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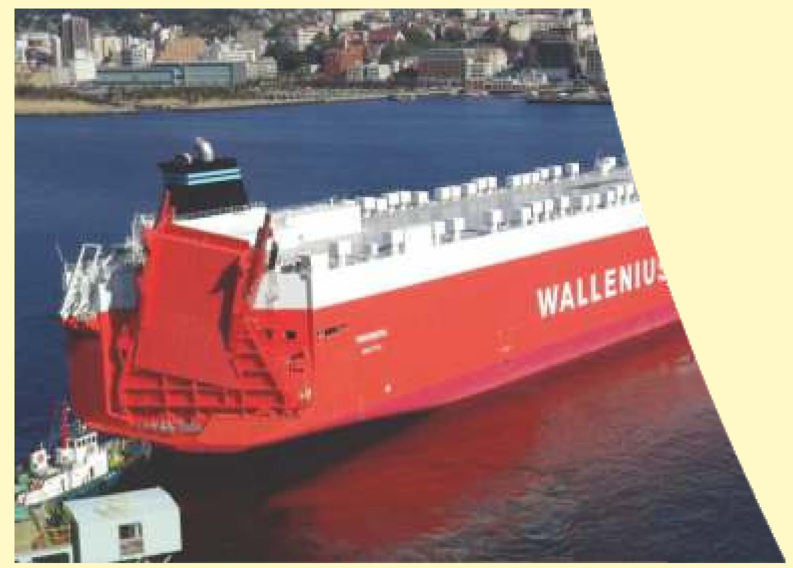
DISTANCE LEARNING MATERIAL FOR SEMESTER 3



INDIAN MARITIME UNIVERSITY

(A Central University under the Ministry of Shipping)

DISTANCE LEARNING MATERIAL
for
SEMESTER 3

DNS Leading to B.Sc
(Applied Nautical Science)

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DISTANCE LEARNING MATERIAL
for
(SEMESTER 3)

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 3 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

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- 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 3 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 3rd, 4th and 5th 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**

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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

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

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- 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 3

- 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 3
Function 1: Navigation

Sr. No.	Topic	Task No.	Task Description	Page No.
1.	Celestial navigation	A1.1.1	Identify and correct sextant instrument errors. Obtain and apply index error.	1 – 3
2.	Celestial navigation	A1.1.2	Obtain accurate bearings of sun, moon, stars and planets.	4 – 9
	Terrestrial and coastal navigation	A1.2.3	Take accurate bearings of a point of land, a lighthouse or a beacon (identified on the chart).	
	Compass - Magnetic and gyro	A1.7.4	Compare compasses and determine compass error using: ❖ Azimuth, choosing the body with most suitable altitude ❖ Amplitude ❖ Transit bearings	
3.	Celestial Navigation	A1.1.3	Recognize conspicuous star constellations and stars of first magnitude. Practice use of star chart and star finder. Identify most suitable celestial bodies during twilight.	10 - 13
4.	Terrestrial and Coastal Navigation	A1.2.1	Recognize various landmarks and aids to navigation, including lighthouses, beacons, buoys and topographical features.	14 - 22
	Charts and Publications	A1.3.1	Demonstrate familiarity with the chart folio system.	
		A1.3.2	Demonstrate understanding of the use of BA Chart 5011 (Symbols and Abbreviations used on Admiralty Paper Charts) and identify various chart symbols; e.g. buoys, marks, wrecks, obstructions, shallow depths, reefs and other dangers to navigation. Correctly interpret information obtained from charts and publications.	
5.	Terrestrial and Coastal Navigation	A1.2.2	Demonstrate understanding of identifying characteristics of lights and of the 'rising' and 'dipping' of lights and compare the observed and charted characteristics of lights	23 – 28
6.	Terrestrial and Coastal Navigation	A1.2.4	Determine the ship's dead reckoning position and estimated position, taking into account winds, tides, currents and estimated speed.	29 - 36
7.	Terrestrial and Coastal Navigation	A1.2.5	Demonstrate understanding of the IALA Maritime Buoyage System for Region A and Region B including the emergency wreck marking buoy.	37 - 45
8.	Charts and Publications	A1.3.3	Make inventory of publications available on bridge.	46 - 51
9.	Charts and Publications	A1.3.4	Demonstrate understanding of the contents and use of relevant BA publications, including: ❖ Weekly, Cumulative and Annual Notices to Mariners ❖ Mariner's Handbook (NP 100) ❖ Catalogue of Admiralty Charts and Publications (NP 131) ❖ Sailing Directions	52 - 60

Sr. No.	Topic	Task No.	Task Description	Page No.
			❖ Ship's Routeing Information ❖ Ocean Passages for the world ❖ List of Lights & Fog Signals (including Digital list of lights) ❖ Tide Tables, Tidal Stream Atlases ❖ Admiralty List of Radio Signals ❖ Routeing charts	
10.	Electronic systems of position fixing and Navigation	A1.5.1	Use GPS fix to plot vessel's position, after applying applicable datum errors	61 - 65
11.	Echo Sounders	A1.6.1	Demonstrate operation of echo sounder and correctly apply the information obtained. Compare observed depth with charted depth after adjusting for tide, etc. Set depth alarm, where fitted	66 - 69
12.	Compass - Magnetic and Gyro	A1.7.1	Demonstrate boxing of compass.	70 - 73
		A1.7.2	Apply magnetic variation and deviation to magnetic compass readings.	
		A1.7.3	Demonstrate the use of deviation card when using magnetic compass readings	
13.	Steering Control Systems	A1.8.1	Perform change-over from manual to automatic steering and vice versa under supervision. Test the system on all modes available, including NFU mode.	74 - 77
		A1.8.2	Adjust various controls available in the steering control system for optimum performance.	
		A1.8.3	Identify various alarms associated with the steering control system. Demonstrate setting and testing of "off course" alarm under supervision	
14.	Meteorology	A1.9.1	Read barometer accurately and obtain corrected barometric pressure.	78 - 83
		A1.9.2	Read barograph if fitted and obtain the barometric tendency.	
		A1.9.3	Read hygrometer/Psychrometer and obtain dew point.	
		A1.9.4	Obtain and record sea and air temperatures.	
		A1.9.5	Estimate wind direction (by wave observation) and wind force using sea state (Beaufort scale).	
		A1.9.6	Estimate swell direction and wave height	
15.	Watch Keeping	A2.1.1	Read and discuss with a senior officer "Watch keeping arrangements and principles to be observed" concerning navigation watch at sea and anchor as stated in STCW 2010.	84 - 91
		A2.1.2	Keep a proper look-out by day and night. Report objects correctly, assess and determine risk of collision.	
		A2.1.3	Read Master's standing and bridge orders. Identify the circumstances for when to call the Master	
16.	Navigational Equipment	A2.2.1	Receive full bridge familiarization as per company's Safety Management System checklist from a navigating officer	92 - 93

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task number: A1.1

Sub-task Reference number: A1.1.1

Topic: Celestial Navigation

Task Heading

- Identify and correct sextant instrument errors. Obtain and apply index error.

