be used and meanwhile the casualty shall be sent to the nearest shore facility. If at sea, Radio medical advice shall further be sought.

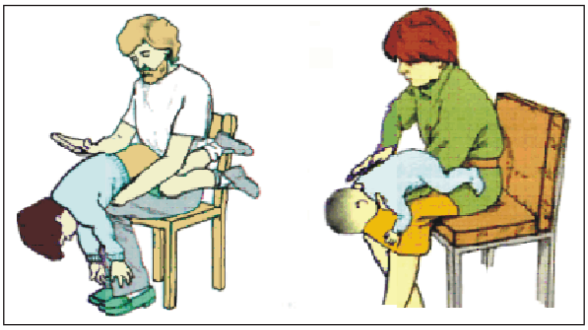
- **Internal bleeding** may be caused due to an internal injury to any of the organs when hit or stabbed, due to a disease such as peptic ulcer or may be due to poison of snake bite. Blood may be observed to be coming out or ear, nose, mouth or rectum. In addition to observations as stated above, the person might feel pain and tenderness around the affected area along with swelling & tension. Injuries caused by greater force will result, in addition to bruising, in the formation of a collection of blood within the deeper tissues called a haematoma. This though not life threatening, causes painful swelling of the affected part.

- Internal Bleeding from injury to internal organs is always very serious and may quickly endanger life. Such bleeding is always concealed and its presence has to be deduced from the history of the injury, a rising pulse rate and the signs and symptoms of shock which occur rapidly. Radio Medical advice shall be sought in such cases at the earliest.

> Suffocation due to gases or smoke is likely to occur in the enclosed spaces. The Casualty shall be brought to open decks as soon as possible. Entry shall NOT be made into the enclosed space for rescue without taking proper precautions. It shall be remembered that dangerous gases may not have smell to warn.

### 5) Suffocation (Asphyxia)

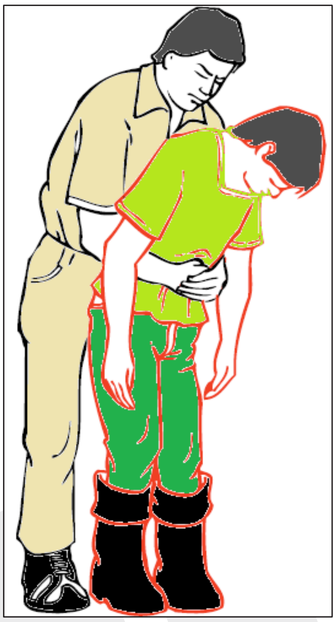
- Suffocation is usually caused by gases, smoke or may be caused by chocking.
- Asphyxia may be caused because of any of the following reasons:



- Pressure on the windpipe or lungs from outside; this can occur in a case of hanging, throttling or strangulation.
- Inhalation of poisonous gases (for example CO, $CO_2$, $H_2S$)
- Swelling of the wind-pipe or bronchioles in the case of Bronchial Asthma
- Obstruction in the wind-pipe such as a coin or a marble swallowed by a child, or food particles such as a piece of chicken bone
- Water entering the wind-pipe and the lungs in case of drowning

- Symptoms and signs of asphyxia are difficulty in breathing, increase in the rate and depth of breathing, blueness of face, lips and fingernails (cyanosis), increase in heart rate, lowering of consciousness, prominence of neck veins, and convulsions.

- The casualty shall be brought into the fresh air and artificial respiration started if not breathing.CPR may be required if the heart stops. Radio Medical Advice shall be sought as required.



- When breathing is restored, the casualty shall be placed in the recovery position.
- **Choking** is usually caused by a large lump of food or other obstruction which may be stuck at the back of the throat. A person who is choking cannot speak or breathe and may soon lose consciousness. 'Heimlich sign' (grasping the neck between two palms) is a visual signal that a person may use to indicate chocking.
- In order to clear the chocking following procedures may be used.
- ❖ Firm slaps on the back, between the shoulder
- ❖ Heimlich maneuver - Sudden and sharp upward thrusts into the casualty's abdomen as shown in the picture

### 6) Drowning

The person shall be brought out of water as soon as possible. The casualty shall be checked for breathing. The patient's face should be turned down to one side and his arms stretched above his head. The water should be drained out of the lungs by raising the middle part of the body. If breathing is missing, artificial respiration and or CPR as required shall be administered. The wet clothes should be removed and the person should be kept warm by covering with a blanket taking precautions for hypothermia.

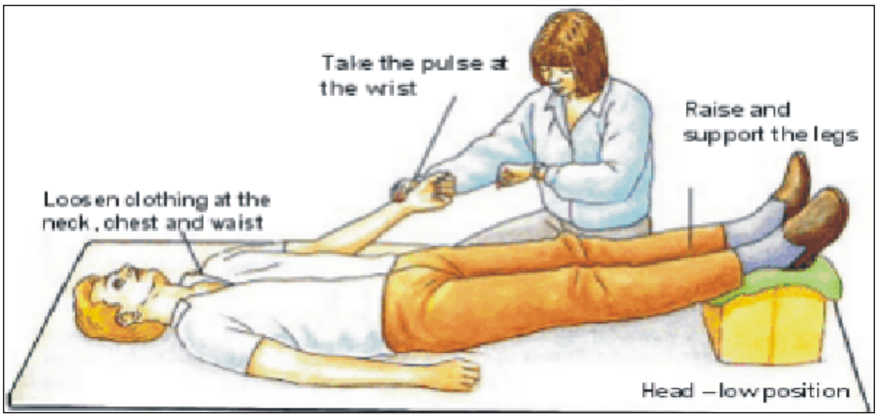
### 7) Shock

- Shock occurs when the body's parts are deprived of oxygen enriched blood. If untreated, the body's vital organs (brain, heart, lungs, and kidneys) can fail, leading to collapse, unconsciousness and eventually death. Shock usually follows from severe injuries such as extensive burns, major crushing injuries, fractures of large bones, and other extensive or extremely painful injuries, poisoning from drugs, gases, and other chemicals. Fear, pain and exposure to cold make shock worse. Severe shock seriously threatens the life of the patient.
- The commonest cause is loss of body fluid from the circulation resulting from external or internal bleeding. The first-aider should always be on the look-out for this condition as it can develop even while the casualty is under close observation.

- Symptoms
- ❖ Pale, cold and often moist skin
- ❖ Rapid and shallow, respirations or irregular and deep breathing
- ❖ Thirst, nausea, and vomiting
- ❖ Weak and rapid pulse, usually over 100bts\min
- ❖ Restlessness, excitement and anxiety followed by mental dullness and subsequent unconsciousness

- First aid
- ❖ Eliminate the causes of shock by controlling bleeding, restoring breathing and relieving severe pain. Keep the patient warm.
- ❖ Injured person shall be made to lie down in a horizontal position with legs elevated approximately 30 cms to assist the flow of blood to the heart and head. However, legs should not be elevated if there is injury to the head, pelvis, spine or chest or difficulty in breathing.
- ❖ Relieve pain as quickly as possible.

- Administer fluids but nothing by mouth if the patient is unconsciousness, drowsy, convulsing or if there is a puncture or crush wound to the abdomen, or a brain injury.




**8) Electrocution and electrical burns**

- The passage of an electrical current through the body may injure the person and cause breathing and heart to stop. The current may cause burns both where it enters the body and where it leaves the body to earth. An alternating current in addition causes muscle spasm and often prevents the casualty from letting go of the power source. A high voltage is usually immediately fatal. Electrical shock may throw the casualty to some distance causing other physical injuries like fractures.
- The rescuer shall not become the next casualty when approaching any person who is in contact with electricity. If possible, switch off the current. Otherwise insulate self before approaching and touching the casualty, by using rubber gloves, wearing rubber boots, or standing on an insulating rubber mat. Rain and drizzle deteriorate insulation.
- Electrical lines shall be removed from the casualty with a wooden pole, an insulated cord or other non-metal object. However, materials such as dry wood or clothing will not protect from a high voltage source and electrical disconnection becomes a must.
- Once clear of power source, the casualty shall be checked for breathing and heartbeat. In case missing artificial respiration and CPR shall be followed. When the casualty is breathing, cool any burnt areas with cold water and apply a clean, dry, non-fluffy covering to these areas. The treatment for electrical burns is the same as thermal burns. It includes relief of pain, prevention and treatment of shock and control of infection. Electrical burns may be followed by paralysis of the respiratory centre, unconsciousness and instant death.


**9) Wounds**

- **Types of wounds** – based on the type how the wound is caused, these may be classified as follows:

- Abrasions (Grazes)
- Incised wounds
- Lacerations
- Punctures
- Bites
- Gun shot

- A wound at any site in the body poses three **problems**:
- Loss of blood by bleeding
- Shock
- Developing infection

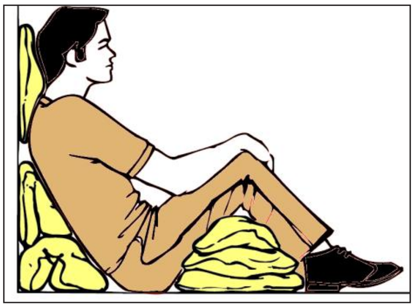
- **First aid for wounds**
- Never wash the wound – except in cases of an animal bite
- Never try to remove pieces of metal or glass from a wound unless they are superficial and can be easily lifted out. If pieces can be removed, these shall be removed by grasping the material with sterile gauze or using sterile forceps
- Do not pour antiseptic into a wound; antiseptics are to be used only for cleaning of superficial wounds and surroundings.
- As soon as possible, cover the wound with a suitable dressing after cleaning; the wound may require additional procedures such as suturing etc.

- **Chest wounds**

  Chest provides a sealed chamber for lungs to operate. A superficial chest wound should be treated as for any wound elsewhere. A penetrating wound (a sucking wound) caused by a puncture of the chest must be sealed immediately, otherwise air is drawn into the chest cavity and the lungs cannot inflate as the vacuum inside the chest is destroyed. A dressing for a sucking wound can be made from a paraffin gauze dressing. Place the paraffin gauze over the wound, smooth the foil on to the chest wall and seal three edges only with zinc oxide adhesive plaster. If nothing else is available, casualty's own bloodstained clothing can be used to plug the wound temporarily. The aim is to prevent air entering the chest but to allow it to escape if necessary. The usual rules about stopping bleeding by pressing where the blood comes from also apply. This is discussed under the header arterial bleeding. Start a pulse chart soon to check on possible internal bleeding in all chest injuries. The respiratory rate should also be recorded. Conscious casualties should be placed in the half-sitting-up position because breathing is easier in this position. Radio Medical advice shall be sought at the earliest.

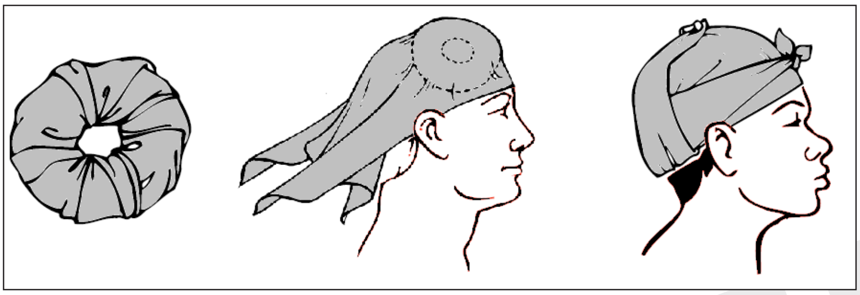
- **Abdominal wounds**

  Abdomen contains number of organs of digestive system and urinary system. A superficial abdominal wound requires the same treatment as any wound. Where the abdominal cover is broken the first aid requires special procedures. If the abdominal contents do not protrude, the wound shall be covered with a large standard dressing and the casualty shall be placed in the half-sitting-up position. In this position the wound will not gape open. As the abdominal muscles are slack, the abdominal contents will not bulge through further. If the wound runs more or less vertically, it may be best to lay the man flat. If the abdominal contents do protrude through the wound, NO attempt shall be made to put them back in. Cover with a loosely applied large standard dressing or dressings until further treatment can be given. Shock will develop quickly and should be treated as described later. Nothing shall be given by mouth. If thirsty, the lips should be moistened. Radio medical advice shall be sought at the earliest.



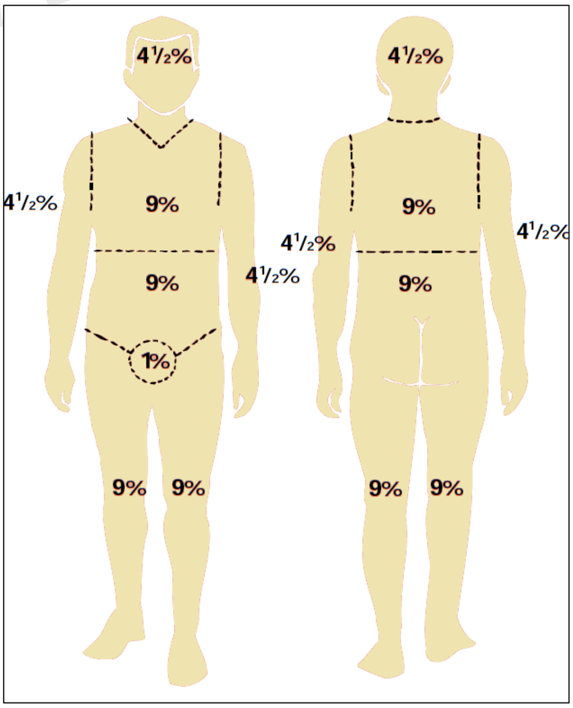
- **Head wounds**

Scalp wounds often bleed briskly. The wound itself should be treated in the same way as any other wound. A firm bandage transmitting the necessary pressure to the pad will usually arrest the bleeding. Firm pressure by the fingers over the pad for a few minutes before it is finally fixed in position will help to stop the bleeding. There are three key indicators of brain injury level of consciousness, pupil size and reaction to light, and signs of paralysis down one side of the body. Bloodstained or sticky clear fluid that trickles from the ear or drips from the nose or both eyes of the casualty slowly turning black due to internal bleeding from skull are signs of internal skull fracture. The possibility of brain damage is of greater importance and radio medical advice shall be sought at the earliest.



- **Face and jaw wounds**
  There is likelihood of suffocation as a result of blood running into the throat. The casualty shall be laid flat in the unconscious position with the more damaged side towards the lower side. With severe wounds there may be loss of the power of speech. When there has been a severe blow to a jaw, especially if the jaw is broken, there may be complications caused by broken dentures, by the loss of teeth and by wounds to gums, the lips, the tongue and the inside and outside of the mouth. For external wounds to the cheek and lips treatment is as for any skin wound. For wounds inside the mouth the casualty shall first rinse his mouth well with antiseptic mouthwash which would further help remove any loose fragments. Pieces of tooth from the gum shall not be extracted forcibly. Further no attempt should be made for suturing deep wounds of the cheek and tongue and serious bleeding should be controlled by pressure. If a jaw is or may be broken the upper and lower jaws should be held together by a bandage with, as far as possible, the upper and lower teeth fitting together as they normally do. If the patient has dentures which still fit adequately he should wear them. Radio medical advice shall be sought for further medication and treatment.

- **Palm of the hand wounds**
  A deep wound of the palm of the hand may cut the large artery in this area. In such cases the bleeding shall be stopped by pressing the appropriate pressure point. The wound shall be covered with a sterile gauze dressing. The pressure to arrest the bleeding may be applied by grasping firmly on a rolled-up 7.5 cm bandage.




**10) Burns and scalds**

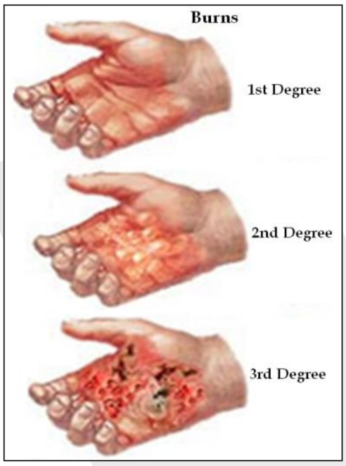
- Seeing a person on fire the immediate action required is to extinguish the fire. This can be done as follows:
  - Using a dry powder fire extinguisher (Any powder which gets in the eye should be washed out immediately after the fire has been extinguished)
  - Laying down and rolling the person on floor and smothering the flames by wrapping him in any available natural fibre

cloth or blanket

- ❖ Throwing buckets of water over the fire

**Area of burn – the rule of nines**
The percentage of burn is calculated as shown in picture.
In children (not babies) the percentage for the head should be doubled and 1%taken off the other areas.

- ➢ Heat burns and scalds are best treated by immersing in cold water. Cooling of extensive burns (>15%) should be avoided for reasons of hypothermia. If it is not possible to cool the burn on the spot, the casualty should be taken to where cooling can be carried out. The clothing shall be removed gently without tearing off whatever is adhering to the skin. The burnt areas shall then be covered with a dry, non-fluffy, dressing which is larger than the burns.
- ➢ In case of chemical splashes the contaminated clothing shall be removed at the earliest and the effected part shall be drenched with water to wash the chemical away. Eyes if affected shall be given priority.
- ➢ **Classification of burns**




- ❖ Skin has an outer layer called epidermis which is the top cover. Underneath lies a deep layer dermis which contains the sweat glands, hair follicles and nerves relaying sensation and pain to the skin. A burn is a wound in which there is a coagulative necrosis of the tissues.
- ❖ First degree burns - when only the outer skin layer is affected; Symptoms - redness, mild swelling, tenderness and pain
- ❖ Second degree burns – when burn extends into dermis; Symptoms - partial skin loss, deep reddening, blister formation, considerable swelling, and weeping of fluid, pain may be severe
- ❖ Third degree burns – when burn involves whole thickness of skin, and may extend to the underlying fat, muscle and bone; Symptoms - whole skin loss, skin may be charred, black or dark brown, leathery or white according to the cause of the burn, usually pain is absent

- ➢ **Complications associated with burns**
- ❖ The complications associated with burns are
  - ✓ Burn shock(Burns involving more than 10% body surface area in a child and 15% in an adult can lead to shock)
  - ✓ Dehydration
  - ✓ Anemia
  - ✓ Infection
  - ✓ Loss of circulating blood
  - ✓ Renal failure
- ❖ The fluid lost in burns is the colorless liquid part of the blood (plasma). The degree of fluid loss may be determined more by the area of the burn than by its depth; the greater the plasma loss, the more severe the degree of shock. Further, due to loss of plasma, the remaining blood is ‘thicker’, and more difficult to pump round the body, throwing extra strain on the heart. Fluid balance shall be tried to achieve by encouraging the patient to drink water or fruit juice. Rehydration powder shall be mixed in the drink. If vomiting occurs and persists, fluid per rectum may be necessary.

- ➢ **First aid**
- ❖ The following casualties of burns require stringent procedures for treatment and care
  - ✓ third degree burns, especially those which encircle chest or limbs
  - ✓ burns of face and genitalia, and large burns around joints
  - ✓ burns of over 18% of the body surface in adults or 10% in children or older persons

- ✓ burns on babies

- ❖ Burns need to be cleaned and covered suitably with sterile dressings along with antibiotic treatment. If suitably maintained in sterile condition, superficial second degree burns usually heal in a week to ten days without scarring. Deeper second degree should heal with little scarring in about three weeks. The burn shall be cleaned around the edges with soap, water and pads, cleaning away from the burn in every direction. Cotton wool or other linty material which is likely to leave bits in the burn shall NOT be used. Blisters shall be left intact. All the dead skin shall be clipped off where blisters have burst. For cleaning, flood the area with clean warm boiled water from a clean receptacle to remove debris. Alternatively, soak a pad in warm boiled water to dab gently at any remaining dirt or foreign matter in the burned area. This will inevitably cause pain. Having cleaned the burn, it shall be covered with the paraffin gauze dressing, overlapping the burn or scald by 50–100 mm, according to its size. To absorb any fluid leaking from the burn a covering of absorbent material such as a layer of sterile gauze, covered with a layer of sterile cotton wool shall be applied. This is held in place by a suitable bandage. The dressing shall be changed if it becomes smelly or very dirty or if the temperature is raised. Antibiotic treatment shall be administered in accordance with radio medical advice.

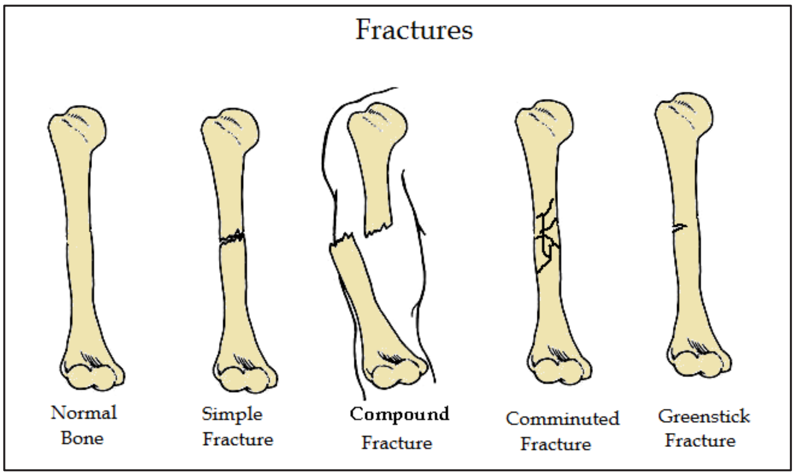
- ➢ **Respiratory burns** are caused by the inhalation of hot gases and air particles, and smoke. Symptoms include burns around the mouth, nose, face, hair and neck. A mild injury to the respiratory passage may have only a cough, hoarseness, or a sore throat but more severe cases may involve marked shortness of breath, persistent coughing, wheezing and hoarseness, swollen throat and/ or partial collapse of lungs. Radio medical advice shall be sought at the earliest.

**11) Fractures**

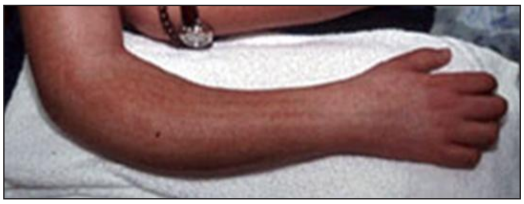
A breach in the continuity of the bone is called fracture.

- ❖ Fractures can be caused by
  - ✓ Direct force - the bone fractured directly below the point of injury / force
  - ✓ Indirect force - the bone is fractured away from the point of application of injury. The applied force is transmitted through the bones and fractures and fractures at a much further site. For example a fall on outstretched hand results in fracture of collar bone.
  - ✓ Muscular contraction - Sudden, vigorous, powerful contraction of quadriceps (thigh muscle) may cause fracture of knee cap.

- ❖ Types of fractures
  - ✓ Simple/ closed fracture
  - ✓ Compound/ open fracture
  - ✓ Complicated fracture
  - ✓ Comminuted fracture
  - ✓ Greenstick fracture



❖ Symptoms
Pain at the site of injury, swelling/ bruising of injured part, tenderness (pain on gentle pressure) over affected area, snap of bone felt/ heard, deformity at the site of fracture, restriction of movement, rapid and weak pulse, falling blood pressure, distortion or irregularity, unnatural movement and grating of bone ends



❖ First aid
- ✓ Bleeding shall be controlled from open wound. Checks shall be made for internal bleeding.
- ✓ The fractures bone shall be supported and immobilized at the earliest. Any splints used for supports or immobilizing shall be suitably padded. Hard splints tightly affixed are likely to cause further wounds.
- ✓ The casualty shall be moved to a comfortable position.
- ✓ The wound shall be cleaned and dressed and medication provided in accordance with radio medical advice. Pain killers shall be administered in accordance with radio medical advice.
- ✓ Check shall be done for blood circulation in the fractured limb. This can be caused by too tight a dressing or clothing or any other reason. Circulation can be checked by seeing the colour of the limb beyond the fracture as turning blue or absence of pulse. In such cases, the dressing and/ or any tight clothing shall immediately be slackened.

➢ **Immobilizing fractures at different locations**
A limb shall be immobilized in the position in which it is found, if it is comfortable. If it does become necessary to move an injured limb, because of poor circulation or for any other reason, first apply traction by pulling the limb gently and firmly away from the body before attempting to move it. Keep pulling until it has been securely immobilized and then release the traction very slowly. Sudden release can cause pain.

➢ **Spine and neck fracture**

❖ The spine carries the spinal cord from the brain to the hips. A fracture in the spine results in damage to the spinal cord. Depending upon the level of injury and extent of damage, the body below the injury is paralysed. A spine fracture at neck level is likely to leave the casualty paralysed by all four limbs.

❖ Wherever any spine damage is suspected the casualty shall be handled with utmost care. Any small movement of spine or distortion is likely to cause further damage to the spinal cord. The casualty shall be moved least only when required. Radio medical advice shall be sought on urgent basis for further treatment.

➢ **Skull fractures**

❖ A skull fracture can be diagnosed by signs such as depression in the skull and presence of bony fragments in the wound on head. Linear fractures of the skull are less obvious and normally only diagnosed on x-rays. Base of skull fractures are the result of indirect force which is transmitted to the base of the skull from a heavy blow to the vault, from blows to the face or jaw or when the casualty falls from a height and lands on his feet. They can be diagnosed by signs such as leaking cerebro-spinal fluid (bloodstained or sticky clear fluid) from the ears or nose, black eyes caused due to bleeding appearing around both eyes.

❖ First aid
An open wound shall be covered to prevent infection. DO NOT poke around in scalp wounds, press over the wound, or try to remove fragments of bone from scalp wounds. Carefully clean the wound and surrounding scalp by irrigating the area with sterile saline

water. Hair should not be allowed to enter the wound. Radio Medical Advice shall be sought at the earliest for further treatment.

- **Dislocations**

- A displacement of a bone from its socket is called dislocation. The commonly affected sites are jaw, shoulder, elbow and ball of thumb.

- Symptoms
  Pain, tenderness, swelling, loss of power, deformity, irregularity, shortening or lengthening of limbs, emptiness of socket

- First aid
  Dislocations can be closed or open. A fracture may also be present and attempted manipulation to reduce the dislocation in these circumstances can make matters worse. Do not attempt to reduce a dislocation. The dislocated part shall be treated in the same manner as fracture.

- **Sprains and strains**

- Sprains and strains are usually the result of twisting, turning or tripping. Pain is usually felt and swelling at the site of injury may follow. It is not usually feasible to differentiate sprains from fractures without x-rays.

- First aid
  As a precautionary measure these shall be treated with a possibility of hidden fracture within. The injured limb shall be elevated. Cold water compresses shall be used to relieve pain. Rest and elevation shall be provided as necessary. Radio medical advice shall be sought for medication. If improvement is observed indicating absence of any fracture, gentle movement of the injured part should be encouraged.

**12) Effects of high temperatures**

Maintaining an ideal body temperature (irrespective of environmental changes) is essential for varies body functions. The human body has Hypothalamus for this function. Normal body temperature is 98.4°F or 37°C.When the ambient temperature is above 32$^{o}$C in very humid climates, or above 43$^{o}$C in dry air, there is a risk of heat illness; heat exhaustion, heat cramps or heat strokes. As a preventive measure for protection from effects of high temperature, outdoor activity during excessive heat shall be avoided. Plenty of fluids shall be drunk when working outdoors, but NO liquor. During outdoor activity, body shall be kept cool by splashing water frequently if possible. Light weight, light- colored, loose-fitting clothes and sun glasses and hat shall be worn. It is recommended that about 4.5 liters of water should be consumed each day. For work in high temperatures, the requirement may rise to 6-7 litres. Vessels trading regularly in hot climates shall carry additional salt tablets. Workers shall work in pairs, when possible, so that the partner can monitor the other and obtain help quickly in emergency.

- **Heat cramps**
- Caused due to raised environmental temperature profuse sweating resulting in excessive loss of salt;
- Symptoms - severe, agonizing cramps involving skeletal muscles especially calves and limb abdomen and chest.
- First aid- shift the patient in the cool environment, consumption of extra fluid with salt

- **Heat syncope**
- Caused due to excessive heat and humidity, loss of vasomotor tone, fainting spells
- Symptoms - patient shows pallor, sweating hypotension and unconsciousness
- First Aid- shift the patient in the cool environment, render fluids

- **Heat exhaustion**
- Marked dehydration with loss of water and vital body salts

- Symptoms - Extreme thirst, headache, weakness, vertigo, fainting spell, increased Pulse over 90/ min, Hypotension patient may develop fever less urine output.
- First Aid- shift the patient in the cool environment, Replenish fluid and salt orally if patient conscious

- **Heat stroke**
- Failure of heat regulator mechanism of body where in heat gain is more than heat loss, body temperature rises to more than 104°F,may lead to damage of liver, kidney and brain,
- Symptoms - Feeling hot, restlessness, high temperature, flushed face with dry skin, headache, rapid / shallow breathing
- First Aid - shift the patient in the cool environment, cool the person by sponging with wet towel, remove tight clothes, place in recovery position

- **Sunburn**

  For sunburn, the patient shall be brought out of the sun and calamine lotion or zinc ointment may be applied to the painful areas. Severe sunburn with blistering should be treated as a second degree burn according to the area of the body involved.

**13) Effects of low temperatures**

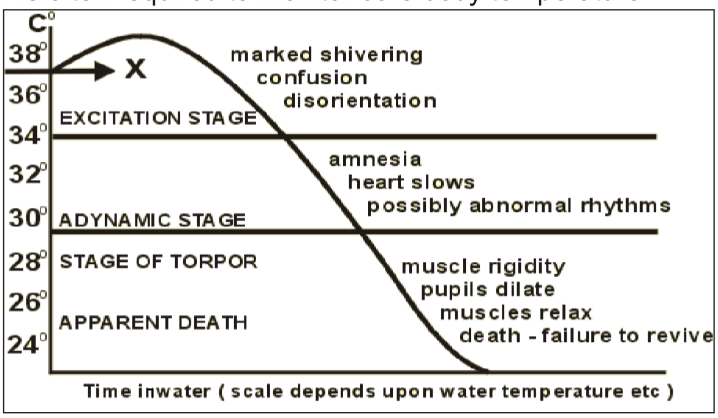
Hypothermia, Frost Bite and Chilblains/ Trench Foot are likely to be caused when the body is not suitably protected from temperature loss. These are likely to occur in freezing air temperatures or immersion in cold water. Drink plenty of fluids, preferably warm sweet beverages (thirst is suppressed in cold climate which could result in de-hydration with reduced fluid intake). Increase caloric intake by 10 to 15% more.

- **Hypothermia**

- Hypothermia is the condition when body core temperature is lowered to less than 35ºC. At and below this temperature normal body functions are impaired and loss of life may occur when the body core temperature falls below 30ºC.

- In a cold environment body heat production automatically increases in order to balance heat loss, but if the rate of heat loss exceeds the rate of heat production then body temperature falls resulting in hypothermia. The rate of heat loss is more pronounced when wet than in dryness. Hypothermia can cause death in less than an hour.

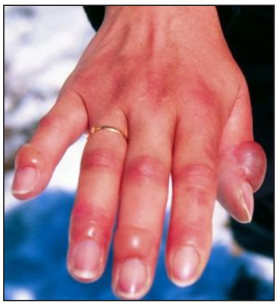
- Symptoms –The gradual sequence of observations is as follows - marked shivering, disorientation, confusion, amnesia, possibly abnormal rhythms, heart slows, muscle rigidity, muscles relax, pupils dilate, death – failure to revive; a low reading rectal thermometer is often required to monitor core body temperature.




- First aid –The person shall be removed from cold environment at the earliest and shifted to warm environment of room temperature not exceeding 22°C. Wet clothing shall be removed and the person shall be covered in dry warm clothing and blankets. It is important that the head is well covered. Warming shall be gradual as rapid warming may lead to collapsing. Warm sweet drinks shall be served to conscious person. If breathing and/or pulse is missing, artificial respiration and/or CPR shall be followed as required.

Liquor shall NOT be served at all. In more serious cases, where the survivor is unconscious or appears apparently dead, slow re-warming is essential. Rapid re-warming by immersion in a hot bath shall NOT be attempted.

- **Frost bite**



- Freezing of tissue fluids due to exposure to freezing temperatures causes slowing and subsequent stoppage of blood flow. Body parts most likely to be affected are nose, ears, hands and feet.
- Symptoms - Extreme waxy pallor of the skin, hard, white, numb patches on exposed skin followed by subsequent blistering & blackening; The depth of tissue damage can be graded, like burns, into 1st degree (frost nip), 2nd degree,3rd degree and 4th degree.
- First aid - As a precautionary measure warm clothing, masks gloves, socks and shoes shall be worn in cold climate. The period of exposure to exposed parts shall be reduced. Affected part wrapped lightly in cotton wool. Constrictions such as rings or watches shall be removed and the affected limb shall be placed in WARM water (100ºF to 112ºF). The affected part shall not be rubbed and the blisters if formed shall not be broken. The person shall not smoke as smoking reduced blood supply to hands and feet. If the skin is observed to be black, radio medical advice shall be sought.

- **Immersion foot**

- Likely to occur when feet have been immersed in cold water for prolonged periods, such as sitting in a survival craft, legs lying wet and immobile for long.
- Symptoms - Numbness, pale skin, painful swelling, blisters and ulcers in the immersed portion of feet.
- First aid – As a precautionary measure, effort should be made to keep their feet warm and dry. Shoe laces should be loosened; the feet should be raised and toe and ankle exercises encouraged several times a day. For treatment, feet shall be removed from water and wrapped lightly in cotton wool. Rapid re-warming shall not be done. Radio Medical Advice shall be taken for further treatment in case blisters are observed.

**Apply Your Knowledge**

1. The junior engineer informs the bridge that an oiler has suffered serious burns in the engine room. The second officer wants you to start giving him first aid immediately. How would you go about treating him?
2. Locate the medicine chest of the vessel and the company specific list of medicines and equipment required to be carried on board your vessel.
3. Discuss the importance of maintaining the medicine inventory and procedure for storage, use and disposal of medicines.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Monitor compliance with legislative requirements

**Task number:** C 6.1

**Sub-task Reference number:** C6.1.7

**Topic:** Familiarize with various statutory regulations and requirements

**Task Heading**

- Recognize the importance of keeping records for all events.

**Objectives**

- Understand the importance of record keeping at sea and records required to be maintained.

**Index**

1) Introduction
2) Records to be maintained
3) Books used for record keeping

**Description**

**1) Introduction**

> Ship's logs supplemented with suitable photographs, as applicable, serve as vital evidences in cases of casualties and claims.

- At sea, the losses may occur which need not necessarily be caused by faults of ship staff. This could be extreme weather conditions, the navigational fault of other vessel or the pilot or any extraordinary conditions beyond control. In such cases, the ship owner is held liable unless it is proved that due diligence was exercised by ship staff and precautions were taken to prevent/minimize the loss. Amongst all evidences, ship's records play a vital role. Improper or insufficient records put the ship owner at risk of being held liable.