Objectives

- Familiarize yourself with sextant and be able to use same.

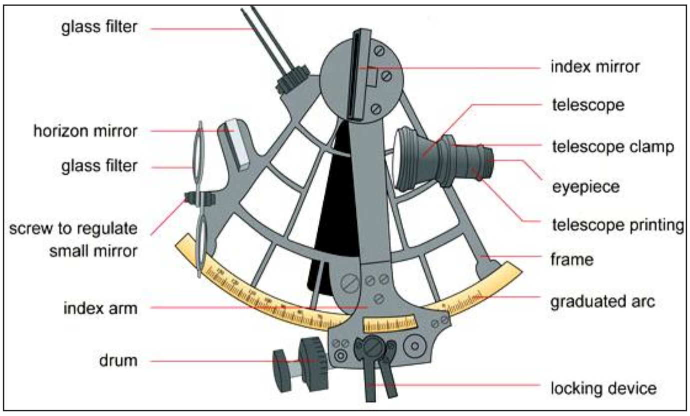
Index

1) Definition
2) Principle of sextant
3) Errors and adjustment of a sextant
    a) Adjustable errors
    b) Non-adjustable errors
4) Taking care of sextant

Description

1) Definition

The sextant is a precision instrument used at sea for measuring altitudes of celestial bodies. It can also be used for measuring horizontal and vertical angles between and of terrestrial objects respectively.



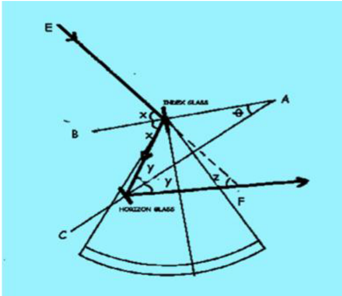
Generally there are two types of sextant:

- Micrometer sextant
- Vernier sextant

The difference lies only in the method of graduating the arc.

2) Principle of sextant

A sextant is based on the optical principles provided below:



- When a ray of light is reflected from a plane surface, the angle of incidence is equal to the angle of reflection; with the incident ray, reflected ray and the normal lying in the same plane.
- When a ray of light, undergoes two successive reflections in the same plane, by two plane mirrors, the angle between the incident ray and the final reflected ray is twice the angle between the mirrors.

3) Errors and adjustment of a sextant

There are two types of errors on sextants: - Adjustable and Non- adjustable errors.

a) Adjustable errors

- **Error of perpendicularity:** The index glass must be perpendicular to the plane of the instrument. It can be checked by moving the index arm to almost near the middle of the sextant arc. Hold the instrument horizontally such that the index mirror is towards the observer. Look into the index mirror to see if the reflected image of the arc is in line with the true graduated arc itself. If these are not in perfect alignment, then the error of perpendicularity exists. This error can be corrected by means of the **first adjustment screw** which is on the back of the Index mirror - (rotate the screw such that the reflected image and the arc itself are in line).

  > Error of perpendicularity can be corrected by adjusting First Adjustment screw.

- **Side error –** This error is caused by the horizon glass not being perpendicular to the plane of the sextant. To check for this error during day - set the index bar at zero and observe the horizon through the telescope, while holding the sextant in a horizontal position. If the true horizon and its reflection on the mirror half of the horizon glass appears in alignment, then no side error is present. If not then side error exists. At night, observe a star through the telescope, keeping the sextant in a vertical position - if the true image and the reflected image are displaced horizontally then side error is present. This error can be corrected by adjusting the **second adjustment screw** which is on the top and at the back of the horizon glass.

  > Side error can be corrected by adjusting Second Adjustment screw.

- **Error of collimation:** This is due to the axis of the telescope not being parallel to the plane of the instrument. This error is generally present only in the old sextants that were provided with an adjustable telescope collar. This error could be corrected in these instruments by means of collimating screws provided on the telescope's collar. In modern sextants - the telescope comes attached to the body of the sextant in such a manner that it cannot tilt and so error of collimation is eliminated.
- **Index error:** After correction of the three errors mentioned above, check if the index glass and the horizon glass are parallel to each other when the index bar is set to zero**.** If not then **INDEX ERROR** exists. The index error can be found by various methods:

- During the day - Set the index bar at zero and keeping the sextant vertical, observe the horizon through the telescope. If the true horizon and the reflected image appear in the same line then there is no index error. If they are not in the same line then adjust the micrometer on the index bar till they are on the same line. This will be the index error which can be "off the arc" or "on the arc" depending whether the reading is below zero or above zero on the scale.

- During the night - The index error can be found by observing a star through the telescope with the index bar clamped at zero. If there is any vertical displacement between the star and its reflection, then index error exists and the amount can be found by adjusting the micrometer.

  The index error can be eliminated by adjusting **the third adjustment screw** which is located below the second adjustment screw and towards the side, at the back of the horizon glass.

  > Index Error can be corrected by adjusting Third Adjustment screw.

  NOTE: When the second and third adjustments being carried out on the horizon glass, one adjustment may affect the other. It is therefore advisable after adjusting one, to check for the other. Any residual error will have to be applied as index error to all sextant observation readings. Generally if the index error is not large (less than 3.0') it is left uncorrected and allowed for when observing altitudes.

b) Non adjustable errors

There are errors which cannot be corrected on board. These include:-

- Prismatic error
- Centering error
- Graduation error

To correct above errors, the sextant would have to be sent ashore to the manufacturers.