**2) Records to be maintained**

- Regulation V/28 of the 1974 SOLAS convention requires all ships engaged on international voyages to keep on board a record of navigational activities and incidents which are of importance to safety of navigation and which must contain sufficient detail to restore a complete record of the voyage. The ship's records of various operations, tests and maintenance procedures are checked during routine surveys, audits and in cases of investigations for casualties.
- In order to be able to restore a complete record of the voyage, records are maintained as follows:
  - Each page of the ship's log-book has a page number printed on it.
  - Handwritten records which need correction are not erased or removed but are rewritten after crossing out the incorrect version.
  - The times used in automatic and permanent recording facilities shall be synchronized by using a common clock.
  - Electronically or mechanically input records shall be protected by means to prevent them from being deleted, destroyed or overwritten.
  - Irrespective of the method of recording, ships should keep records for as long as at least last one year or more as specified in company procedures.
- The following events and items shall be recorded as appropriate.
  - Before commencement of voyage
    Details of all data relating to the general condition of the ship including the following

- ✓ manning and provisioning
- ✓ cargo aboard, quantity and lashing
- ✓ draught
- ✓ result of stability/stress checks when conducted
- ✓ inspections of controls for
  - the steering gear
  - navigational and radio communication equipment
  - engines and machinery

❖ During the voyage
Details related to the voyage shall be recorded which include
- ✓ courses steered and distances sailed
- ✓ position fixes
- ✓ weather and sea conditions
- ✓ cargo checks, lashing checks and ventilation
- ✓ changes to the voyage plan
- ✓ details of pilots' embarkation/disembarkation
- ✓ entry into areas covered by ship routeing or reporting systems
- ✓ compliance with ship routeing or reporting systems

❖ Records of special events
Details on special events such as
- ✓ death and injuries among passengers and crew
- ✓ malfunctions of shipboard equipment and aids to navigation
- ✓ potentially hazardous situations
- ✓ hazardous incidents / occurrences
- ✓ emergencies and distress messages received

❖ Additionally while at anchorage or in port
- ✓ Details on operational or administrative matters
- ✓ details related to the safety and security of the ship

➢ In addition to above the following shall be recorded as and when appropriate

❖ Record shall be maintained mentioning the dates when musters are held, details of abandon ship drills and fire drills, drills of other life-saving appliances and dates of on board training. If a full muster, drill or training session is not held at the appointed time, an entry shall be made in the log-book stating the circumstances and the extent of the muster, drill or training session held.

❖ Record shall be maintained for on-board maintenance of life-saving appliances, firefighting appliances, navigational equipment, and other deck/engine equipment as per the planned maintenance schedule.

❖ Record shall be maintained on board for the work and rest hours of watch-keepers and other seafarers.

❖ As required by the radio regulations, record shall be maintained, of all incidents connected with the radio communication service which appear to be of importance to safety of life at sea.

❖ Ship's draught shall be checked regularly during loading or unloading. Each draught and tonnage observation shall be recorded in a cargo log-book. On completion of loading of the ship and prior to its departure, the ship's trim shall be checked and stability ascertained and it shall be recorded that the ship is in compliance with stability criteria in the relevant regulations.

❖ Opening and closing time of the watertight doors, ramps and openings shall be recorded in the deck log.

❖ On passenger ships the information about all passengers such as their name, age, gender and any passenger with special needs shall be recorded.

- Records of navigational activities shall be maintained in the ship's log-book or in another form approved by the local administration. Methods of recording should be permanent and may be handwritten, electronic or mechanical.
- In general, information on the events and items adequately recorded in a special-purpose log need not be duplicated in the ship's log book.
- The records shall be maintained in English or the language of flag state. The shipping company or the master, as appropriate, shall determine the appropriate working language for the vessel. The language adopted as working language shall be recorded in the ship's log-book.
- A detailed list of records and files/ registers to be maintained is provided in the company specific SMS procedures which shall be followed.

**3) Books used for record keeping**

- Books used for record keeping are
  - Deck log book
  - Movement book
  - Official log book
  - Chart correction log
  - Radar log
  - GPS log
  - VHF log
  - Controls testing and pilot cards file
  - Passage plan register/ file
  - GMDSS log
  - Weather reports log
  - Bridge equipment/ radio equipment maintenance register
  - Emergency drills record
  - Ship's medical Log
  - Cargo record book
  - Ship's stability and stress calculations log
  - Ballast log
  - Gangway register
  - LSA/FFA maintenance register
  - Deck Machinery maintenance register
  - Chain register
  - Planned maintenance schedule register
  - Engine room machinery tests/ maintenance register
  - Oil record book
  - Garbage record book
- The electronic devices which automatically record data in electronic form or in the form of print out are listed below. Printouts wherever generated shall be kept in record files.
  - Echo-sounder
  - Course recorder
  - Barograph
  - ECDIS
  - Engine telegraph data logger
  - Voyage data recorder
  - Navtex and EGC reports
  - Ship's loadicator
  - ODMCS
  - Inert gas pressure/ oxygen content monitor
- Voyage data recorder is an electronic means for navigational record keeping of bridge. However, it is available only for a limited duration of 12hrs or more and is aimed only for

providing an additional record which will be helpful in investigations in case of a casualty. Having VDR installed on board does not relieve the ship of any other procedures of record keeping manual or automatic.

**Apply Your Knowledge**

1. List the records to be maintained when the vessel experiences heavy weather.
2. Discuss the procedures to be followed when vessel suffers cargo damage due to heavy weather.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Monitor compliance with legislative requirements

**Task number:** C 6.1

**Sub-task Reference number:** C6.1.8

**Topic:** Familiarize with various statutory regulations and requirements

**Task Heading**

- Read the objectives of ISM Code and discuss with STO.

**Objectives**

- Understand the objectives and procedures of implementation of ISM code

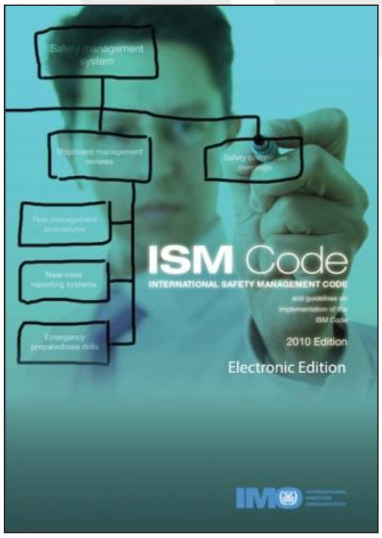
Please read this task in conjunction with task C6.1.2

**Index**



**Description**

**1) International Safety Management (ISM) code**




- The ISM code evolved through the development of the guidelines on management for the safe operation of ships and for pollution prevention, taking the form of "International Safety Management" (ISM) code in 1993. New chapter IX was added to SOLAS in 1994 making the compliance with ISM code mandatory for passenger ships, tankers, bulk carriers and cargo high speed craft from 1$^{st}$July 1998. Further amendments to this chapter in SOLAS made ISM code applicable to other cargo ships as well from 1$^{st}$ July 2002 onwards.

- The ISM code provides an international standard for the safe management and operation of ships and for pollution prevention. The effective implementation of ISM code greatly depends on continued commitment, competence, attitudes and motivation of individuals, at all levels, in the company and on board ships.

- The ISM code is drawn to support and encourage the development of a safety culture within the shipping industry whilst improving compliance with the requirements of international conventions with a systematic approach. The code points that good safety management requires commitment from the top management.

- The implementation of ISM code is carried out by establishment of a safety management system (SMS) by shipping company. The system is implemented ashore and on ships of the company. The system is then inspected and verified by classification societies authorized by local governments. The ship is certified for compliance by means of Safety Management Certificate (SMC) and the company by Document of Compliance (DOC). Further continued compliance is monitored by periodic internal/ external audits and regular port state control inspections.

- Safety Management System (SMS) is a structured and documented system enabling shipping company personnel to effectively implement the company's safety and environmental protection policy. The safety management system is drawn in compliance with mandatory rules, regulations, applicable codes, standards and guidelines.
- Document of Compliance (DOC) is the document issued to a company by the classification society when the company complies with the requirements of the ISM Code. DOC is issued to the shipping company when the shore side aspects of the safety management system are found to fully comply with the requirements of the ISM Code. The DOC is specific to the ship types operated by the company and for which the SMS is implemented at the time of the audit. A copy of the DOC is placed on board each of the company's ships.
- Safety Management Certificate (SMC) is the document issued to a ship which signifies that the shipping company and its shipboard management operate in accordance with the company's approved SMS. Subsequent to a successful audit a SMC is issued to each individual ship provided that the shipping company holds a valid DOC. The original SMC is placed on board and a copy is retained in the company's office records.

**2) Objectives of ISM code**

- The code aims to ensure safety at sea, prevention of human injury and loss of life, and avoidance of damage to the marine environment and property, the full process being coordinated by the shipping company.
- The code specifies the objectives that the shipping company shall focus upon in relation to safety management. These are
  - providing safe working environment on board its vessels and establish safe working practices
  - addressing all identified risks to its ships, personnel and the environment and establishing appropriate safeguards
  - continuously improving safety management skills of personnel ashore and aboard ships, including preparing for emergencies related both to safety and environmental protection

**3) Implementation of ISM code**

SMS sets the procedures for conduct of operations in a standard, safe and scheduled order. The system implements safety management by establishing:

- A safety and environmental-protection policy
- Standard procedures to ensure safe operation of ships and protection of the environment
- Levels of authority and lines of communication between and amongst, shore and shipboard personnel
- Procedures for identifying and reporting accidents and non-conformities
- Procedures to prepare for and respond to emergency situations/ contingency plans
- Procedures for audits, reviews and certification

- **Safety and environmental protection policy**

- In order to achieve the objectives as outlined in the ISM code, the shipping companies establish a safety and environment protection policy. This is in the form of a generalized statement identifying the goals to achieve and is implemented and maintained at all levels of the organization, both ship-based and shore-based. The company's policy statement is fundamental to the system and is examined during the document review.
- The policy statement is a clear and concise

> SMS lists the procedures to be followed mostly in the form of checklists. The reason being the SMS covers all the operations and effectiveness of implementing the SMS is likely to be affected by bulk of information and hence the principle of Keeping it Short and Simple (KISS) is followed.

statement emphasizing on the company's commitment to safety and the environment. It identifies a strategy by which the company aims to achieve its policy objectives and includes methods to encourage improvement in safety awareness and safety management skills. The policy is endorsed by the senior management of the company.

➢ **Standard procedures to ensure safe operation of ships and protection of the environment**

❖ SMS manuals specify the standard procedures for the shore management operations and ship's operations are to be conducted in efficient and safe manner. Copies of Shipboard SMS manuals are placed on board for quick reference. These are reviewed regularly and updated as required.

❖ Various tasks involved in key shipboard operations are identified and are assigned to qualified personnel. Checklists are provided for most of the operations. The safe procedures, checks and precautions related to each operation are listed. The procedures also include the additional precautions that will be required with respect to special hazards for example navigation in restricted visibility. The operations include
✓ Bridge procedures, navigation, voyage planning and watchkeeping
✓ Engine room watchkeeping, bunkering and other engine room operations
✓ Cargo watchkeeping and deck operations

➢ **Planned maintenance schedule**

❖ The shipping company establishes procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations, manufacturer's instructions and with any additional requirements as may be established by the company.

❖ Procedures are established to ensure that maintenance, surveys, repairs and dry-docking are carried out in a planned and structured manner with safety as a priority. Suitably qualified personnel familiar with the maintenance requirements are assigned the responsibility for maintenance of specific equipments. Additional technical support is provided by the shore-side management team.

❖ Maintenance procedures provide specific work instructions to ensure the operation is carried out effectively and safely. These also mention the precautions that shall be observed for the operation such as isolation, depressurizing or blanking of the system etc.

❖ Procedures are further stated for keeping record of maintenance activities and reporting of any defects as observed.

❖ Additionally the equipment, machinery and systems failure of which may result in hazardous situations are identified as **'Critical Equipment'**. Procedures are mentioned to ensure reliability of these systems and the provision of alternative arrangements in the event of sudden failure. The procedures and the frequency for regular testing of stand-by systems is mentioned in order to ensure that one failure does not result in the total loss of that critical function.

➢ **Procedures to prepare for and respond to emergency situations/ contingency plans and emergency drills**

❖ SMS manuals on board further contain the procedures to respond to potential emergency shipboard situations. This is usually in the form of contingency plans and checklists.

❖ Contingency Plans mention the role and responsibilities of shore and ship personnel at the time of an emergency, their names and contact numbers, procedures to be followed in response to varying emergency scenarios, checklists for a range of emergencies and procedures for requesting emergency services from third parties. A database of ship's plans, particulars of vessels, emergency response capabilities, damage stability information and pollution prevention equipment is readily provided both on board and in shore office.

- ❖ Further the procedures and frequency of emergency drills for training are also provided in the SMS manuals.

- **Procedures for identifying and reporting accidents and non-conformities**
SMS follows the process of continuous review based on observations and hazardous occurrences. Specific procedures are mentioned for identifying and reporting accidents and non-conformities. Sample formats are drawn specifying the essential information required for suitable analysis. These shall be followed as and when an incident/ accident/ non-conformity is reported.

- **Levels of authority**
For effective implementation of SMS, ISM code requires the authorities and responsibilities to be defined clearly. This is documented in the SMS manuals.

❖ **Shipping company's responsibility**

- ✓ The shipping company develops the SMS systems to be used on board its vessels. The details of the responsible people ashore are mentioned in the SMS manual. Further details are provided of people responsible for coordinating the SMS procedures between the vessels and the shore office. The roles and responsibilities of each are specified in the SMS manual. Schematics or flowcharts are drawn to document lines of authority and inter-relations between roles.

- ✓ The shipping company holds the responsibility for manning the vessel with qualified and experienced master, officers and crew. The shipping company also sets in the procedures for the on board familiarization of all officers and crew with respect to ship, safety procedures and equipments and job familiarization.

- ✓ Company addresses the training needs of individuals, both ashore and onboard though refresher training courses and on the job experience and establishes procedures for the same. The shipping company shall also ensure that the crew on board is able to communicate effectively overcoming the linguistic barriers. The SMS manuals on board are developed in the language understood by all crew.

❖ **Designated Person Ashore (DPA)**

- ✓ DPA is a person designated in the shore office having direct access to the highest level of management. DPA acts as a quick link between the company and those on board. Designated person is suitably qualified and experienced in ship operations and management systems and is fully conversant with the company's safety and environmental protection policies and Safety Management System. He holds a key role in the monitoring process regarding implementation of the SMS. The role and responsibilities of the DPA have been discussed under task C6.1.2 which shall be referred to.

❖ **Master's responsibility**

The master is required to be fully conversant with the company SMS. The responsibility for implementing all relevant aspects of the company's SMS on their vessels lies with the Master. This includes implementing the safety and environmental-protection policy of the company on board, motivating the crew in the observation of that policy, issuing appropriate orders and instructions in a clear and simple manner, verifying that specified requirements are observed and reviewing the SMS and reporting its deficiencies to the shore based management.

> Master has the overriding authority to deviate from the documented system in time of crisis and seek assistance from the company if required. This statement is also documented in the SMS manuals.

❖ **Responsibilities of officers and crew**

The responsibilities of each officer and crew are mentioned in the shipboard SMS manual. These include the responsibilities in the job field as well as the responsibilities with regards to safety and environmental protection. Responsibilities are further mentioned regarding reporting the near misses and hazardous occurrences. The authority and reporting line is also mentioned in the SMS manuals.

❖ **Safety officers, safety management team and safety committee onboard**

✓ Usually the chief engineer and the chief officer are designated to act as safety officers on board for their respective departments. They are responsible to assist and advise the Master in implementation of the Shipboard SMS. The tasks of the safety officers include
- Enabling proper functioning of the ship's safety committee
- Enforce all safety and pollution prevention rules and regulations
- Anticipating safety concerns in their respective areas of responsibility
- Stop any work likely to cause a serious accident
- Take corrective action to eliminate unsafe practices
- Investigate accidents and near misses occurring on board
- Investigate all complaints made by shipboard personnel concerning safety

✓ Safety management team usually comprises of the master and other officers of the management level on board. Responsibilities of the safety management team include
- planning and carrying out unscheduled and planned maintenance on board
- carrying out routine inspections
- make out an action plan for all safety committee recommendations
- wherever required supplement instructions and procedures provided in shipboard SMS Manual with ship specific procedures
- follow up any incident with a prompt and thorough investigation

✓ The safety committee is the safety forum on board focusing on creating a safe and healthy working environment on board. The safety committee assists the safety officers to investigate near misses, accidents and hazardous occurrences occurring on board. The safety committee comprises of all department heads including representatives of crew. Safety committee meetings are conducted at regular intervals as specified in the SMS manuals. The meetings focus on
- Discussing findings of inspections of work places with a view to eradicate unsafe practices and implement corrective measures
- Investigation of causes of accidents and incidents and unsafe practices and proposal for preventive action to be taken
- Actions required to be taken for enhancing safety consciousness in ship's staff
- Suggestions received from ship's staff to improve safety standards on board
- Discussion of fleet circulars issued by the shipping company

➢ **Lines of communication between and amongst, shore and shipboard personnel**
- ❖ The SMS manuals specify the reporting lines of communication on board and in the shipping company.
- ❖ Procedures for communication between ship and shore are also specified.
- ❖ A list of names and contact numbers of all relevant parties to be contacted in case of contingencies is provided separately.
- ❖ In addition procedures are mentioned in case the next of kin of a crew member needs to be notified or where the master is required to communicate with the media.

**4) ISM certification process and audits**

➢ The first step whereby a company intends to implement ISM code is by initial audits. The shipping company's shore-based organization is audited for compliance with the requirements of the ISM code. Following the satisfactory completion of this audit an interim DOC is issued to the company. DOC is issued in respect of the types of ships operated by the company at the time of initial verification and for the type of ships they intend to operate in the near future and which are covered within the SMS. Interim DOC is valid for 12 months. The company will need to prove that measures are in place to implement the full requirements of the ISM Code within the period of validity of the Interim DOC.

➢ Having an interim DOC, the company has to ensure that key elements of the ISM Code have been included in the shipboard SMS and the same has been assessed during the audit of the company's SMS. The ship's master and officers shall be made familiar with the SMS and arrangements for its implementation and essential instructions shall be provided in the working language of ship prior to sailing. The shipping company shall carry out an internal audit of the ship within 3 months. The company's ship is then audited by classification society to verify compliance with the requirements of the ISM Code. During the period of validity of the Interim DOC the ships are issued an Interim SMC. An interim SMC is valid for 6 months.

- When sufficient objective evidence has been compiled to provide evidence that the SMS is effectively implemented in respect of the ship types, the company is audited again prior to the expiry of the interim DOC. Following a successful audit, interim DOC is withdrawn and full term DOC is issued. This is followed by auditing ship and issuing SMC to the ship as well.
- A DOC or SMC cannot be issued when a major non-conformity is raised.
- The DOC and SMC are valid for five years from the date of completion of the initial audit. A DOC is subject to annual verification by certifying authority conducted within ± 3 months of the anniversary date. SMC is subject to intermediate verification by certifying authority between the second and third anniversaries. Additionally annual internal safety audits are carried out in the company office and on board ships by the shipping company. The annual and intermediate audit should determine the effective functioning of the SMS and ensure that any amendments made since the previous verification comply with the requirements of the ISM Code.
- An Interim DOC is issued to facilitate initial implementation of the Code when
  - a company is newly established
  - new ship types are to be added to an existing DOC
- An Interim SMC is issued
  - to new ships on delivery
  - when a company takes on responsibility for the operation of a ship which is new to the company
  - when a ship changes flag
- **Renewal audits** - The audit for the renewal of a DOC or SMC are carried out within 3 months prior to the expiry date of the existing certificates. The renewal DOC or SMC audit includes assessment of all elements of the SMS relating to the ship and shore management addressing all sections of the ISM code and evaluate the effectiveness of the SMS in meeting the objectives of the ISM Code.

**5) Procedures for audits**

- Compliance with the requirements of the ISM Code are verified by audits and inspections checking if
  - the SMS meets the requirements and objectives of the ISM Code
  - the personnel are trained and familiar with the tasks for which they are responsible
  - the operations are conducted in accordance with the company's procedures with due regard to safety and environment protection.
- Safety management audit is a systematic and independent examination to determine whether the SMS activities and related results comply with planned arrangements, whether these arrangements are implemented effectively and whether they are suitable to achieve the objectives of the ISM Code. Auditing is a sampling process and the auditor may not identify all existing non-conformities.
- The objective of the audit is to verify that the SMS has been effectively implemented within the company's management structure both ashore and on board.

ISM code defines

**"Observation** means a statement of fact made during a safety management audit and substantiated by objective evidence." An observation requires follow up but it is not necessary to provide evidence of the corrective action taken for an Observation to the certifying authority.

**"Objective evidence** means quantitative or qualitative information, records or statements of fact pertaining to safety or to the existence and implementation of a SMS element, which is based on observation, measurement or test and which can be verified."

**"Non-conformity** means an observed situation where objective evidence indicates the non-fulfillment of a specified requirement of the ISM Code."Non-conformity shall be corrected by suitable follow up and should normally be closed out within three months from the date of the audit.

**"Major non-conformity** means an identifiable deviation which poses a serious threat to the safety of personnel or the ship or a serious risk to the environment that requires immediate corrective action and includes the lack of effective and systematic implementation of a requirement of this Code." A ship with a major non conformity is not allowed to sail. A major non-conformity on ship audits requires corrective action at least to a level of 'non-conformity' in order to allow the vessel to sail.
Where a major non-conformity is downgraded to non-conformity, at least one additional audit should be carried out within the time frame indicated in the agreed corrective action plan to verify that effective actions are taken.
Following an ISM audit, a copy of observations, non-conformities and major non-conformities are handed over to the vessel for follow up.

- SMC audits are carried out on board. The procedure is usually as follows:

- Opening meeting
- General inspection of vessel
- Document review – SMS manuals and other certificates
- Interview of master
- Interview of chief engineer
- Interview of chief officer
- Interviews of deck officer/deck crew, engineer officer/engine crew, cook/catering staff
- Assessment of shipboard operations and emergency preparedness
- Having completed above a list is prepared for observation and findings and non-conformities, if any, and the required follow-up
- Closing meeting
- An audit report is completed to record the audit findings within 15 days from the date of the audit. The audit report includes names of audit team members and names and ranks of auditees, an assessment of compliance with each relevant section of the ISM code, opening & closing meeting details, any non-conformities and observation raised and positive findings.
- The agreed corrective actions shall be completed by the agreed dates. Failure to correct non-conformities may affect the validity of SMC certificate.
- When a major non-conformity has been identified the DOC and SMC may be suspended or cancelled. In case where a DOC is suspended or cancelled, all SMCs associated with the DOC will likewise be invalidated rendering the ships liable to detention.

**6) Port state control inspections**

The role of port state control is to verify compliance of the ship with the international conventions. In this regard, port state control inspections check the vessel for the compliance with ISM code also. The inspection focuses on checking the DOC and SMC of the vessel and checking whether the crewmembers are familiar with the company safety and environmental protection policy. A vessel in the absence of SMC is not allowed to sail out. The absence of valid ISM certification might also lead to a ship being detained.

**Apply Your Knowledge**

1. Attend a safety committee meeting on board and discuss the minutes of the meeting.
2. Locate the DPA of your company and his contacts as provided in the SMS manuals.
3. Discuss the importance of planned maintenance.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Monitor compliance with legislative requirements

**Task number:** C 6.1

**Sub-task Reference number:** C6.1.9

**Topic:** Familiarize with various statutory regulations and requirements

**Task Heading**

- Check the contents of the ship's articles of agreement.

**Objectives**

- Know the seamen's articles of agreement

**Index**

1) Seamen's articles of agreement

**Description**

**1) Seamen's articles of agreement**

- International Labour Organization in year 1926 defined “Seamen's Articles of Agreement Convention”. All member countries follow the guidelines provided in this convention regarding employment of seafarers on the ships of their flag. Rules are made by local national law for implementation of the ILO convention.
- The ILO convention on seamen's articles of agreement has 23 articles covering the topic. The convention is to be followed by owners, ship managers, masters and seafarers. The ‘Articles of Agreement’ is an agreement of terms and conditions of employment between the employer and the seafarer and is established for the welfare of both.
- The articles of agreement are signed both by the ship owner or his representative and by the seaman. The agreement states clearly the respective rights and obligations of each of the parties.
- This agreement between employer/employer’s agent and the seafarer is subject to the condition that the seafarer will serve in capacity/rank on wages as indicated with other terms of employment and service conditions as per the relevant collective bargaining agreement sector-wise as applicable.
- By signing the articles of agreement, the seaman signs the agreement stating conditions under which seaman will be employed on board. The agreement may be made either for a definite period or for a voyage or, if permitted by national law, for an indefinite period from the date of the first signature.
- Every seaman is given a document [Continuous Discharge Certificate (CDC)] containing a record of his employment on board the vessel.
- The agreement mentions
  a) the surname and other names of the seaman, the date of his birth or his age, and his birthplace
  b) the place at which and date on which the agreement was signed
  c) the name of the vessel or vessels on board which the seaman undertakes to serve
  d) the number of the crew of the vessel, if required by national law
  e) the voyages to be undertaken, if this can be determined at the time of making the agreement
  f) the capacity in which the seaman is to be employed
  g) if possible, the place and date at which the seaman is required to report on board for service
  h) the scale of provisions to be supplied to the seaman

i) the amount of his wages
j) the conditions for termination of the agreement that is
- if the agreement has been made for a definite period, the date fixed for its expiry
- if the agreement has been made for a voyage, the port of destination and the time which has to expire after arrival before the seaman shall be discharged
- if the agreement has been made for an indefinite period, the conditions which shall entitle either party to rescind it, as well as the required period of notice for rescission

k) the annual leave with pay granted to the seaman after one year's service with the same shipping company, if such leave is provided for by national law
l) If national law provides that a list of crew shall be carried on board it shall specify that the agreement shall either be recorded in or annexed to the list of crew.

- If the agreement for an indefinite period is to be terminated by either party, at least 24 hours' notice is required while the vessel is in a port where the vessel loads or unloads. Notice shall be given in writing or as prescribed by national law. National law further advises the exceptional circumstances in which notice even when duly given shall not terminate the agreement.
- The agreement can further be terminated on mutual consent of the parties, if medical evidence indicates that a seaman is incapable of continuing to perform his duties by reason of illness or injury, or in case of death of the seaman, if a seaman is absent without leave at a time fixed for sailing, if in the opinion of the master continued employment of the seaman is likely to endanger the vessel or any person on board, loss or total un-seaworthiness of the vessel or any other cause that may be provided in national law.
- The agreement also defines the circumstances in which the owner or master may immediately discharge a seaman. Also the agreement defines the circumstances in which the seaman may demand his immediate discharge. The seaman shall be entitled to his wages up to the time of his leaving his employment.
- An entry is made in the seaman's book while he is discharged. Further he may request to obtain from the master a separate certificate as to the quality of his work or a certificate indicating whether he has fully discharged his obligations under the agreement.
- The copies of articles of agreement are provided to master on board the ship, seafarer, shipping master, employer/employer's agent, seamen's provident fund organization and seafarers' welfare fund society.

**Apply Your Knowledge**

1. Check the salient features of seaman's articles of agreement.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Monitor compliance with legislative requirements

**Task number:** C 6.1

**Sub-task Reference number:** C6.1.10

**Topic:** Familiarize with various statutory regulations and requirements

**Task Heading**

- Assist in making official log book entries.

**Objectives**

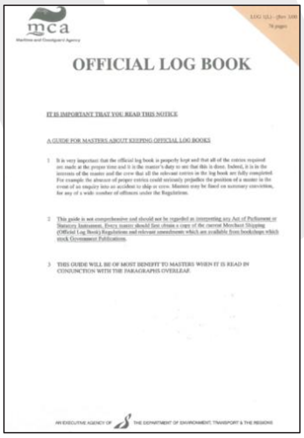
- Understand the importance and procedure of record keeping in official log books

**Index**

1) Official log book
2) Entries to be made in official log book

**Description**

**1) Official log book**




- Regulations in the national maritime law of the country where the ship is registered require the ship to maintain some specific records in a prescribed format. This is often called the “Official Log Book” (OLB) of the vessel.
- The official log book is maintained and retained in custody of master. This is usually maintained as a distinct book separate form any other log. This book serves as the legal document as required by national maritime law. If the book is not maintained as required, it may lead to penalties against shipmasters and their owners and cause inconvenience to the crew. The absence of proper entries also hinders the coordination of disciplinary actions on board.
- Entries are made in the official log book in the chronological order without leaving any blank spaces in between. In case an entry needs to be modified or deleted, it shall be neatly strike off by a single line and counter signed by the person modifying it. Erasing or use of white ink is not permitted.
- An entry in the official log book shall be made as soon as possible after the occurrence to which it relates usually within twenty-four hours of the occurrence.
- Any person willfully involved in destroying, mutilating or rendering illegible any entry in any official log book or willfully making a false or fraudulent entry or omitting a significant entry is held liable to punishment as prescribed by national maritime law which may include imprisonment.
- Every entry in the official log book shall be signed by the master and by the mate or some other member of the crew and additionally
    - by the medical officer on board, if any, in case of an entry relating to personal injury or death
    - by the mate and by some member of the crew besides the master in case of an entry relating to the property of a seaman or wages due for a deceased seaman
- The official logbook for the voyage is required to be delivered to the assigned authority (shipping master) of the country upon arrival usually within 48 hrs of arrival. Some flag states may require the completed book to be handed back to them. In cases where the

ship is being abandoned it is recommended to carry important documents and the official logbook which shall later be delivered to the assigned authority.

- Details of births/ deaths happening on board shall be submitted with the authority (directorate of shipping) as required by national law.

**2) Entries to be made in official log book**

- Entries to be made in official log book are listed by the national maritime law. These usually include
- details of change of Masters
- details of all officers and crewmembers on board
- details of any crewmember transferred from one ship to another
- cases whereby a crewmember is promoted to a higher grade of service with the date of such promotion, the grade and the rate of wages which the seaman is to receive
- cases of illness, hurt or injury happening to a crewmember with the nature thereof and the medical treatment adopted (if any) and the progress
- cases of births happening on board and the cause thereof along with any additional information as relevant
- cases of deaths happening on board and the cause thereof along with any additional information as relevant
- cases of marriages taking place on board with the names and ages of the parties
- cases whereby a crewmember is involved in misconduct on the part of any certified officer or is found drunk
- offences committed by a crew member for which punishment is inflicted on board and the punishment inflicted
- cases whereby a crewmember is deserted being absent without leave and/or failing to report back prior ship's departure from the port
- cases where the allowance of provisions to a crew member is reduced, together with the quantity as per the articles of agreement and the quantity so reduced
- cases whereby a crewmember is dis-rated along with relevant reasons
- a report on the quality of work and character of each member of his crew; or a statement from the master where the master declines to give an opinion along with reasons
- name of every seaman or apprentice who ceases to be a crewmember for reasons other than by death, with the place, time, manner and cause thereof
- details of the wages due and property of the crewmember who dies during the voyage
- every conviction of a crewmember by a legal tribunal and the punishment inflicted
- every important accident or damage to ship or cargo
- orders of Marine Board
- details of inspection of provisions and water carried out
- details regarding Load line, free board and draught and occasions when the load lines are exceeded and reasons thereof
- details of occasions on which boat drill, fire drill, etc., is practiced, or lifesaving, fire appliances are examined
- details regarding received distress signals or messages from a vessel, aircraft or person is in distress at sea; reasons, if any, for not going to the assistance of persons in distress after having received a distress signal
- entries regarding time of opening/closing watertight doors
- entries regarding inspections of watertight doors
- any other matter which is to be or may be prescribed for entry in the official log

**General offences against discipline**

A seaman or an apprentice is considered guilty of an offence against discipline if he commits any of the acts as mentioned in the national maritime law. These usually include the following:

- quitting the ship without leave after her arrival at her port of delivery and before she is placed in security
- willful disobedience to lawful commands or willful neglect of duty
- assaulting the master or any other officer of the ship
- combining with any of the crew to disobey lawful commands or to neglect duty or to impede the navigation of the ship or retard the progress of the voyage
- willfully causing damages to ship or committing criminal misappropriation or breach of trust in respect of, or willfully damaging any of her stores or cargo

**Apply Your Knowledge**

1. Refer to the official log book on board and list the various entries made in this book.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Monitor compliance with legislative requirements

**Task number:** C 6.1

**Sub-task Reference number:** C6.1.11

**Topic:** Familiarize with various statutory regulations and requirements

**Task Heading**

- Demonstrate understanding of the STCW2010/ILO rest hour requirements with respect to seafarers and the importance of maintaining proper rest hour records.

**Objectives**

- Understand the need and requirements for organizing work and rest hours

**Index**

1) Need for organizing work and rest hours
2) STCW 2010/ ILO rest hour requirements with respect to seafarers
3) Sample form for work/ rest hour record

**Description**

**1) Need for organizing work and rest hours**

- For the welfare of seafarers, employment on board is regulated by "Maritime Labour Convention" developed by International Labour Organization (ILO). One of the important conditions of employment is agreed hours of work and rest.

| |
|---|
| Hours of work are defined as time during which seafarers are required to do work on account of the ship and hours of rest means time outside hours of work |

- International Convention on Standards of Training, Certification and Watch-keeping for Seafarers (STCW) is drawn by the IMO to standardize the training and certification process of seafarers. It specifies the hours of work and rest for watch-keepers to ensure that they are not affected by fatigue and are fit to carry out safe watch-keeping.

**2) STCW 2010/ ILO rest hour requirements with respect to seafarers**

- Taking into account of the danger posed by fatigue of seafarers, especially those whose duties involve the safe and secure operation of a ship, a maximum number of hours of work (not to be exceeded in a given period of time), or a minimum number of hours of rest (to be provided in a given period of time), is fixed.
- All persons who are assigned duty as officer in charge of a watch or as a rating forming part of a watch and those whose duties involve designated safety, prevention of pollution and security duties shall be provided with a rest period of not less than
  - a minimum of 10 hours of rest in any 24-hour period
  - 77 hours in any 7-day period
  - The hours of rest may be divided into no more than two periods, one of which shall be at least 6 hours in length, and the intervals between consecutive periods of rest shall not exceed 14 hours
- The requirements for rest periods laid down above need not be maintained in the case of an emergency, or in other overriding operational conditions. The term "overriding operational conditions" usually does not include routine activities associated with the normal operation of the vessel, such as arriving and departing port, and cargo operations.
- In order to ensure a continued safe operation of ships in exceptional conditions, certain exceptions from the above requirements for the rest periods are allowed. Exceptions may

be allowed from the required hours of rest provided that the rest period is not less than 70 hours in any 7 day period and also

- ❖ such exceptional arrangements shall not be extended for more than two consecutive weeks
- ❖ the intervals between two periods of exceptions shall not be less than twice the duration of the exception
- ❖ the hours of rest may be divided into no more than three periods, one of which shall be at least 6 hours and none of the other two periods shall be less than one hour in length
- ❖ the intervals between consecutive periods of rest shall not exceed 14 hours
- ❖ exceptions shall not extend beyond two 24-hour periods in any 7-day period

- ➢ The rest hour limits now apply to most seafarers on board, including masters.
- ➢ Musters, fire-fighting and lifeboat drills, and drills prescribed by national laws and regulations and by international instruments, shall be conducted in a manner that minimizes the disturbance of rest periods and does not induce fatigue.
- ➢ For a seafarer available on call, such as for unattended machinery spaces, the seafarer shall be provided with an adequate compensatory rest period if the normal period of rest is disturbed by call-outs to work.
- ➢ Watch schedules shall be posted where they are easily accessible. The schedules shall be established in a standardized format in the working language or languages of the ship and in English.
- ➢ Records of each individual seafarer's rest hours shall be maintained and this is likely to be inspected during port state control inspections. Watch-keepers and others as mentioned above, when found not complying with work/ rest hour requirements are treated as the personnel were employed on watch-keeping duties when they were not fit for duty. Such an observation may lead to detention of ship.
- ➢ Seafarers are required to review and sign a record of their work/rest hours periodically (typically at least once a month) to ensure they comply with the minimum rest hours stipulated. This record shall be endorsed by the master or by a person authorized by the master and by the seafarers.
- ➢ Records of daily hours of rest of seafarers shall be maintained in a standardized format, in the working language or languages of the ship and in English, to allow monitoring and verification of compliance.

Master of a ship has an overriding authority to suspend the schedule of hours of rest and require a seafarer to perform any hours of work necessary for the immediate safety of the ship, persons on board or cargo, or for the purpose of giving assistance to other ships or persons in distress at sea; and this may be continued until the normal situation has been restored. However, as soon as practicable after the normal situation has been restored, the seafarers who have performed work in a scheduled rest period shall be provided with an adequate period of rest.