4) Taking care of sextants

- Always handle sextant with great care – a slight jolt may permanently damage it.
- Always hold the instrument by the frame or the handle. When taking the sextant out of the box, hold the frame with the left hand and hold the handle with the right hand.
- Never leave the sextant exposed to direct sunlight.
- When you are using the sextant in damp weather - take care to clean the sextant with a soft cloth. Moisture can damage the polished surface of the mirrors.
- Stow the sextant in a place free from vibration and dampness.
- When stowing the sextant for a long period of time a thin coat of vaseline on the arc is advisable.

Apply Your Knowledge

1. Discuss the procedure for calculating index error of sextant on board your ship and find same.

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task number: A1.1, A1.2, A1.7

Sub-task Reference number: A1.1.2, A1.2.3, A1.7.4

Topic: Celestial Navigation, Terrestrial & Coastal Navigation and Compass - Magnetic and Gyro

Task Heading

- Obtain accurate bearings of sun, moon, stars and planets.
- Take accurate bearings of a point of land, a lighthouse or a beacon (identified on the chart).
- Compare compasses and determine compass error using:
  - Azimuth, choosing the body with most suitable altitude
  - Amplitude
  - Transit bearings

Objectives

- Familiarize with various methods to obtain compass error, practice use of azimuth mirror and take accurate bearings of celestial and terrestrial objects and calculate compass errors.

Index

1. Azimuth circle
2. Using azimuth circle for taking bearings/ azimuths
3. Various methods for obtaining compass error
4. Definition of azimuth
5. Procedure for observing azimuth
6. Procedure for calculating actual azimuth (ABC tables/ calculator)
7. Definition of amplitude
8. Procedure for observing amplitude
9. Finding compass error by transit bearings
10. Sample calculations

Description

1) Azimuth circle

> Basically, azimuth and bearing are the same in meaning: the horizontal angle that a line drawn from your position to the object sighted makes with a line drawn from your position to true north. The word azimuth, however, applies only to bearings of heavenly bodies. For example, it is not the bearing, but the azimuth of the Sun; and not the azimuth, but the bearing of a Light house

Azimuth circle is a non magnetic metal ring equipped with sighting devices for observing bearings of objects (celestial bodies, terrestrial bodies, targets, vessels, etc). It consists of a graduated ring equipped with a sighting vane on each side, which fits concentrically over a compass/ compass repeater. To ensure that the compass is exactly kept horizontal when taking an observation, generally the azimuth rings are provided with two bubble gauges, which must be aligned properly when taking an observation.

Azimuth Circle

2) Using azimuth circle for taking bearings/ azimuths

Taking a bearing of a terrestrial object
Assume that you are taking a bearing of a lighthouse. Place the azimuth circle on the gyro repeater, and make sure that the circle rotates freely. Train the vanes on the lighthouse so that the lighthouse appears behind the vertical wire in the far vane. Drop your gaze to the prism at the base of the far vane, and then read the bearing indicated by a hairline in the prism.

Taking an azimuth of a celestial body
The azimuth circle may be used in two ways to measure the azimuth of a celestial body. The first method is used with a brilliant body such as the sun. Other than the vanes, there is a concave mirror and a prism attachment on the circle. Sight the azimuth with the mirror on your side and the prism towards the observed body. Light from that body is reflected from the concave mirror into the prism. The prism, in turn, throws a thin beam of light on the compass card. This beam strikes the graduation that indicates the azimuth. The second method is used for azimuths of bodies whose brightness is not sufficient to throw such a distinct beam. There is a pivoted dark glass behind the far vane on the azimuth circle which can be adjusted to pick up celestial bodies at various altitudes. When a body is sighted, its reflection appears behind the vertical wire in the far vane, and its azimuth can be read under the hairline in the prism. Bearings taken when the azimuth circle is not exactly horizontal are inaccurate, and hence alignment of the bubble gauges is important.

3) Various methods for obtaining compass error

Three important methods described in detail in this module for obtaining compass error are:

a) Azimuth
b) Amplitude
c) Transit bearings

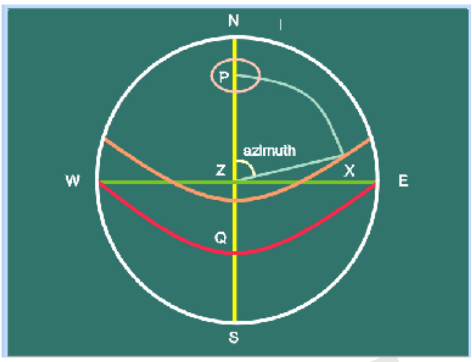
4) Definition of azimuth

In open seas, heavenly bodies are used to determine the compass error. Watch keepers must calculate compass error at least once every watch and after every major alteration of course. Azimuth is also used when calculating sights to obtain the position line of the heavenly body.

The **azimuth** of a heavenly body is defined as the angle at the observer's **zenith** or the arc of his **rational horizon**, contained between his **celestial meridian** and the vertical circle through the body.

Looking at the figure

- NESW- is the celestial sphere as depicted in equidistant projection on plane of observer's rational horizon.
- P - is the elevated pole.
- X - is the position of heavenly body on the celestial sphere
- Z - is the zenith of the observer
- QZ- is the latitude of the observer.
- Angle PZX- azimuth angle



5) Procedure for observing azimuth

- Identify a heavenly body whose azimuth you want to take.
- Ensure that the altitude is not too high or too low (preferably between 20° and 60°
- Take the compass bearing of the body and at the same time note the corrected GMT, and your DR (dead reckoning) position.

6) Procedure for calculating actual azimuth (ABC tables/ calculator)

Use of ABC tables

- Obtain the declination of the body and the LHA (local hour angle) of the body at that time from the nautical almanac.
- With LHA and DR latitude as arguments, obtain value of "A" from ABC tables. 'A' is named opposite to latitude, except when hour angle is between 90 degrees and 270 degrees.
- With LHA and declination as arguments, obtain value of "B". 'B' is always named same as declination.
- Calculate "C" which is the algebraic sum of "A" and "B".
  - If 'A' and 'B' are same names then add and retain the name
  - If 'A' and 'B' are contrary names then subtract and retain name of the larger one
- Now enter table "C" with DR latitude and value of "C" obtained as above to get the azimuth. Naming of azimuth is as follows:
  - The prefix 'N' or 'S' of value 'C' above is retained.
  - For finding the suffix whether 'E' or 'W' - If LHA is between 000° & 180°, the body lies to the West and if it is between 180° and 360° the body lies to the East.