**Model format for a table of shipboard working arrangements**[1]

Name of ship:________________ Flag of ship:__________ IMO number (if any):__________ Latest update of table:__________ ( ) of ( ) pages

The maximum hours of work or minimum hours of rest are applicable in accordance with: ________________ (national law or regulation) issued in conformity with ILO's Seafarers' Hours of Work and the Manning of Ships Convention, 1996 (No. 180), and with any applicable collective agreement registered or authorized in accordance with that Convention and with the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended (STCW Convention).[2]

Maximum hours of work or minimum hours of rest:[3]________________

Other requirements:________________

| Position/Rank[4] | Scheduled daily work hours at sea | | Scheduled daily work hours in port | | Comments | Total daily work/rest[3] hours | |
|---|---|---|---|---|---|---|---|
| | Watchkeeping (from – to) | Non-watchkeeping duties (from – to)[5] | Watchkeeping (from – to) | Non-watchkeeping duties (from – to)[5] | | At sea | In port |
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Signature of master ________________

[1] The terms used in this model table are to appear in the working language or languages of the ship and in English.

[2] See overleaf for selected extracts from ILO Convention 180 and the STCW Convention.

[3] Delete as applicable.

[4] For those positions/ranks that are also listed in the ship's safe manning document, the terminology used should be the same as in that document.

[5] For watchkeeping personnel, the comments section may be used to indicate the anticipated number of hours to be devoted to unscheduled work and any such hours should be included in the appropriate total daily work hours column.

### 3) Sample form for work/ rest hour record

**Model format for record of hours of work or hours of rest of seafarers**[1]

Name of ship: ________________ IMO number (if any): ________________ Flag of ship: ________________ Page 1 of 2

Seafarer (full name): ________________ Position / rank: ________________

Month and year: ________________ Watchkeeper:[2] yes ☐ no ☐

**Record of hours of work/rest**[3]

Please mark periods of work or rest, as applicable, with an X, or using a continuous line or arrow.

**COMPLETE THE TABLE ON THE REVERSE SIDE**

The following national laws, regulations and/or collective agreements governing limitations on working hours or minimum rest periods apply to this ship:

________________

***I agree that this record is an accurate reflection of the hours of work or rest of the seafarer concerned.***

Name of master or person authorized by master to sign this record ________________

Signature of master or authorized person ________________ Signature of seafarer ________________

A copy of this record is to be given to the seafarer. This form is subject to examination and endorsement under procedures established by ________________ (name of competent authority)

[1] The terms used in this model table are to appear in the working language or languages of the ship and in English.

[2] Check √ as appropriate.

[3] Delete as appropriate.

Page 2 of 2

Please mark periods of work or rest, as applicable, with an "X", or using a continuous line or arrow

| Hours | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | Hours of rest in 24-hour period | Comments | NOT TO BE COMPLETED BY THE SEAFARER[1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | | | | | | | | | | | | | | | | | | | | | | | | | | | Hours of work or rest, as applicable, in any 24-hour period[2] | Hours of work or rest, as applicable, in any 7-day period[2] |
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| Hours | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | | | | |

[1] For completion and use in accordance with the procedures established by the competent authority in compliance with the relevant requirements of the Seafarers' Hours of Work and the Manning of Ships Convention, 1996 (Convention No. 180).

[2] Additional calculations or verifications may be necessary to ensure compliance with the relevant requirements of the Seafarers' Hours of Work and the Manning of Ships Convention, 1996 (Convention No. 180) and the International Convention on Standards of Training, Certification and Watchkeeping, 1978, as amended (STCW Convention).

## Apply Your Knowledge

1. Locate the watch-keeping schedules posted on your vessel.
2. Discuss the procedure of filling up your company specific work/rest hour form and the related record keeping.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Contribute to the safety of personnel and ship

**Task number:** C 7.1

**Sub-task Reference number:** C7.1.5

**Topic:** Safety of personnel and ship

**Task Heading**

- Identify and discuss with the Chief Officer the hazards involved in carrying out various jobs and control measures required to be put in place prior carrying out any job, including use of proper PPE.

**Objectives**

- To identify the hazards related to various shipboard operations

Please read this task in conjunction with tasks C7.1.2 and C7.1.3

**Index**

1) Shipboard activities and hazards
2) Hazard identification and risk analysis techniques
3) Task analysis procedures
4) Hazard and risk control
5) Personal Protective Equipment (PPE)

**Description**

**1) Shipboard activities and hazards**

Personnel engaged in shipboard activities may be exposed to miscellaneous hazards. The hazards can be classified as follows:

- **Human-related hazards**
  Human error occurs when a person’s ability falls below what is needed to successfully complete a task. This may be due to a lack of ability and/ or because the existing ability hampered by adverse conditions. A comprehensive examination of all human-related hazards needs to be performed while estimating the risk. Personal factors and unfavourable conditions which constitute hazards may be listed as follows.
  - Personal factors
  - Organizational and leadership factors
  - Task features
  - Onboard working conditions

- **Shipboard hazards to personnel**
  - Inhalation of harmful fumes, toxic gases etc.
  - burns from substances like acids, alkalis and chemicals
  - electric shock from machinery, equipments and poor insulations
  - person falls from height or slips
  - falls overboard
  - other operational injuries, pilot ladder/pilot hoist operation etc.

- **Hazards to the vessel**
  - Loss of watertight integrity
  - Hazards external to the ship

- **Hazardous substances on board ship in following spaces**
  - Accommodation areas
  - Deck areas
  - Machinery spaces

- **Potential sources of ignition in following spaces**
  - General
  - Deck areas
  - Machinery spaces

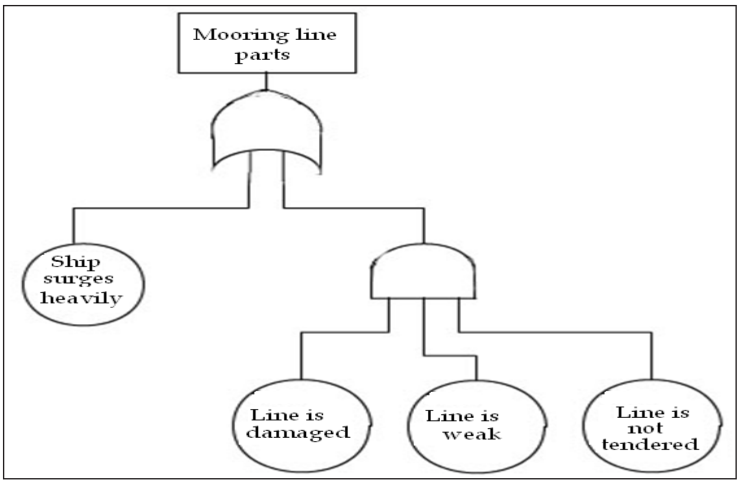
- **Additional hazards from cargo operation**
  - Flammability
  - Toxicity
  - Corrosion
  - Liquefaction
  - Polymerization
  - Spontaneous combustion
  - High density cargo

- **Operational hazards**
  - Static electricity built up due to various operations such as due to unearthing of ship before tanker operations
  - Smoking in unauthorized zones, open decks
  - Use of unapproved electrical equipment
  - Use of power tools, high pressure equipments
  - Use of communication equipment which are not intrinsically safe
  - Spontaneous combustion
  - Pollution
  - Naked lights
  - Enclosed spaces

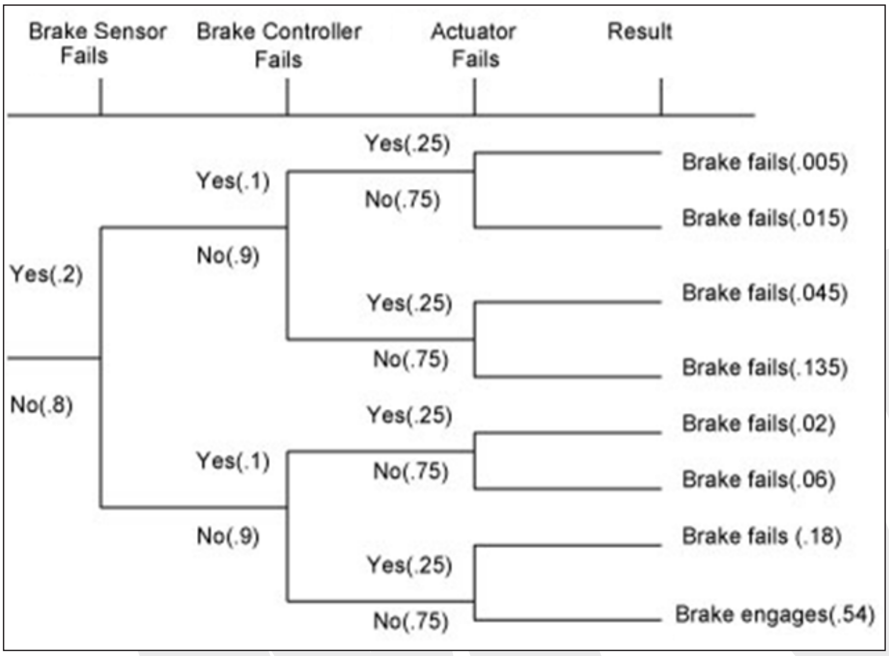
**2) Hazard identification and risk analysis techniques**

- **Fault tree analysis**

A fault tree is a logic diagram showing the causal relationship between events which singly or in combination occur to cause the occurrence of a higher level event. It is used in fault tree analysis to determine the probability of a top event, which may be a type of accident or unintended hazardous outcome. Fault tree analysis can take account of common cause failures in systems with redundant or standby elements. Fault trees can include failure events or causes related to human factors. The development of a fault tree is by a top-down approach. The causes or events are considered systematically at levels below the top level. If two or more lower events need to occur to cause the next higher event, this is shown by a logic 'and' gate. If any one of two or more lower events can cause the next higher event, this is shown by a logic 'or' gate. The logic gates determine the addition or multiplication of probabilities (assuming independence) to obtain the values for the top event.



- **Event tree analysis**
  An event tree is a logic diagram used to analyse the effects of an accident, a failure or an unintended event. The diagram shows the probability or frequency of the accident linked to those safeguard actions required to be taken after occurrence of the event to mitigate or prevent escalation. The probabilities of success or failure of these actions are analyzed. The success and failure paths lead to various consequences of differing severity or magnitude. Multiplying the likelihood of the accident by the probabilities of failure or success in each path gives the likelihood of each consequence.

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- **Failure mode and effect analysis**
  FMEA is a technique in which the system to be analyzed is defined in terms of functions or hardware. Each item in the system is identified at a required level of analysis. The effects of item failure at that level and at higher levels are analyzed to determine their severity on the system as a whole. Any compensating or mitigating provisions in the system are taken account of and recommendations for the reduction of the severity are determined.

- **Hazard and operability studies (HAZOPS)**
  These studies are carried out to analyse the hazards in a system at progressive phases of its development from concept to operation. The aim is to eliminate or minimize potential hazards. Teams comprise of safety analysts and specialists in the subject system, such as designers, constructors and operators. The team members may change at successive phases depending on the expertise required. In examining designs they systematically consider deviations from the intended functions, looking at causes and effects. They record the findings and recommendations and follow-up actions required.

- **What if analysis technique {SWIFT - Structured What If Technique}**
  "What If Analysis Technique" is suited for use in a hazard identification meeting with a group of carefully selected 7 to 10 persons experienced persons covering the topics under consideration. The system, function or operations under consideration, drawings, technical descriptions etc. are discussed in detail. This is followed by brainstorming, where the facilitator leader guides by asking questions starting with 'what if?' The questions span topics like operation errors, measurement errors, equipment malfunction, maintenance, utility failure, loss of containment, emergency operation and external influences. When the ideas are exhausted, previous accident experience maybe used to check for completeness.

The hazards are considered in sequence and structured into a logical sequence, in particular to allow cross-referencing between hazards. The hazard identification report is usually developed and agreed in the meeting, and the job is done and reported when the meeting is adjourned. A meeting typically takes three days. If the task requires long meetings it is broken down into smaller sub-tasks.

- **Risk contribution tree**
  Under this technique the risks are distributed amongst different accident categories and sub-categories on a diagrammatic form. Structuring the tree starts with the accident categories, which may be divided into subcategories to the extent that available data allow and logic dictates. The preliminary fault and event trees can be developed based on the hazards identified in step 1 to demonstrate how direct causes initiate and combine to cause accidents (using fault trees), and also how accidents may progress further to result in different magnitudes of loss (using event trees).

- **Influence diagrams**
  Influence diagram approach models the network of influences on an event. These influences link failures at the operational level with their direct causes and with the underlying organizational and regulatory influences. The influence diagram approach is based on expert judgments and is particularly useful in situations for which there may be little, or no empirical data available. The approach is capable of identifying all the influences that help explain why a marine risk profile may show high risk levels in one aspect (or even vessel type) and low risk level in another aspect. The influence diagram recognizes that the risk profile is influenced by human, organizational and regulatory aspects; it allows a holistic understanding of the problem area to be displayed in a hierarchical way.

**3) Task analysis procedures**

- **High-level task analysis**
  High-level task analysis follows the procedure as mentioned below.
  - ✓ describing all operations within the system in terms of the tasks required to achieve a specific operational goal
  - ✓ considering goals associated with normal operations, emergency procedures, maintenance and recovery measures

- **Detailed task analysis**
  Detailed task analysis is undertaken to identify the overall task to be done, subtasks to be dealt, people involved in the task, the procedure of work both in normal and emergency situations, controls, displays, tools to be used and factors likely to influence performance.

- **Extended task analysis (XTA)**
  The activities which comprise XTA techniques are as follows
  - ✓ The interviewer asks about the conditions which enable or disable certain actions to be performed, and how a change in the conditions affects those choices. The interviewer examines the individual’s intentions to make sure that all relevant aspects of the situation have been taken into account. This is done in order to build up a good understanding of what the individual is doing and why and how the process change under varying conditions.
  - ✓ The interview is recorded, transcribed and subsequently analyzed qualitatively.
  - ✓ The analysis is then represented in an appropriate format.
  - ✓ The procedure is concluded by validation activities such as observation, hypothesis.

**4) Hazard and risk control**

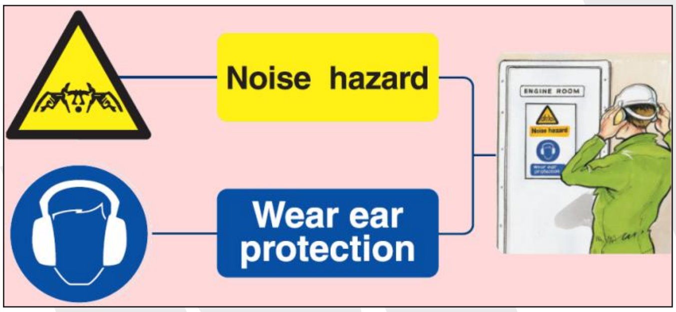
- **Technical controls**
  The hazards can be controlled at very first stage while implementing the following
- ❖ Providing ergonomic design of equipment and work spaces considering the requirements of the job to be performed

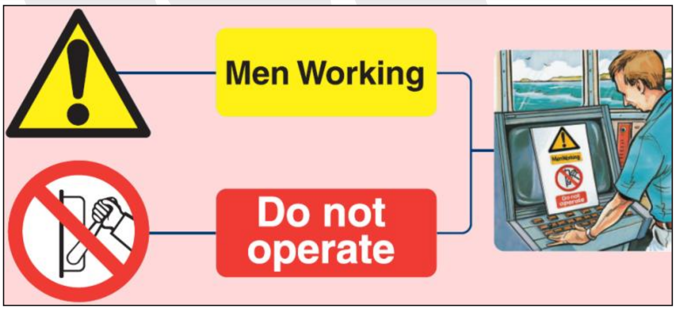
- ❖ Providing good layout of bridge and machinery spaces
- ❖ Providing ergonomic design of the man-machine interface/human computer interface
- ❖ Establishing specification of information requirements for the crew to perform their tasks prior designing
- ❖ Clear labeling and instructions on the operation of ship systems and control/communications equipment

➢ **Working environment controls**

Prior assigning tasks, comprehensive analysis of working environment shall be done. This will include considering the following

- ❖ Checking the ship stability condition and the resulting effect on crew of working under conditions of pitch/roll
- ❖ Evaluating the weather effects, including fog, heavy seas etc. and establishing the additional needs as made necessary
- ❖ The ship’s location, open sea, approach to port which may govern that a certain operation may be carried out or not
- ❖ Availability of appropriate levels of lighting for operations and maintenance tasks and for day and nighttime operations
- ❖ Consideration of noise levels (particularly for effect on communications)
- ❖ Consideration of the effects of temperature and humidity on task performance
- ❖ Consideration of the effects of vibration on task performance






➢ **Controls for personnel**

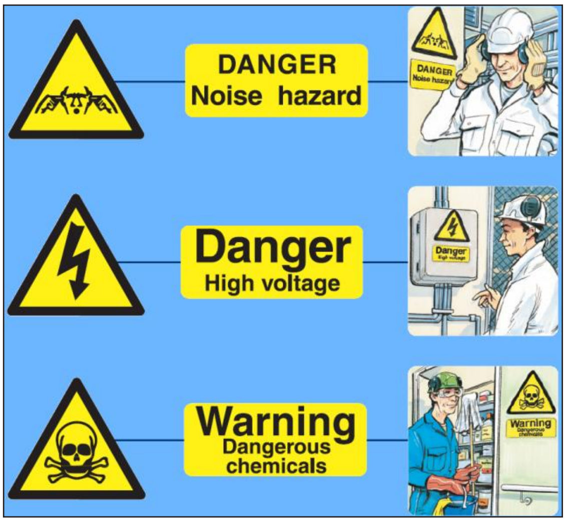
These are the factors used to control the hazards due to human errors.

- ❖ Appropriate training for crew members for the defined tasks
- ❖ Providing sufficient manpower
- ❖ Effective means to overcome language barriers and cultural issues
- ❖ Workload assessment
- ❖ Providing suitable arrangements to address motivational and leadership issues

➢ **Organizational and management controls**

The following issues shall be addressed suitably

- ❖ Development of organization policies on recruitment, selection, training, crew levels and make up, competency assessment, etc.
- ❖ Development of operational and emergency procedures
- ❖ Use of safety management systems
- ❖ Provision of weather forecasting/routeing services





**5) Personal Protective Equipment (PPE)**

- Personal protective equipment provides a barrier against injury from specific hazards, including health hazards. This section shall be read in continuation to task C 7.1.3.
- All routes of exposure must be evaluated when considering appropriate PPE and the barriers selected based on risk of and consequence of exposure. These shall be determined from all available sources including but not limited to MSDS, tanker safety guide, chemical dictionary and chemical data and safety guides.

> PPE does not reduce the hazard posed by the cargo. The effectiveness of this barrier will be lost if the PPE is used incorrectly or is of the wrong type or is

- The type and degree of protection required is dependent on the properties of the materials/ cargoes being handled, the level of risk of exposure, whether the job is continuous or intermittent and the prevailing environmental conditions. The resistance and limitations of the desired PPE should always be checked before being put into use. These must be informed to the ship staff intending to use the equipment. The required level of the PPE must be decided for every operation considering the factors mentioned above.


- The PPE guide provided must be consulted.
- Master and the safety officer must assess the properties of the materials being handled and then decide on the level of PPE, which is required for the ship staff as well as

visitors. The technical specifications of the required PPE are provided in the company SMS which shall be insisted upon.

- ❖ While exposure and hazard risk will be evaluated on a case-by-case basis, as part of the cargo plan the following will always apply.
  - ✓ Spill cleanup will always represent high exposure risk.
  - ✓ Sampling at the manifold, pump-stack, and tank dome will always represent high exposure risk.
  - ✓ Hose connection and disconnection will represent high risk unless hose clearing methods are confirmed as 100% effective and the cargo is not under option 5 of the PPE matrix given above.
- ❖ Chemical suits shall be used for cargoes which pose a hazard to health through skin absorption or those that destroy tissue, cause the skin to burn or leave scars.
- ❖ Body protection is designed to prevent exposure to gas, vapour, mist, liquid droplets, and liquid splash to the body including skin, eyes, and mucous membranes. All necessary care should be taken to prevent contact of chemicals with skin and eye. This protection consists of barrier clothing, shields, and barrier creams. Barrier clothing includes gloves and boots; shields include chemical resistant goggles, aprons, and splash guards. The level and type of protection required is to be determined by evaluating exposure risk and hazard risk.
- ❖ Contaminated clothing should always be washed or hosed down before the wearer takes it off. Once used, it must never be brought into the accommodation or any other living spaces and kept in containers.

➢ **PPE for visitors**

- ❖ In case visitors such as cargo surveyors arrive to the gangway without necessary safety PPE they shall be provided such from the ships equipment or be denied access to the deck. If the operation being carried out involves a high risk cargo requiring PPE, a notice shall be placed at the base of the gangway which states as follows:

| |
|---|
| **A high hazard cargo operation is in progress. Authorized visitors to contact vessel at this point and not proceed to vessel unescorted.** |

- ❖ When contacted, the vessel shall arrange for a ship staff to meet the visitor at the base of the gangway. The ship staff shall confirm if the required PPE is donned by the visitor. Any shortfall of PPE shall be provided by the vessel. Should the person reach the deck level without appropriate PPE, the vessel shall stop cargo operations, until the person is taken to safe areas.
- ❖ During the handling of those cargoes considered as high hazard risk, visitors shall not be permitted access to the cargo deck area while any high-risk operation is in progress or if there is any exposure risk present
- ❖ During routine cargo operations, of high hazard risk cargoes, where exposure risk is low; visitors wearing the appropriate PPE may be allowed access to the main deck at master's discretion. For persons such as cargo surveyor, whose presence in such areas is necessary during the cargo operation, the duty officer must ensure that appropriate PPE is donned by the person.

➢ **PPE maintenance**

PPE shall be maintained in accordance to manufactures recommendations. Records of maintenance and inspection / checks shall be maintained on board. PPE must be properly cleaned and inspected after each use and confirmed by the safety officer to be in good order ready for immediate use prior returning to stowage.

**Apply Your Knowledge**

1. Discuss the hazards and procedures for carrying out repairs inside a ballast tank, whereby a stuck valve on the ballast line is to be repaired.
2. Read any two case studies provided as SMS circulars and discuss the salient features with respect to hazards and precautions taken.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Contribute to the safety of personnel and ship

**Task number:** C 7.1

**Sub-task Reference number:** C7.1.6

**Topic:** Safety of personnel and ship

**Task Heading**

- Assist in carrying out a formal risk assessment for a critical job and understand the importance of risk assessment before carrying out a job.

**Objectives**

- Understand the significance and procedure of risk assessment for shipboard tasks.

**Index**

1) Introduction
2) Process of risk assessment and control
    a) Classification of work activities
    b) Hazards identification
    c) Estimation of risk
    d) Identification of risk controls
    e) Determining the tolerability of the risks
    f) Preparing the risk control action plan
    g) Reviewing adequacy of action plan
    h) Ensuring risk control effectiveness and monitoring

**Description**

**1) Introduction**

- In order to ensure the safety of the personnel, maritime labour convention and the national laws require the seafarers employed on board to be adequately safeguarded against harmful exposures while carrying out the shipboard tasks. ISM code emphasizes on following safe procedures for all shipboard tasks with regards to safety and environmental protection.

- The shipboard tasks may involve different types of hazards, which may affect the personnel, the ship and the environment. The safeguards shall be established on the basis of hazards associated with the task. To assess all associated hazards, it becomes a must to carry out formal risk assessment of each and every task prior the task is carried out. Formal risk assessment is an important process for ensuring the occupational safety of workers.

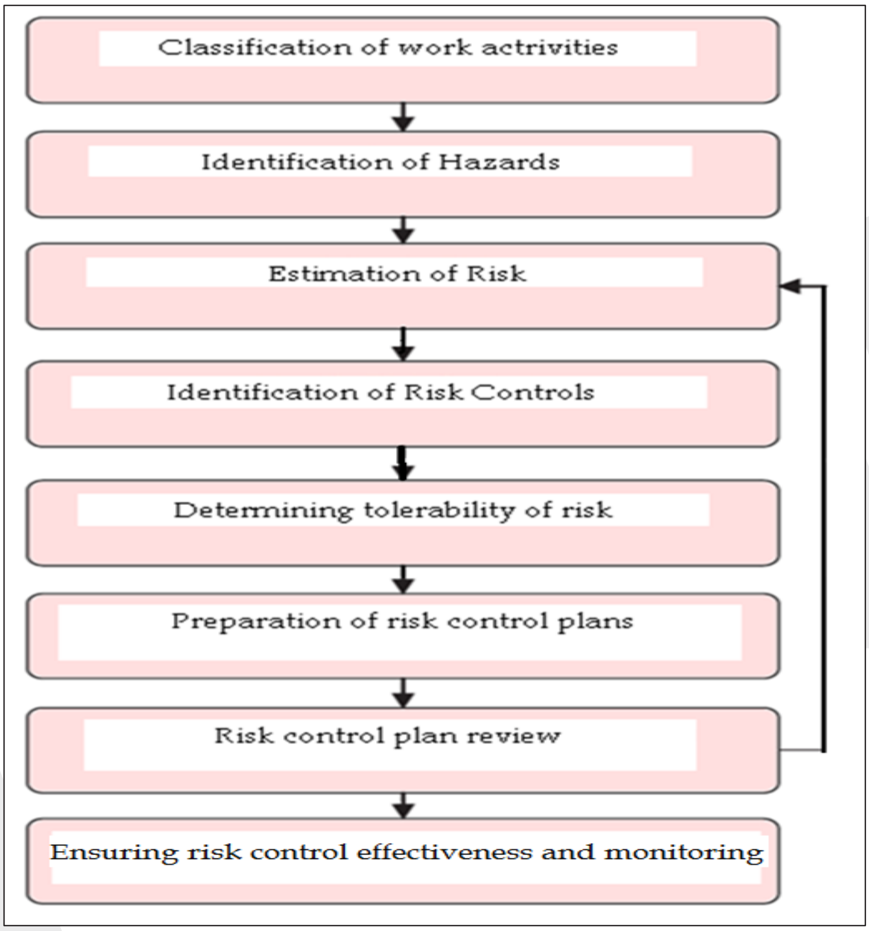
> Risk assessment can be defined as a careful examination of what, in the nature of operations, could cause harm, so that precautions can be taken to prevent harm. The aim is to ensure occupational health and safety of the personnel. A risk assessment should be comprehensive and shall involve assessment of the hazards associated with the task and the assessment of existing preventive measures for effectiveness before

- The shipping companies in their SMS manuals specify safe working procedures and work permit system. The SMS work procedures and work permit systems cover all routine shipboard operations. However the processes need to be reviewed each time prior carrying out the individual task. It becomes furthermore important when carrying out a critical task.

- The factors to be considered while carrying out risk assessment of a task are the hazards of the task, the potential harm/ damage associated and the likelihood of occurrence. As far as possible, exposure to hazards shall be avoided; however in cases of unavoidable hazards, proper evaluation of the same and the engaging means to minimise the same is required. Risk assessment shall include both the immediate and long term health and safety consequences.

- Risk assessment should be seen as a continuous process. The work force is required to observe and keep a check on all hazards during the course of the task and shall ensure that if any unusual development or event is observed, the person in charge of the operation is advised in due time. Validity of the hazards prevention measures shall be reviewed while the operation is in progress.

## 2) Process of risk assessment and control




### a) Classification of work activities

- Operation groups are classified as:-
  - Navigation
  - Cargo operations
  - Deck operations and maintenance
  - Machinery operation and maintenance in engine room
  - Machinery operation and maintenance outside engine room spaces
  - Electrical equipment maintenance

- The task to be performed shall be identified and the following shall be determined:
  - Whether it is a scheduled task such as planned maintenance or an emergency schedule
  - The location of task
  - Personnel involved in task, and number of trained/experienced personnel to be engaged
  - Expected duration of the task and stages, identifying the critical stages

**b) Hazards identification**

- Having established the nature of work activity, associated hazards need to be identified. Hazards by the nature of the task can be mechanical, electrical, physical, radiation, fire and explosion, chemical, biological, psychological.
- Hazards associated with shipboard operations may affect the personnel, ship, cargo or the environment as the case may be.
- Risks to personnel include fatality, injury or short term/ long term effects on the person's health.
- Risks to environment include marine pollution and resulting clean-up costs and fines to organization.
- Risks to vessel/ cargo include risks due to failure of equipment or failure to follow procedures. These are risks of damage to ship, equipment or cargo and/or the risk of delays to operations (cargo or navigation).

> The simplest manner in which hazards can be identified is by answering a few questions:
> - What is to be done
> - How is it to be done
> - Where is it to be done
> - Is there any source of harm
> - Who/ what could be harmed
> - What could be the harm
> - How could the harm occur

- Various hazards associated to shipboard activities may be listed as
- Hazards from heat/ fire/ explosion
- Exposure to chemicals
- Exposure to chemical fumes from cargo or other chemicals
- Hazards from long term physiological effects e.g. exposure to fumes/ substances above the Threshold Limit Value (TLV).
- Exposure to high / low temperatures
- Hazards from electrical equipments/ appliances/ machinery
- Hazard from high pressure equipments and machinery
- Hazards from work in high sound areas
- Hazards from work in restricted spaces such as inadequate head room, ventilation, lighting etc.
- Hazards from works to be performed at heights which include falls from heights, falling tools, materials etc.
- Hazards from manual handling
- Hazards from rough seas on open decks
- Hazards due to severe weather conditions such as icing
- Hazards due to inherent properties of cargoes such as polymerisation, spontaneous heating/ combustion etc.
- Pollution hazard caused due to intentional or accidental release of oil, garbage, noxious liquids and chemicals

- Most of the above are not uncommon and are likely under standard shipboard procedures in SMS Manuals. However there could be extraordinary conditions which may require all new formal risk assessments. These include
- Steering gear / emergency steering inoperational / malfunctioning
- Vessel disabled due to main engine breakdown
- Emergency fire pump inoperational
- Main / emergency air compressor not working
- Lifeboat not lowering
- Emergency generator inoperational
- Breakdown of main generator(s) leading to issues with power supply
- Emergency batteries defective
- OWS 15 ppm alarm inoperational
- Bilge pumping arrangement from cargo holds or engine room or steering flat / pump room / forepeak store defective
- Fire detection system inoperational
- MF/HF DSC equipment inoperational

- ❖ Gyro inoperational
- ❖ Radars inoperational
- ❖ Mooring winch / windlass inoperational
- ❖ Sat-C EGC inoperational – vessel transiting in TRS prone areas
- ❖ Approved loading instrument inoperational
- ❖ Voyage charts not available on board
- ❖ Berth unsuitable for vessel due to berth incompatible with ship size, obstructions or other reasons
- ❖ Vessel changes route to ice bound area

The hazards from shipboard activities have been discussed under task C7.1.5 in detail.

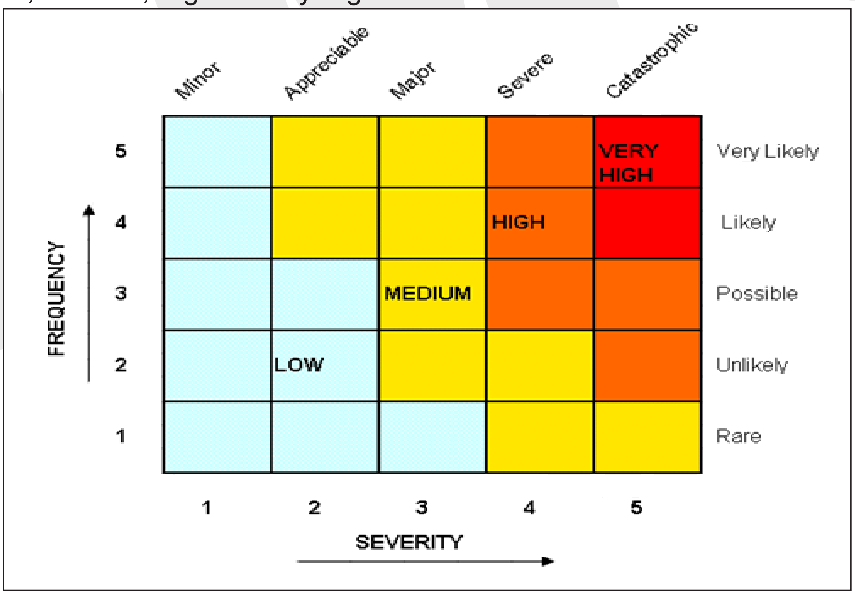
**c) Estimation of risk**

- ➢ The risk from the hazard may be determined by estimating two components:
- ❖ the potential severity of harm
- ❖ the likelihood that harm will occur

- ➢ Various shipboard activities can be categorised on the basis of severity of harm ranging from slight to moderate to severe harm.

- ➢ The frequency or likelihood can further be estimated on the basis of following factors
- ❖ number of personnel exposed; the more the number of personnel, more likelihood of the harm
- ❖ frequency and duration of exposure to the hazard; longer the duration, more the risk
- ❖ exposure to the elements
- ❖ protection afforded by personal protective equipment and its limitations
- ❖ possibility of unsafe acts by persons for example
- ❖ effects of failure of power or water supply
- ❖ effects of failure of plant and machinery components and safety devices

- ➢ Based on above factors a matrix as shown below can be used to estimate Risk Ranking of Low, Medium, High or Very High.




- ➢ Shipping companies provide the tables to estimate the values of severity and likelihood of harm on the basis of past observations.

**d) Identification of risk controls**

- ➢ Established good practices of work as mentioned in the company SMS and publications such as code of safe working practices for merchant seaman, tanker safety guide, bulk (BLU code) / chemical (IBC) / gas (IGC) code, MARPOL, SOPEP, Security plan, BWMP, P.M.S., cargo securing manual, IMDG Code, ISGOTT, LSA code, FFA code.

- ‘Existing controls’ are safety measures to be taken on board, which are listed for the various activities that are carried out on board the vessel. For example, during an operation, controls could include:-
- ❖ Safety devices in the equipment
- ❖ Proper use of checklist and Work permits
- ❖ Implementation of company procedures, charterer’s instructions, port regulations, industry regulations and guidelines
- ❖ Adequate number of personnel involved
- ❖ Appropriate design and construction
- ❖ Adequate knowledge or skill based on training
- ❖ Locating, identifying and adapting to control systems
- ❖ Planned maintenance
- ❖ Use of proper tools and equipment

- In most cases existing or planned controls will be already in place to prevent the harmful effect of a hazard. To decide if risk still exists, it is important to identify all the controls that are in place and which contribute to the safety of the operation.

**e) Determining the tolerability of the risks**

- Having identified the hazards, the risk and the existing control measures, the tolerability need to be established.

> Tolerable here means that the risk has been reduced to a level that is “As Low As Reasonably Practicable” (ALARP).
> The ALARP principle establishes the relationship between the cost/benefit of implementing controls and the acceptability of risk in a hazardous activity. In simple words ALARP principle allows cost to be taken into account in determining how far to go in the effort of reducing the risk. If a risk reduction measure involves a ‘grossly disproportionate’ cost, it can be considered as not “reasonably practicable”.

- Based on above parameters the risk may be classified into three types:

- ❖ High risk/ unacceptable
  For example, entering an inerted cargo tank without proper gas freeing and ventilation for repairing a damaged valve

- ❖ Moderate risk/ ALARP
  For example, carrying out hot work on a tanker in designated area

- ❖ Negligible risk / acceptable
  For example, cleaning routines in galley

- The shipping company in the SMS manuals establish tolerability criteria to provide a basis for consistency in all its risk assessments. This is drawn with reference to the risk matrix discussed above.

**f) Preparing the risk control action plan**

- Having established the risk, depending upon the tolerability criteria the action plan for controlling risk shall be made. The process is specified in the company SMS manuals.