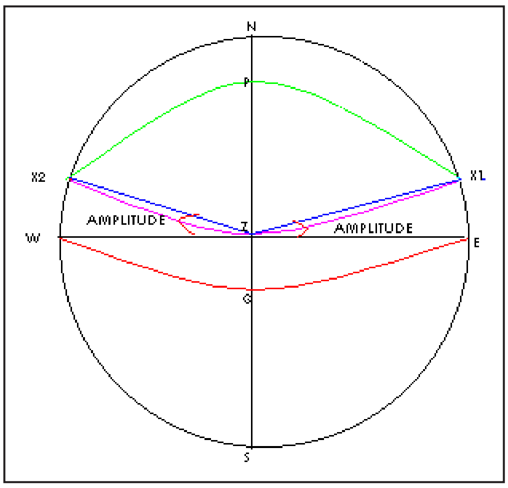
The method of naming (N or S, E or W) and signs (+ve or -ve) of the values of 'A', 'B' & 'C' obtained from the ABC tables are given in the tables itself.

Use of calculator

A = Tan Lat/ Tan P
B = Tan dec / Sin P
Tan Az = 1 / C x Cos Lat

Rules for naming A, B, C and Azimuth are as explained above (given in the nautical tables)

If LHA between 000° and 180°, P = LHA
If LHA between 180° and 360°, P = 360 - LHA
If LHA is 360° or 180° then **azimuth** will be 000° or 180° (Body on the observer's meridian or inferior meridian)



7) Definition of amplitude

The amplitude of a body is the angle at the observer's zenith or the arc of his rational horizon contained between the observer's prime vertical, and the vertical circle through the body, at theoretical rising or setting.

Looking at the figure

- NESW is the celestial sphere as depicted in equidistant projection on plane of observer's rational horizon.
- P - is the elevated pole.
- X_1 and X_2 – Celestial body rising and setting respectively. Centre of each celestial body is on the rational horizon.
- Z - is the Zenith of the observer
- QZ- is the latitude of the observer.

Important points to consider when taking amplitude

- Amplitude is always taken when the heavenly body is either rising or setting on the horizon.
- Normally amplitude is taken of sun and moon and not of stars and planets as they are not visible during rising or setting.
- Amplitude is always taken when the true altitude of the sun or moon is 0°. For the sun, this is when the lower limb of the sun is about 1/2 its diameter above the horizon – this is to compensate for maximum refraction which occurs when the body is on the horizon.

8) Procedure for observing amplitude

- Take the gyro bearing of the sun or moon when the body is rising/ setting. For Sun, take the observation when its lower limb is about 1/2 its diameter above the horizon.
- Note the GMT and the DR of the vessel at the time of taking the observation.
- Obtain the body's declination for that time.
- Calculate the amplitude using the formula :
  Sin Amplitude = Sin Declination x Sec Latitude
- Amplitude can also be found by referring to Norie's or Burton's nautical tables.
- Note when rising, the amplitude is named E……° N or S (according to the name of the declination) and when setting it is named W……° N or S (according to the name of the declination). It is read as, for e.g. 10 degrees north of east.

9) Finding compass error by transit bearings

When a vessel is navigating in coastal areas, it may be possible to observe two fixed objects, especially landmarks that are directly in line. In such a case, the watch keeping officer can find the compass error instantly because when two objects are seen in a line, the ship lies on the same line, called a transit line. The bearing taken in such a case is called a **transit bearing** and can be compared with the **true bearing** that is measured from the navigational chart. The difference between the observed bearing and the true bearing is the compass error. Following is the procedure to obtain the compass error by transit bearings:

- Select two conspicuous objects on the chart and measure the true bearing between them.
- The watch keeping officer must be ready before the ship arrives in line (in transit) with the two objects. When they are observed exactly in line with each other, observe the compass (gyro or magnetic) bearing of the object.
- Compare the true bearing with the observed bearing and the difference is the compass error.

10) Sample calculations

a) Sample calculation (Azimuth- Sun)

On 09th May 2006 at 05h30m00s UTC, a vessel in position (latitude 55° 00'N longitude 002°00'W) observed the sun bearing 073° by magnetic compass. Find the compass error. If variation is 5°W, calculate deviation.

GHA Sun (09d 05h): 255° 53.2’
Increment (30m 00s): 007° 30.0’

GHA Sun: 263° 23.2’
Longitude (W): (-) 002° 00.0’ *(minus- since longitude is westerly)*

LHA Sun: 261° 23.2’

Declination (09d 05h): N 017° 19.2’
d (0.7) (+) 00.4’

Declination Sun: N 017° 19.6’

P= 360 - 261° 23.2’= 98° 36.8’ *(If LHA>180°, P= 360- LHA)*

A = Tan Latitude/ Tan P
A = Tan 55° 00’/ Tan 98° 36.8’
A = 0.216327037 N (*A is named opposite to latitude, except when hour angle is between 090° and 270°*)

B = Tan Declination/ Sin P
B= Tan 017° 19.6’/ Sin 98° 36.8’
B = 0.315534702 N *(B is always named same as declination)*

C = A+B = 0.531861739 N *(C correction, A+/- B: If A and B have same name- add, If different name- subtract)*

Tan Azimuth = 1/ (C X Cos Latitude)
Tan Azimuth = 3.278007549
Azimuth = N 73.0° E *(Azimuth takes combined name of C correction and Hour Angle- If LHA is between 0° and 180°, it is named “west”, if LHA is between 180° and 360°, it is named “east”)*

True Azimuth= 73.0°
Compass Azimuth= 73.0°

Compass Error = NIL
Variation= 5.0° West

Deviation= 5.0° East

b) Sample calculation (Azimuth- Stars)

On 05th May 2006 at 11h00m00s UTC, a vessel in position (latitude 04° 30’N longitude 010°00’W) observed the star Canopus bearing 145° by compass. Find the compass error. If variation was 4.0° East, calculate deviation.