- Controls should be chosen taking into account the following, which are in order of effectiveness:
- ❖ Elimination
- ❖ Substitution by something less hazardous and risky
- ❖ Enclosure (enclose the hazard in a way that eliminates or controls the risk)
- ❖ Guarding/Segregation of people

> Risk control measures can be divided into two types:
> - ❖ Control measures to directly control the hazard, e.g. – a fire extinguisher at the site of hot work
> - ❖ Control measures to reduce likelihood of the hazard, e.g. – removal of flammable materials from the site of hot work

- ❖ Safe system of work that reduces the risk to an acceptable level
- ❖ Written procedures that are known and understood by those affected
- ❖ Review the blend of technical and procedural control
- ❖ Adequate supervision
- ❖ Identification of training needs
- ❖ Information/Instruction (signs, hand-outs)
- ❖ Personal Protective Equipment (last resort) – cannot be controlled by any other means
- ❖ Emergency equipment relevant to the specific hazards and emergency and evacuation plans

- ➢ Action plan shall provide for details related to the task such as
- ❖ Personnel assigned to do the job
- ❖ Requirement of work permits
- ❖ Isolation and tagging required
- ❖ Correct procedures and PPE required

**g) Reviewing adequacy of action plan**

The action plan shall now be reviewed for checking

- ❖ If the revised controls bring the risk to tolerable risk levels
- ❖ If there are any new hazards created
- ❖ Feedback from shipboard personnel on the practicality of any existing or planned controls and suggestions for improvement
- ❖ If the revised action plan is practical and not likely to be disregarded

**h) Ensuring effectiveness of risk control and monitoring**

- ➢ Risk assessment and control is a continual process. The effectiveness has to be monitored throughout the course of the operation in view that new hazards may develop.
- ➢ Implicit assumptions forming the basis of risk assessment need to be checked with actual on scene situation in order to ensure that they remain valid.
- ➢ Dynamic factor involved in the risk assessment shall be reviewed which may require revision of the assessment. These include
- ❖ expansion, contraction or restructuring of activities
- ❖ relocation of responsibilities
- ❖ changes to methods of working or patterns of behaviour
- ❖ occurrence of a hazardous event during the operation

**<u>Tool Box Meeting</u>**

Toolbox meeting is a formal meeting conducted by person in-charge of task to ensure that all team members fully understand the task. Written records for the meeting are not required. The Purpose of toolbox meeting is to ensure that all parties including any contractors involved within the planned work are fully aware of all aspects of the work scope.

Following, as applicable, should be discussed

- Task to be carried out.
- Procedure to follow including communication.
- Permit to work.
- Responsibilities of each crewmember involved.
- Safe access to work site.
- Significant hazards identified in the risk assessment.
- Control measures for risks involved.
- Tools, equipment and PPE required.
- Contingency plan.

**Apply Your Knowledge**

1. A "special" operation is an operation carried out infrequently on board a ship. Assess the risk and attach the risk assessment sheet for a special operation to be conducted on board your ship. Mention the essence of the subsequent tool box meeting conducted prior to commencement of the operation.
2. Discuss the risks involved when the vessel is surging alongside due to swell and the necessary control measures.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Contribute to the safety of personnel and ship

**Task number:** C 7.1

**Sub-task Reference number:** C7.1.7

**Topic:** Safety of personnel and ship

**Task Heading**

- Demonstrate understanding of company's accident investigation and reporting procedure.

**Objectives**

- Understand the importance of accident Investigation and reporting and the respective procedures

**Index**

1) Need of investigations
2) Definitions
3) Investigation process
4) Commercial and legal aspect of accident investigation and reporting

**Description**

**1) Need of investigations**

- An incident is an undesired event, which may result in causing
  - harm to people
  - damage to environment
  - damage to property or process loss
- The aim of investigating near misses, incidents and accidents is to learn from the mistakes / errors in-order to prevent a recurrence. Lessons that can be learnt help in creating a good safety culture in the organization. Preventing accidents also improves the profitability of a business.
- An investigation helps to
  - Identify immediate and not so apparent basic root causes
  - Establish preventive strategies to avoid similar incidents from recurring in the future
  - Establish trends in incident causes and on their basis establish training needs
  - Identify any new hazards which might have crept in
  - Satisfy industry / legal requirements
  - Classify them in line with marine injury reporting guidelines

**2) Definitions**

- **Unsafe act** is an act, which varies from the accepted safe practice and creates a hazard to persons, property or environment, e.g., failure to use personal protective equipment.
- **Unsafe condition** is defined as a condition, which varies from a normal safe condition and, if not corrected could lead to an accident, e.g., defective PPE.
- An **Event** relating to a person or object may be defined as the contact with a source of energy. As an example when a moving object strikes a person, the kinetic energy transfers to the body. Events 'Precede a Loss'.
- A **Near-miss** is a sequence of events and/or conditions that could have resulted in loss is termed a near miss. The potential loss is somehow prevented only because of a fortuitous break in the chain of events and/or conditions.
- **Hazardous occurrence** is an occurrence beyond a near miss where the threshold limit is crossed. For a person, any pain / bruise / cut or other injury indicates that threshold limit

has been crossed or exceeded. For a material, any kind of damage, deformation, or other change from initial state, indicates that the threshold limit has been crossed.

- **Accident** means any occurrence on board a ship or involving a ship whereby there is loss of life or major injury to any person on board, material damage to ship, cargo, other property or to the environment.
- A **hazard** is a source of potential harm or damage or a situation with potential for harm or damage.
- A **Very serious casualty** means a casualty to a ship, which involves the total loss of the ship, loss of life or severe pollution.
- A **Serious casualty** means a casualty which does not qualify as a very serious casualty and which involves a fire, explosion, grounding, contact, heavy weather damage, ice damage, hull cracking or suspected hull defect, etc., resulting in
  - Structural damage rendering the ship unseaworthy, such as penetration of the hull underwater, immobilization of main engines, extensive accommodation damage etc.
  - Pollution in any quantity
  - A breakdown necessitating towage or shore assistance
- The term **serious marine incident** includes any marine casualty or accident, which results in any of the following (ref: USCG)
  - One or more deaths
  - An injury to a crewmember, passenger, or other person which requires professional medical treatment beyond first aid, and, which renders the individual unfit to perform routine vessel duties
  - Damage to property, in excess of $100,000
  - Actual or constructive total loss of any self-propelled vessel, of 100 grosses tons or more.
  - A discharge of oil of 10,000 gallons or more into the navigable waters of the United States, whether or not resulting from a marine casualty
  - A discharge of a reportable quantity of a hazardous substance into the navigable waters of the United States, or a release of a reportable quantity of a hazardous substance into the environment of the United States, whether or not resulting from a marine casualty.
- **Pollution** is defined as the release of any substance to the environment, which can result in harm to the environment. This includes release of
  - Oil into water
  - Toxic chemicals or gases into the water or air
  - Solids classified as Marine Pollutants into water
  - Garbage, sewage or ballast water that is not permitted for discharge into water
- The **immediate causes** of an accident are the circumstances that immediately precede the contact. These could be ‘unsafe (substandard) acts’ or ‘unsafe (substandard) conditions’, e.g.; use of defective tools or equipment.
- **Root causes** are the real causes, indirect causes, underlying or contributing causes that allowed a substandard practice or substandard condition to exist. These are generally divided into personal factors and job factors. personal factors include causes such as lack of knowledge or skill. Job Factors include causes such as inadequate maintenance, inadequate work standards.

**3) Investigation process**

- **What to investigate?**
  All incidents, including near misses and minor injuries must be investigated to identify and control safety, health or pollution hazards before they cause a more serious incident. Near misses have the same causes they fortunately did not lead to losses or accidents.

➢ **Who should investigate?**

❖ Depending upon the seriousness of the incident and the potential or actual loss, damage or injury involved, the investigation team shall be formed. The team shall exclude the people involved in the incident. The investigation team usually includes master, chief engineer or chief officer, department heads, bosun or fitter, office representative, as per requirements set by shipping company and surveyors from Insurers and P&I clubs. The safety officer or department head should investigate near miss incidents.

❖ All fatality investigations shall include a representative from the office (or an external person appointed by the office). Similarly investigations of property damages of high value and accidents causing significant or long term impact on the environment shall include an office representative. DPA or a person appointed on his behalf shall appoint and authorize the team for conducting the investigation. Shipping companies may appoint independent surveyors and/or surveyors from Insurers and P&I clubs.

➢ **When to investigate?**

The investigation should be conducted as soon as possible, after the immediate steps, required for the safety of the people or vessel, have been completed. Evidences shall be collected, recorded and preserved as memories are likely to fade. It is further imperative to write notes on how the incident occurred as soon as possible after the event.

➢ **How to investigate?**

❖ **'Big Picture' first**

Have a look at the scene of the accident and try to identify the people, equipment, materials and conditions present at the scene of the accident. Take photos, video recordings of the site.

❖ **Interview the witnesses**

- ✓ Interviews should be done as quickly as possible after the incident so that people do not forget the details.
- ✓ Each person shall be interviewed separately.
- ✓ Interviewing at the site of the accident is helpful.
- ✓ Any personnel directly involved with the operations leading to incident, should be asked about their routine working schedule and rest periods immediately preceding the incident to confirm if they were adequately rested or could be suffering from fatigue at the time of incident.
- ✓ The possibility of effect of drugs and alcohol must be investigated.

❖ **Collection of evidence**

The evidences relating to the incident are mostly found onboard the ship and these evidences are needed by the P&I Club and other parties for proper investigations. This is in order to evaluate the damage and to establish liability and to defend claims which are received from injured persons, the owners of damaged cargo or property, or from a terminal operator. The evidences collection will include

- ✓ Using visual aids such as photographs (with date/time imprinted), sketches, maps, etc.
- ✓ Thorough examination of equipment and surroundings
- ✓ Inspection reports, maintenance records, log books etc.
- ✓ Collecting Interview reports
- ✓ Shore based testing of samples

➢ **Correlating and reviewing information**

Having completed the evidence collection the incident stages shall be correlated with evidences. It may require re-interview of witnesses to clarify any doubts. The facts shall be carefully analyzed. Drawing a timeline of the events helps in analyzing the accident.

➢ **Report generation and reporting**

❖ Reports shall comprise of sketches, photos and descriptions as applicable. Clarity of the report is

> The judgments shall be free from bias and based on facts and not on pre-determined views.

important as people reading the report have not seen the incident site and have not heard the evidence. The readers should be able to clearly understand the facts through the report.

- The company specific reporting procedures shall be followed as provided in shipboard SMS manuals. The people mentioned in these manuals shall be notified on occasions within the specified time frame as mentioned, through appropriate communication channels. The manuals may also include specific codes to be used in the reports for reporting various details.
- In addition to the main report the following details shall be added in the report, as applicable
  - ✓ Man hours lost
  - ✓ Delay to vessel, if any
  - ✓ Known / expected costs
  - ✓ Total loss including loss of revenue
- Reports are usually made on following occasions
  - ✓ All Injuries, major/ minor incidents, damages, delays to vessel or cargo, fines or losses
  - ✓ Occupational diseases
  - ✓ Pollution incidents including oil spill contained on board
  - ✓ Release of toxic vapours
  - ✓ PSC deficiencies, fines etc.

➢ **Follow up and closing out of incident report**

- Preventive actions identified during investigation must be implemented within three months of incident and report closed. Any delays should be immediately notified to shipping company.
- In case the implementation of the corrective and preventive actions requires action by a shore based office, the shore staff shall coordinate the same.
- All injury and incident reports, along with findings of analysis or investigation and corrective and preventive action taken must be discussed in the QHSE meeting.

> Corrective actions for an incident or a near miss shall be the first priority and must be taken

- The effectiveness of the corrective and preventive actions must be reviewed during subsequent safety meetings and master's review.

➢ **Sharing lessons learnt**

In case, any breach of regulations or company SMS procedures, considered critical, is identified during investigation, a notification is sent to the ships as soon as possible by relevant department. The Company sends a short summary of the important accident reports to all the ships, with a view to prevent similar accidents on other ships. In case of major accidents, company shall share the lessons learnt with appropriate industry groups, e.g., classification societies, professional institutes, shipyards etc. Major incidents would form a part of case studies for senior officer seminars.

**4) Commercial and legal aspect of accident investigation and reporting**

➢ ISM code requires proper investigation of all incidents occurring on board.

➢ Hull and machinery of the ship is insured by hull and machinery underwriters. Protection and indemnity (P&I) clubs insure ship owners and managers for their liabilities to third parties arising out of the operation of ships. The main elements of P&I cover are
- personal injuries to crew, stevedores and passengers
- physical damage caused to docks, fixed or floating objects and collision damage caused to other ships
- pollution

- cargo loss or damage which occurs when the cargo is in the custody of the ship
- stowaway and ship security problems

- The accidents such as pollution can lead to huge claims. For establishing claim liabilities the Insurers and P&I clubs conduct investigations. The evidences are often required in case trials in the legal proceedings. In addition to evidences (including log books), protests need to be lodged by the master in the form of sea protest when suspecting cargo damage due to heavy seas enroute.
- The P&I clubs and the insurers assign guidelines for shipboard collection of evidences and reporting procedures. Based on these guidelines procedures are established and mentioned in the company SMS manuals. Additionally a club rule book is usually provided on board for reference.
- In the event of an incident or allegation P&I clubs mention certain Do's and Don'ts which shall be followed.

**Apply Your Knowledge**

1. Discuss how you would carry out an investigation for a drugs found on board in crew recreational area while at sea.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Contribute to the safety of personnel and ship

**Task number:** C 7.1

**Sub-task Reference number:** C7.1.8

**Topic:** Safety of personnel and ship

**Task Heading**

- Identify and analyze three near misses occurring during the time onboard and discuss results with the chief officer.

**Objectives**

- Understand what is a near – miss and the purpose and process of reporting the same

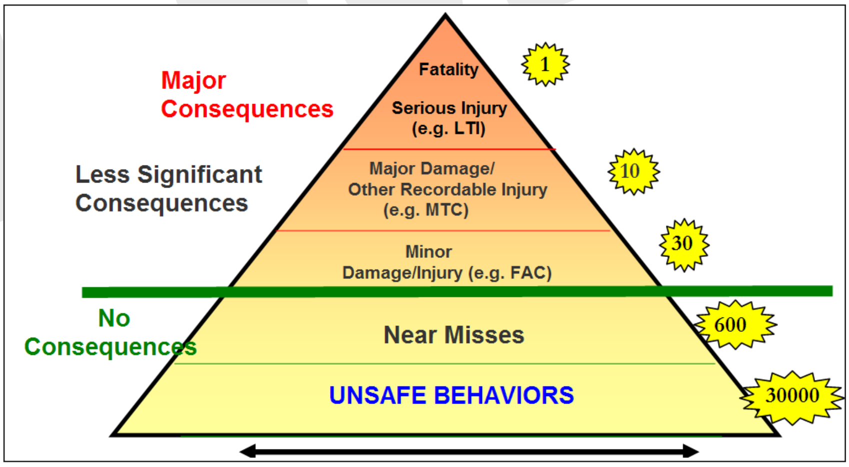
**Index**

1) Near-miss
2) Near-miss investigation process
3) Near-miss reporting procedure
4) Barriers to reporting near-misses

**Description**

**1) Near-miss**

- A sequence of events and/or conditions that could have resulted in loss is termed a near miss. The potential loss is somehow prevented only because of a fortuitous break in the chain of events and/or conditions. The potential loss could have been human injury, damage to property or environmental damage leading to loss of life or huge financial costs arising out of repairs, replacement costs, scheduling delays, contract violations, loss of goodwill etc. Statistics show that for every major injury, about 10 minor injuries, 30 property damages, 600 near misses and 30,000 unsafe acts / conditions occur. Study of near misses can therefore be used to prevent more serious incidents. It is important that each and every near miss on board is identified, reported and analyzed for root causes.




- Near misses can further be identified as of following types:

❖ Any event that leads to the implementation of an emergency procedure, plan or response and thus prevents a loss.
❖ Any event where an unexpected condition could lead to an adverse consequence, but which does not occur.
❖ Any dangerous or hazardous situation or condition that is not discovered until after the danger has passed.

**2) Near-miss investigation process**

Investigating and reporting of near-misses is an integral component of continuous improvement in safety management systems. In accordance with SMS procedures established by shipping company, all near miss situations shall be investigated and reported. In-depth investigation is required of those near-misses which are likely to recur and/or which could have had severe consequences. The ultimate objective of near-miss reporting and investigating is to identify areas of concern and implement appropriate corrective actions to avoid future losses.

- Gathering information
  Information is gathered for ensuring that an understanding can be reached about what, how, who, and why the near-miss occurred. Data gathering is done by interviews of key personnel and the collection of data using things such as photographs, VDR recordings, charts, logs, or any damaged components, existing safeguards in place to protect the persons, and the operational systems impacting the near-miss event.

  As a minimum, the following information should be gathered about any near-miss:
  - Who and what was involved?
  - What happened, where, when, and in what sequence?
  - What were the potential losses and their potential severity?
  - What was the likelihood of a loss being realized?
  - What is the likelihood of a recurrence of the chain of events and/or conditions that led to the near-miss?

- Analyzing information
  Collected information shall be analyzed to check if all questions are resolved or any additional information still needs to be collected to resolve open questions about the near-miss and its causes. The end goal of this activity is to identify all causal factors.

- Identifying causal factors
  Having identified who, what, where, why, and when of the near-miss and the human errors, structural/machinery/equipment/outfitting problems, and external factors that led to the near-miss, the causal factors that contributed to the near-miss shall now be identified. There are a variety of identification methods for this purpose, including taxonomies of causes. These can be used for deep probing past the most evident causes. There should be consistency in the identification and nomenclature of causal factors across near-miss and casualty/incident reports.

- Developing and implementing recommendations
  Implementing appropriate recommendations is the key to eliminating or reducing the potential for the reoccurrence of similar near-misses or more serious losses. Recommendations shall be made depending upon all of the identified causal factors. These recommendations shall be implemented to improve organizational and shipboard policies, practices and procedures.

- Completing the investigation
  Depending on the depth of analysis performed and the extent of risk a report is generated either brief or extensive, as applicable. These are further collated and stored for further trend analysis in long term. Near-miss reports should be considered along with actual casualty or incident reports to determine trends.

**3) Near miss reporting procedure**

- Companies establish safety management systems whereby the procedure for reporting near misses is defined.

- Individuals are usually hesitant to report near misses. To facilitate participation and encourage involvement, near misses shall be reported in confidence. It is recommended that the immediate superior obtains the near miss reports and passes them on to the higher rank without names.

- Crew should be encouraged to use the ‘Safety Suggestions’ notebook to write near miss reports.
- The near miss reports should then be discussed in the next safety committee meeting with all staff, and analyzed to find the causes of the near miss and what could be done to prevent accidents. Statistics on numbers of reports received every month from the crew onboard should be recorded in the safety committee meeting minutes.
- Corrective actions must be taken immediately to show commitment and usefulness of the reporting to the individual.
- All near misses, which have a major and above potential for loss and/ possible and above frequency/probability/chances of reoccurring should be sent to the shipping company office where these are treated in strict-confidentiality. The reports are usually sent to the Designated Person Ashore (DPA) for investigations and records.
- Every near miss report must be analyzed for the potential for loss as well as the possibility of reoccurrence. This helps in focusing attention on the important issues. Corrective action to prevent accidents which may have resulted should be taken immediately.

**4) Barriers to reporting near-misses**

- Main barriers to the reporting of near-misses include
    - the fear of being blamed, disciplined, embarrassed, or found legally liable
    - blame-oriented culture prevailing in an organization
    - unsupportive company management attitudes such as complacency about known deficiencies
    - insincerity about addressing safety issues and discouragement of the reporting of near-misses by demanding that seafarers conduct investigations in their own time

> Just culture
> An atmosphere of responsible behaviour and trust whereby people are encouraged to provide essential safety-related information without fear of retribution

These barriers can be overcome by management initiatives such as

- Encouraging a ‘just-culture’ in the company which covers near-miss reporting
- Assuring confidentiality for reporting near-misses
- Personal information should not be retained once the investigation and reporting processes are complete
- Ensuring that investigations are adequately resourced
- Following up on near-miss report suggestions and recommendations
- Wide dissemination of decisions

**Apply Your Knowledge**

1. Discuss the near miss reporting procedure as specified in your company specific SMS procedures.
2. Identify and analyze three near misses occurring during the time onboard and discuss results with the chief officer.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Contribute to the enhancement of maritime security through heightened awareness

**Task number:** D1.1

**Sub-task Reference number:** D1.1.8

**Topic:** Ship security

**Task Heading**

- Demonstrate an understanding of the use and function of Ship Security Alert System (SSAS).

**Objectives**

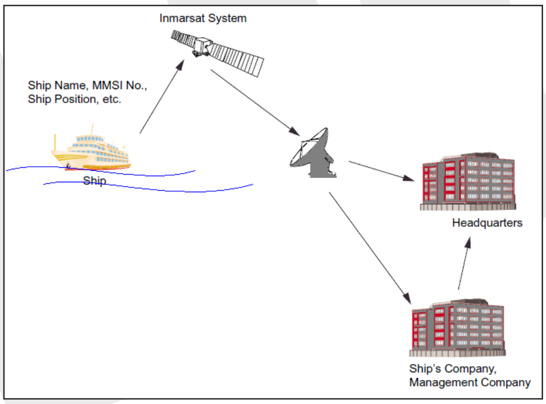
- Understand the purpose and operation of Ship Security Alert System.

**Index**

1) Ship Security Alert System

**Description**

**1) Ship Security Alert System**




- The ship security alert system (SSAS) is provided to a ship for the purpose of transmitting a security alert to the shore authority and to the company to indicate that the security of the ship is under threat or has been compromised. SOLAS chapter XI-2, regulation 6 requires ships to be provided with a ship security alert system.
- The procedures for the security alert are a part of the ship security plan and are individual to the ship. The ship security alert procedures are preferably NOT of an internationally agreed format for all ships. The purpose is to send a covert signal or message from a ship without many people on board knowing that any such action has been taken. No alarm is activated on board or to inform ships in vicinity keeping the alerting process secretive.
- The ship security alert system has at least two activation points, one of which is located on the bridge. The procedures for the use of the ship security alert system and the location of the activation points are given in the ship security plan. Measures are incorporated in the activation points to avoid their inadvertent operation and the generation of false alerts. To initiate the transmission of a ship security alert any one of the activation point needs to be activated.
- Ship security alert system is powered from the ship's main source of electrical power and an alternative source of power.
- The authority ashore receiving the alert notifies further authorities responsible for maritime security in country in whose vicinity the ship is presently operating.
- Possible methods of achieving the alert are as follows:
- ❖ A system may employ proprietary tracking equipment provided by traffic service providers.
- ❖ A system may utilize modifications of GMDSS equipment.

- The ship security alert system, when activated, continues transmission of the security alert until deactivated and/or reset. The ship security alarm system is not transmitted to any other ship station.
- Routine testing of the ship security alert system is carried out on board. Testing of installed SSAS involves sending of test message to the designated authorities. The CSO (company security officer) and other involved authorities could be informed well before regarding the test.

**Apply Your Knowledge**

1. Read the user's manual for the SSAS system provided on board your vessel. Locate the activation points for the SSAS system.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Contribute to the enhancement of maritime security through heightened awareness

**Task number:** D1.1

**Sub-task Reference number:** D1.1.9

**Topic:** Ship security

**Task Heading**

- Identify the circumstances when Declaration of Security (DOS) is carried out.

**Objectives**

- Understand purpose and procedure of DOS.

**Index**

1) Declaration of Security
2) Request of DOS by a ship
3) Request of DOS by a port facility
4) Sample DOS

**Description**

**1) Declaration of Security**

- A declaration of security (DOS) is an agreement between a port facility and a ship or between a ship and another ship. It confirms the security responsibilities of each party during a ship/port interface or a ship-to-ship activity. DOS is a written agreement between a port facility and a ship visiting that facility on their respective security responsibilities during the visit. A DOS provides detailed measures to be shared or additionally provided and by which party.
- Declaration of security is normally not required when both the port facility and the ship are operating at Security level 1. The precise circumstances when a DOS is to be requested by a ship from a port facility or another ship can be established through the ship's security assessment.
- The circumstances are determined by assessing the risk that the ship/port interface or ship-to-ship activity poses to persons, property or the environment. These circumstances are usually specified by the designated authority or administration for inclusion in port facility security plan (PFSP) and ship security plans (SSP). DOS is required in the following scenarios:

❖ When a ship is operating at a higher security level than the port facility with which it is interfacing
❖ When there has been a security threat or a security incident involving a port facility or a ship with which it is interfacing
❖ A port facility or ship is operating at security level 3
❖ There has been a change to the security level applying to a port facility or a ship with which it is interfacing
❖ A specific ship/port interface could endanger local facilities or residents
❖ A specific ship/port interface could pose a significant pollution risk
❖ A ship/port interface involves embarking or disembarking passengers or handling of dangerous cargo
❖ A ship is undertaking a ship-to-ship activity while operating at a higher security level than the other ship
❖ A ship-to-ship activity involves the transfer of passengers or dangerous cargo at sea
❖ A ship-to-ship activity could involve the risk of significant marine pollution

- ❖ There is a government-to-government agreement requiring a DOS covering specified international voyages and the ships engaged on such voyages or ship-to-ship activities during such voyages
- ❖ A ship is using a non-SOLAS port facility
- ❖ A ship is undertaking a ship-to-ship activity with a non-SOLAS ship
- ❖ A non-SOLAS ship proposes to use a SOLAS port facility
- ❖ A ship is not compliant with the maritime security measures [e.g. without a valid International Ship Security Certificate (ISSC)]

- ➢ A DOS covers the security responsibilities to ensure
- ❖ ensure the performance of all security duties
- ❖ monitor restricted areas to ensure that only authorized personnel have access
- ❖ control access to the port facility and ship
- ❖ monitor the port facility, including berthing areas and areas surrounding the ship
- ❖ monitor the ship, including berthing areas and areas surrounding the ship
- ❖ handle cargo and unaccompanied baggage
- ❖ monitor the delivery of ship's stores
- ❖ control the embarkation of persons and their effects
- ❖ ensure that security communication is readily available between the ship and port facility

- ➢ The maritime security measures do not apply to the off-shore activities beyond the country's territorial sea but within its exclusive economic zone or continental shelf. It is likely that SOLAS ships will operate in these waters and interface with off-shore installations and undertake ship-to-ship activities with a non-SOLAS ship. In such cases DOS is carried out between ship and offshore installation including single buoy moorings, mobile offshore drilling units, floating production storage and offloading vessels (FPSOs).

- ➢ Ships are recommended to keep records of covering at least ship's last ten ports of call available for inspection by government officials undertaking control and compliance measures under the maritime security measures.

**2) Request of DOS by a ship**

- ❖ A ship can request that a DOS be agreed by a port facility or another ship. The circumstances when such a request should be made will be those specified in the SSP. If a ship requests for a DOS, the port facility has to acknowledge the request made. However, the port facility need not compulsorily agree to a DOS with the requesting ship unless the circumstances relating to the request conform to those in the PFSP.

- ❖ The requirement for a ship to initiate, complete and retain a DOS is determined as stated in the ship's security plan. The shipping companies provide a model form for a DOS in the SSP. The SSP mentions the procedures to be followed and the security measures and procedures to be implemented when initiating a DOS or responding to a request for a DOS.

- ❖ The DOS is completed in a language common to both parties, by the ship's security officer (SSO). When completed, it is signed and dated both by the SSO and the port facility security officer (PFSO). In the case of ship-to-ship activity, it must be signed and dated by both ship SSOs. The DOS only takes effect after it has been signed by both parties. For a ship-to-ship activity, in place of port facility, the respective responsibility is accepted by each ship in accordance with their SSP.

**3) Request of DOS by a port facility**

- ❖ The circumstances, when the port facility can initiate a DOS are documented in the PFSP. When a port facility initiates a DOS, the request shall be acknowledged by the ship's SSO and the ship must comply with the request if the ship intends to continue its interface with the port facility. If a ship is operating at a higher security level than the port facility the ship/port interface should take place at its higher security level.

❖ DOS is completed by the PFSO in this case. It is completed in a language common to both parties, and signed/ dated both by the PFSO and the ship's security officer. When a port facility initiates a DOS, the request shall be acknowledged by the ship's SSO and the ship must comply with the request.

**4) Sample DOS**

**Form of a Declaration of Security between a ship and a port facility[s]**

**DECLARATION OF SECURITY**

| | |
|---|---|
| Name of Ship : | |
| Port of Registry : | |
| IMO Number: | |
| Name of Port Facility : | |

This Declaration of Security is valid from ............................. until ……………………. , for the following activities ..........................................................................

(list the activities with relevant details)

under the following security levels

| | |
|---|---|
| Security level(s) for the ship : | |
| Security level(s) for the port facility : | |

The port facility and ship agree to the following security measures and responsibilities to ensure compliance with the requirements of Part A of the International Code for the Security of Ships and of Port Facilities.

| | The affixing of the initials of the SSO of PFSO under these columns indicates that the activity will be done, in accordance with relevant approved plan by | |
|---|---|---|
| **Activity** | **The port facility:** | **The ship:** |
| Ensuring the performance of all security duties | | |
| Monitoring restricted areas to ensure that only authorized personnel have access | | |
| Controlling access to the port facility | | |
| Controlling access to the ship | | |
| Monitoring of the port facility, including berthing areas and areas surrounding the ship | | |
| Monitoring of the ship, including berthing areas and areas surrounding the ship | | |
| Handling of cargo | | |
| Delivery of ship's stores | | |

[s]This form of Declaration of Security is for use between a ship and a port facility. If the Declaration of Security is to cover two ships this model should be appropriately modified.

| | | |
|---|---|---|
| Handling unaccompanied baggage | | |
| Controlling the embarkation of persons and their effects | | |
| Ensuring that security communication is readily available between the ship and port facility | | |

The signatories to this agreement certify that security measures and arrangements for both the port facility and the ship during the specified activities meet the provisions of chapter XI-2 and Part A of Code that will be implemented in accordance with the provisions already stipulated in their approved plan or the specific arrangements agreed to and set out in the attached annex.

Dated at ............................................................ on the ............................................................

| Signed for and on behalf of | |
|---|---|
| The port facility: | The ship: |
| (signature of Port Facility Security Officer) | (Signature of Master or Ship Security Officer) |

| Name and title of person who signed | |
|---|---|
| Name: | Name: |
| Title: | Title: |

| Contact details<br>(to be completed as appropriate)<br>(indicate the telephone numbers or the radio channels of frequencies to be used) | |
|---|---|
| for the port facility: | for the ship: |
| Port Facility: | Master: |
| | Ship Security Officer: |
| Port Facility Security Officer: | Company: |
| | Company Security Officer: |

## Apply Your Knowledge

1. Check your vessel's DOS records and discuss the salient features of the same with reference to increasing security levels with your Shipboard Training Officer.

**Function:** Controlling the operation of the ship and care for persons on board

**Competence:** Contribute to the enhancement of maritime security through heightened awareness

**Task number:** D1.1

**Sub-task Reference number:** D1.1.10

**Topic:** Ship security

**Task Heading**

- Understudy team leaders in various security drills.

**Objectives**

- Understanding the purpose and procedure of conducting Security Drills

**Index**

1) Introduction
2) Security drills and exercises
3) Records pertaining to security drills and training

**Description**

**1) Introduction**

- The ship security plan is prepared to address three elements with regards to ship security:

- Awareness: A vessel's crew should continually be aware of their environment and the domain in which they are operating as the critical first step to prevent acts threatening the security of vessels.
- Prevention: Prevention measures are those designed to increase the difficulty of unauthorized boarding, prevent the introduction of prohibited weapons, incendiaries, or explosives, and prevent the unauthorized operation of a vessel.
- Response: A vessel's crew should be prepared to respond within their capabilities to acts that threaten the security of the vessel.

- The objective of conducting security drills and exercises is to ensure that shipboard personnel are proficient in all assigned security duties at all security levels and are able to identify any security related deficiencies, which need to be addressed.

**2) Security drills and exercises**

- A security drill is usually conducted at least once every three months, in accordance with the shipboard SMS and ship security plan. Additionally in cases where more than 25% of the ship's personnel has been changed, at any one time, with personnel that has not previously participated in any drill on that ship, within the last 3 months, a drill should be conducted within one week of the crew change. An entry shall be made in the security logbook regarding the conduct of the drill.

- Following aspects in relation to security shall be covered in drills
- Actions in case of security threats and procedure of raising the security level
- Use of established keyword alerts to be used in sending a message under duress and to be used on board when security of the vessel is threatened
- Activation procedure of the ship security alert system
- Calling emergency stations and procedures to carry out a

shipboard search
- Evacuating the ship or leaving the port
- Use of appropriate security contingency plans
- Procedures, instructions and guidance on the use of the ship security equipment, including the routine testing and operating instructions
- Additionally, actions in cases of bomb threat
  - ✓ Procedures of interpreting and analyzing bomb threats received verbally or in writing
  - ✓ Extracting maximum details from verbal communication in order to identify and locate the bomb and the informer
  - ✓ Access control and tightening of restricted areas
  - ✓ Procedures of carrying out shipboard search
  - ✓ Procedures of tampering with equipment / cargo / stores
  - ✓ Cordoning off the area/ device
  - ✓ Procedures to avail shore based assistance
  - ✓ Preparing for subsequent occurrences of bomb explosion such as structural damage, fire etc.
  - ✓ Precautionary measures while carrying out the search and other operation

- Additionally, actions in incidents of piracy and hijacking
  - ✓ Identifying precautionary measures and proper vigilance procedures
  - ✓ Procedures to maintain a 24 hour visual and security watch
  - ✓ Procedures of establishing emergency radio contacts
  - ✓ Use of lights, water hoses, ship's whistle etc. to reduce opportunities for theft
  - ✓ Actions on detecting attackers/ pirates
  - ✓ Actions in case of hijacking or seizure of ship or personal
  - ✓ Actions in cases whereby a ship is hijacked to be used as weapon or means to cause damage
  - ✓ Procedures to deal with attack on vessel whilst at sea
  - ✓ Procedures for dealing with terrorists in cases of hijack including co-operation with terrorists and identifying dangers of provocation
  - ✓ Procedures for preservation of life and personal safety of all innocent parties involved
  - ✓ Procedures to be followed in cases of military action by authorities
  - ✓ Procedures to deal with stowaways

- Actions in cases involving smuggling of weapons or similar equipment
  - ✓ Procedures to deal with unidentified objects / explosives on vessel
  - ✓ Procedures in case of attack from seaward whilst at berth or at anchor
  - ✓ Monitoring the ship and surroundings
  - ✓ Damage control procedures in case of damage to ship / port by explosion arson / sabotage
  - ✓ Crew readiness at enhanced security levels

- In addition, **security exercises** shall be conducted in order to test vessel security plan and include the substantial and active participation of personnel on board who have security responsibilities.

**3) Records pertaining to security drills and training**

- Ship security officer shall be maintaining the following records with respect to training and security drills. These records shall be maintained for duration as specified by the vessel's flag state administration, usually for at least three years. These records shall be protected from unauthorized access or disclosure. It shall be noted that SSP is generally not subject to inspection by port state control officers unless the PSC officer have clear grounds to believe that the ship is not in compliance with the requirements of ISPS code.

The SSO shall ensure that records kept in electronic format are protected from deletion, destruction and revision.

- ❖ details of security training, including the date, duration and description and the names of the participants
- ❖ details of security threats, breaches of security and security incidents, including the date, time, location and description, the response to them and the person to whom they were reported
- ❖ records of maintenance, calibration and testing of equipment used for security
- ❖ practices or lessons learned that might improve the vessel security plan
- ❖ the approved vessel security plan and details of each periodic review of the vessel security plan, including the date on which it was conducted, the findings of the review and any amendments to the plan that are recommended

**Apply Your Knowledge**

1. Attend a ship security drill and understand your responsibilities.
2. Discuss the procedures for carrying out a bomb search on board and precautions to be observed while carrying out the search.