GHA Aries (05d 11h): 028° 10.7’
Increment (00m 00s): 000° 00.0’

GHA Aries: 028° 10.7’
Longitude (W): (-) 010° 00.0’ *(minus- since longitude is westerly)*

LHA Aries: 018° 10.7’
SHA Canopus: (+) 263° 59.0’

LHA Canopus: 282° 09.7’

Declination: S 052° 42.1’

P= 360 - 282° 09.7’= 77° 50.3’ *(If LHA>180°, P= 360- LHA)*

A = Tan Latitude/ Tan P
A = Tan 04° 30'/ Tan 77° 50.3'
A = 0.016960803 S (*A is named opposite to latitude, except when hour angle is between 090° and 270°*)

B = Tan Declination/ Sin P
B= Tan 052° 42.1'/ Sin 77° 50.3'
B = 1.342905601 S *(B is always named same as declination)*

C = A+B = 1.359866404 S *(C correction, A+/- B: If A and B have same name- add, If different name- subtract)*

Tan Azimuth = 1/ (C X Cos Latitude)
Tan Azimuth = 0.737640253
Azimuth = S 36.4° E *(Azimuth takes combined name of C correction and Hour Angle- If LHA is between 0° and 180°, it is named "west", if LHA is between 180° and 360°, it is named "east")*

True Azimuth= 143.6°
Compass Azimuth= 145.0°

Compass Error = 1.4° West
Variation = 4.0° East
Deviation = 5.4° West

c) Sample calculation (Amplitude- Sun)

On 07th May 2006 at sunset, a vessel in position (latitude 10° 00'N longitude 010°00'W) observed the sun bearing 288° by compass. Find the compass error.

LMT Sunset		07d	18h	13m	
LIT	(+)	00d	00h	40m	
UTC Sunset		07d 18h 53m			*(added- since longitude is westerly)*

Declination (07d 18h):		N 016° 55.5'
d (0.7)	(+)	00.6'

Declination Sun:		N 016° 56.1'

Sin Amplitude = Sin Declination/ Cos latitude
= Sin 016° 56.1'/ Cos 10° 00'
= 0.295780189

Amplitude= W17.2N *(The prefix of amplitude is named easterly if body is rising, and westerly if body is setting. The suffix is named same as declination)*

True Bearing= 287.2°
Compass Bearing= 288.0°

Compass Error = 0.8° West

Apply Your Knowledge

1. Determine compass error (magnetic and gyro) using azimuth - choosing a suitable celestial body (Sun/ Stars/ Planets/ Moon). Apply variation to find the deviation of the magnetic compass.
2. Determine compass error using amplitude -Sun.

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task number: A1.1

Sub-task Reference number: A1.1.3

Topic: Celestial Navigation

Task Heading

- Recognize conspicuous star constellations and stars of first magnitude. Practice use of star chart and star finder. Identify most suitable celestial bodies during twilight.

Objectives

- Familiarize yourself with use of star chart and be able to recognize star constellations and stars of first magnitude.

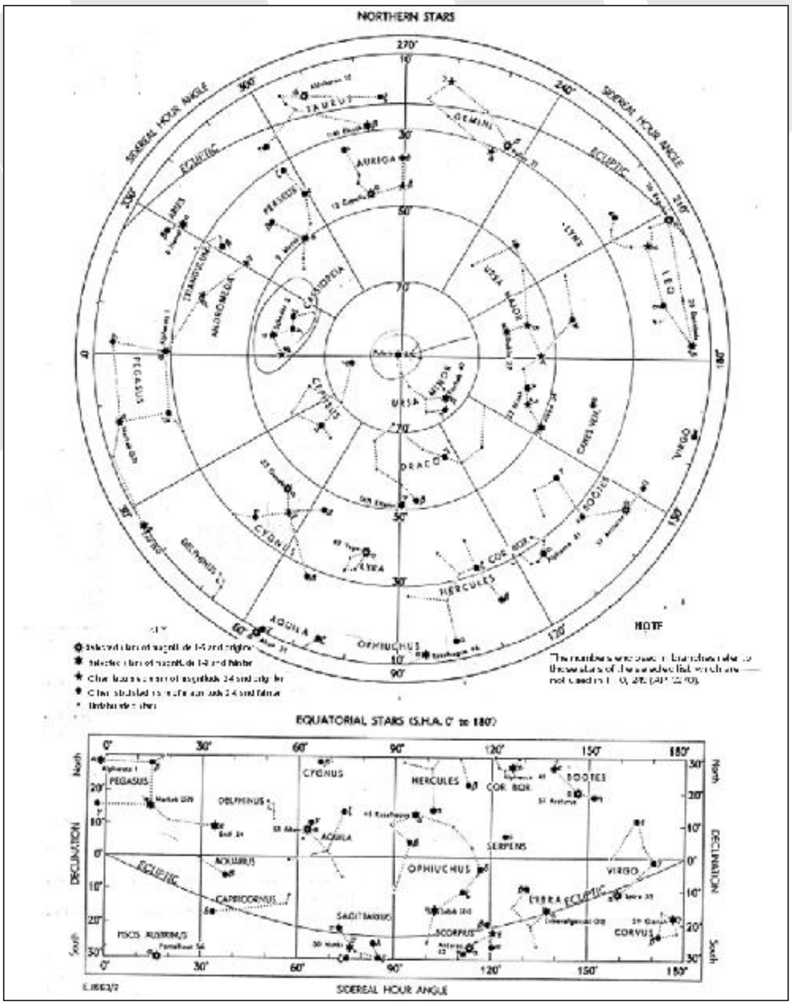
Index

1. Introduction
2. Star constellations
3. Star finder and identifier

Description

1) Introduction

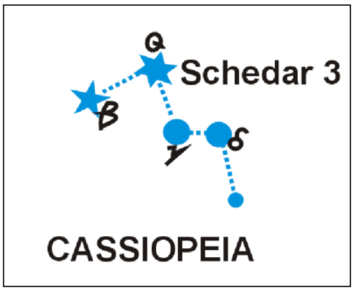
In earlier days when electronic navigation was not available, navigation in the open sea was solely done using sun and stars to plot the ship's position. Constellations were identified and stars which are most useful to navigation were tabulated in the nautical almanac for this purpose. 57 stars are used in navigation and they are shown in the daily pages of the almanac with their SHA and declination. A star chart showing the northern stars, the southern stars and the equatorial stars is also given in the almanac.



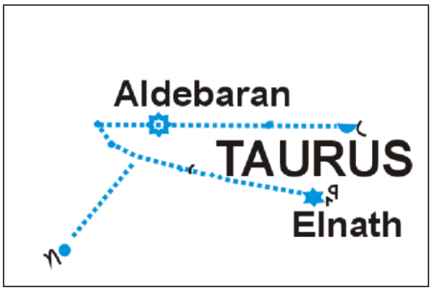
2) Star constellations

Constellations are identified by the shape the stars they contain take when seen from the earth's surface.

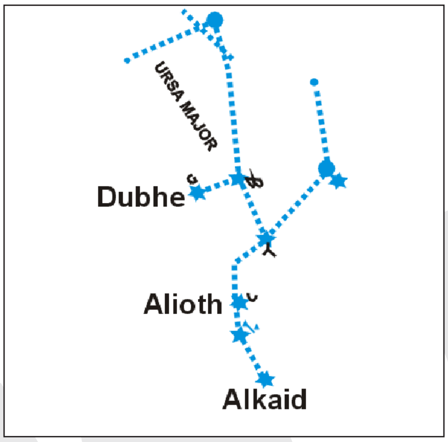
Some examples are as follows:



Cassiopeia - The Shape of a chair



Taurus - Shape of a 'V'



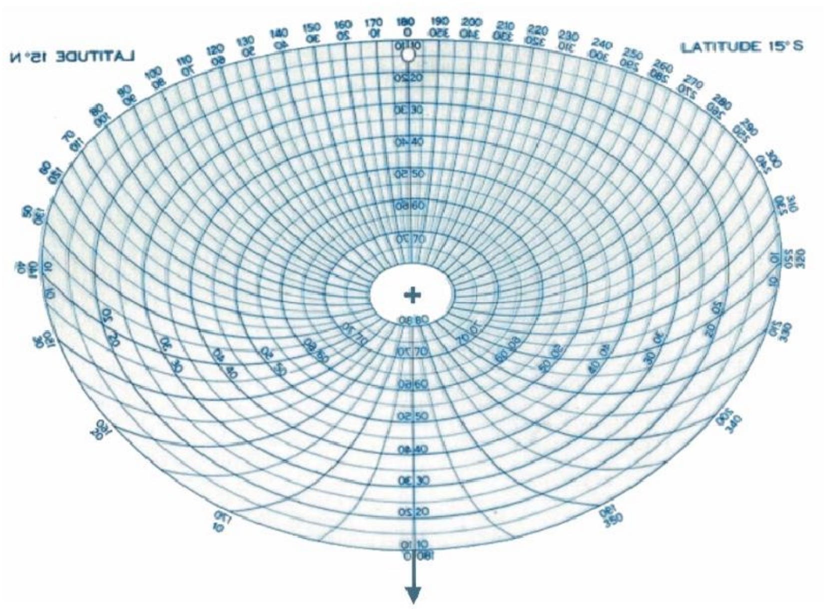
Ursa Major

Look at the star chart given in the Almanac and familiarize yourself with these constellations.

3) Star finder and identifier

To assist the navigating officer in finding or identifying a star a "star finder and identifier" is provided. This consists of a star base with the northern sky on one side and the southern sky on the other, and seven (7) templates centered at 10º intervals of latitude along with an instruction chart. Each side of template is marked for use either in the northern hemisphere or southern hemisphere.

How to use the star finder to identify or locate stars:-



Template of 15 degree N latitude

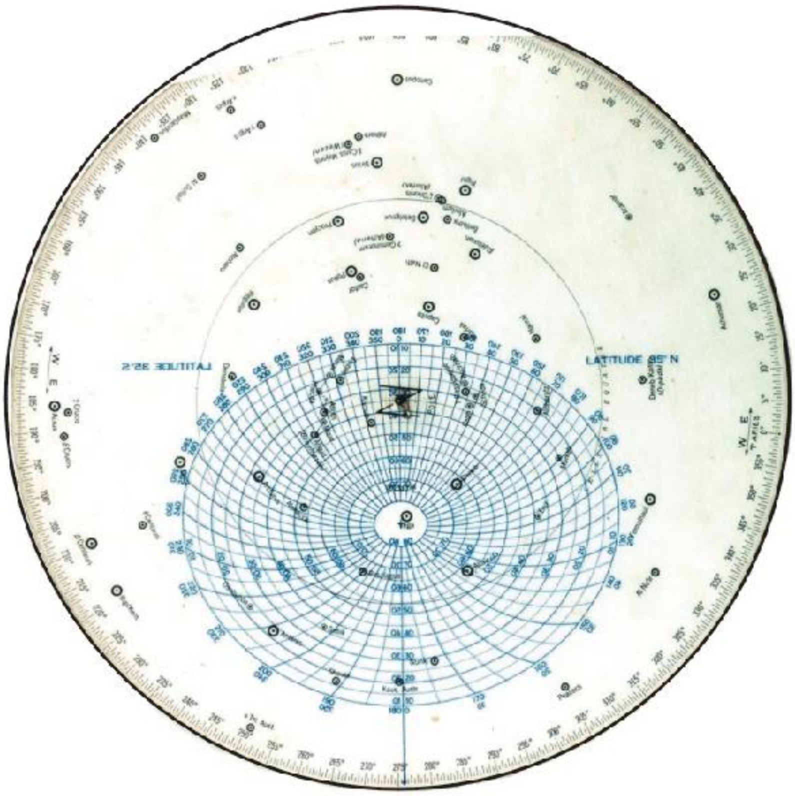
- Choose the template nearest to your DR (dead reckoning) latitude. For example if your DR latitude is 7º 30'N choose the template for 5º N.
- Center it on the star base by placing the hole over the pin in the center of the base, with proper hemisphere side up.
- Look up in the nautical almanac for that particular day and time and calculate the GHA (Greenwich Hour angle) for Aries.
- Apply the DR longitude to get the LHA for Aries.
- Rotate the template to bring the arrow of the 0º - 180º line to the degree mark on the outer edge of the base corresponding to LHA of Aries.
- The 0º-180º line when thus set for a specified time becomes the observer's local meridian.
- Stars in the visible sky whose altitudes are over 10º are then enclosed within the blue grid of the template and their approximate altitudes and azimuths may be read off.

Look at the example below which will give you a better idea.
Example: At sea on May 24th, 1998, in DR latitude 38ºN, longitude 50ºW, GMT 05h 37m 00s find the altitude and azimuth of navigable stars visible in the sky.

GMT	:	05h 37m 00s
GHA Υ : (05h)	:	316º35.8'
Increment 37m00s	:	+ 9º16.5'
GHA Υ(05h 37m 00s)	:	325º52.3'
DR Long (50ºW)	:	- 50º00.0'
LHA Υ	:	275º52.3'

(DR Longitude to be subtracted if Longitude is West and added if Longitude is East)

Now we have DR Latitude: 38ºN and LHA Υ 275º 52.3
Using the north side of the star base, place the 35º N template over the pin in the center of the base.



Star finder base in conjunction with 35° N template to find the stars available for observation

Set the arrow of lat 35ºN template on LHA ♈ of 275º 52.3' and read the altitude and azimuth of stars enclosed with in the blue grid.

STARS	AZIMUTH	ALTITUDE
Antares	208º	22º
Arcturus	272º	33º
Dubhe	332º	22º
Deneb	060º	64º
Markab	090º	25º
Nunki	173º	28º

As shown above the star available at any time on the sky whether in the northern hemisphere or the southern hemisphere can be found out. Note only the 57 navigable stars having an altitude of more than 10º can be located.

Apply Your Knowledge

1. Using the star chart identifier, ship's position and present time, name seven stars with the greatest magnitude and calculate their azimuth and altitude. Choose the three most suitable stars for celestial observation to fix the ship's position and explain why.

Function: Navigation

Competence: Plan and conduct a passage and determine position.

Task Reference No: A1.2, A1.3

Sub task Reference Nos.: A1.2.1, A1.3.1, A1.3.2

Topic: Terrestrial and Coastal Navigation, Charts and Publications

Task Heading

- Recognize various landmarks and aids to navigation, including lighthouses, beacons, buoys and topographical features.
- Demonstrate familiarity with the chart folio system.
- Demonstrate understanding of the use of BA Chart 5011 (Symbols and Abbreviations used on Admiralty Paper Charts) and identify various chart symbols; e.g. buoys, marks, wrecks, obstructions, shallow depths, reefs and other dangers to navigation. Correctly interpret information obtained from charts and publications.

Objectives

- Familiarize with various navigational charts, chart projections, chart folios, understand how to interpret and use the charts and identify various aids to navigation.

Index

1) Introduction to navigational charts
2) Salient features of a navigational chart
3) Chart projections
4) Chart folios
5) Measuring distances on mercator charts
6) Reading coordinates and positions on the chart
7) Measuring courses/ directions/ bearings on mercator charts
8) Chart symbols and interpretation of information on charts
9) Tools for chart work

Description

1) Introduction to navigational charts

A navigational chart is one of the most important navigational aids on board a ship. It is a graphical representation of maritime area and adjacent coastal regions which are available for marine navigation. It also includes sea areas, rivers, lakes, canals and land immediately adjacent to it. For proper navigation at sea, inland waters, on the coasts of land and on river we require different scale charts – i.e. small scale charts and large scale charts. Large scale charts give more details of the area. Depending on the scale of the chart, it may show depths of water and heights of land (topographic map), natural features or nature of the seabed, details of the coastline, underwater structures, corals, reefs, navigational hazards, locations of natural and man-made aids to navigation, information on tides and currents, local details of the earth's magnetic field, and man-made structures such as harbours, buildings, and bridges. Charts are essential tools for marine navigation. Navigational charts may be in the form of printed paper charts or computerised electronic navigational charts (Discussed in details in ECDIS module). Recent technologies have made available paper charts which are printed "on demand" with cartographic data that has been downloaded to the commercial printing company as recently as the night before printing. With each daily download, critical data such as local notice to mariners is added to the on-demand chart files so that these charts will be 100% up to date at the time of printing.

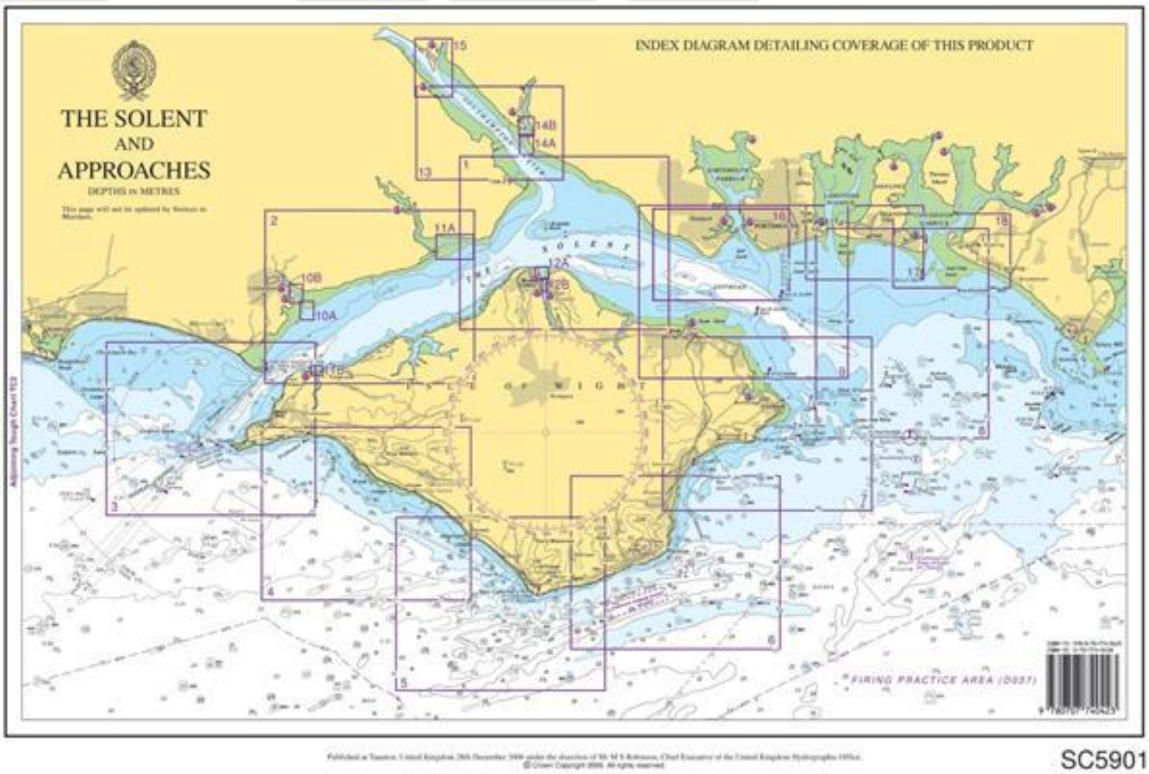
A navigational chart is primarily used for marine navigation. Unlike a map, navigational charts provide a lot of information to the mariners, as mentioned above, which is of great importance to navigation. All charts are drawn to a particular scale. Small scale charts are the charts which cover a wider area but give less information. Large scale charts cover smaller areas when compared to small scale charts but they provide much more detailed information.

> It is prudent for the Navigating Officer to know what scale of chart is to be used. **Small scale** charts may be used when navigating in oceans and open waters where there is enough sea room to navigate but large scale charts must be used when navigating in congested waters, coastal waters, or when approaching ports and harbours.

Nautical charts are based on hydrographic surveys. As surveying is laborious and time-consuming, hydrographic data for many areas of sea may be dated and not always reliable. Depths are measured in a variety of ways. Historically, the sounding line was used. In modern times, echo sounding is used for measuring the seabed in the open sea. When measuring the safe depth of water over an entire obstruction, such as a shipwreck, the minimum depth is checked by sweeping the area with a length of horizontal wire. This ensures that difficult to find projections, such as masts, do not present a danger to vessels navigating over the obstruction. Nautical charts are issued by the national hydrographic offices in many countries. These hydrographic offices provide regular, generally weekly, updates of their charts.

2) Salient features of a navigational chart

Navigational charts are either metric charts or fathom charts. They can be easily distinguished by the colour used on the charts. On the metric charts the land masses are shown in yellow colour where as on fathom charts land is shown in grey colour.



Navigational Chart (BA)

With the permission of your chief officer or duty officer take out one metric chart and one fathom chart and note the relevant information as discussed below.

- Do you know how to identify a chart? Each chart is identified by its chart number which is printed on left top and right bottom corners outside the margin.
- Did you notice the basic colour difference between a Metric chart and a Fathom chart as mentioned above?
- Look below the title of the chart which has a phrase stating “Depth in Meters” or “Depth in fathoms”. Sometimes you may also find statement like “Soundings in meters” or “Soundings in feet or fathoms”. These statements also indicate whether the chart is metric or fathom chart.
- Now look at the title of the chart which gives the name of the chart or the area where the chart is applicable. The name or the title of the chart is at the most conspicuous place and it is placed in such a way as to not to interfere with any navigational information given on the chart.
- Below the title of the chart, look for some additional information given like unit of height and depths (have explained earlier), references datum used, type of projection and natural scale of the chart.
- Do you know what a natural scale of the chart is? It is the ratio of unit distance (length) on the chart to the corresponding distance on the earth’s surface (both measured in same units). For e.g. if the natural scale is 1:25,000 – this means that 1 cm length of chart corresponds to 25,000 cms on the earth’s surface.
- Can you locate the compass rose on the chart? These are compass engravings to facilitate plotting of bearings, directions and courses. Some of these have two concentric rings – the outer one representing the *true north* directions and the inner one representing the *magnetic north*.
- Bottom corner gives the *Date of* edition of the chart. This indicates the date when this chart was partly or completely revised and published. Note down the new edition of both the charts which you have picked out.
- Corrections to charts both small and large are printed on the left hand corner below the bottom margin. This is described in detail in the chart correction module.
- The vertical scale on the left and right hand side is known as the Latitude scale and the scale on the top and bottom is known as the Longitude scale. Distance on a mercator chart is taken on the latitude scale. The latitude and longitude are marked in degrees and minutes (1^0 = 60 minutes) and each minute of the latitude scale corresponds to 1 nautical mile on the chart (at the same latitude).
- For e.g.: If the ship is at 20^0N latitude and if you have to measure a distance in the same place, then you should use the latitude scale at 20^0N. Similarly distances on a chart between two positions is therefore measured along the latitude scale in between the corresponding latitudes of the two positions.
- On metric charts, depths are given in metres and sometimes in meters and decimetres where as heights are always printed in metres. For e.g.: 8_6 on a metric chart indicates a depth of 8 metres and 6 decimetres. On a fathom chart 9_4 indicates depth of 9 fathom and 4 feet. (1 fathom = 6 feet).
- Source data: On all modern charts, the Source data inset is placed at a convenient location indicating source of hydrographic information used in construction of the chart. This includes the year, name of the agency and scale of hydrographic survey of each section of the chart.
- Chart datum: It is the lowest level of water that is reached (rarely, if ever) in that location. Charts datum is defined as a level so low that the tide will not frequently fall below it. Modern practice is to establish datum at or near the level of lowest astronomical tide (L.A.T).
- L.A.T. – is the lowest level which can be predicted to occur under average Meteorological Conditions and under any combination of astronomical conditions. Storm surges may however cause lower levels to occur.

- All depths and drying heights are measured from this arbitrary level.
- Some features of the coast are exposed during low water or low tide. Such features are generally referred to as drying heights and are usually indicated with numbers underlined. For e.g. 5 (On a metric chart, this means that the drying height is 5 metres).
- Continuous lines with sounding figures, circling an area or a line zig-zagging along the coast represent depth contours. These are lines joining areas with the same depth measured from the chart datum.
- Heights of mountains cover a large area but the point at which the height is measured is indicated by means of a point. For e.g.: • 245 means the height of that point is 245 metres.
- Soundings below 5 metres are indicated by light blue colour on a metric chart and a light blue colour strip (ribbon) is printed towards shallow side of 10 metre depth contour. Blue tint, in one or more shades and tint ribbons, are shown to different limits according to the scale and purpose of the chart and the nature of the bathymetry.

3) Chart projections

A navigational chart is a 2-dimensional representation of a 3-dimensional world. And although it results in various distortions, as long as the following two requirements are met we can use this image for navigational purposes.

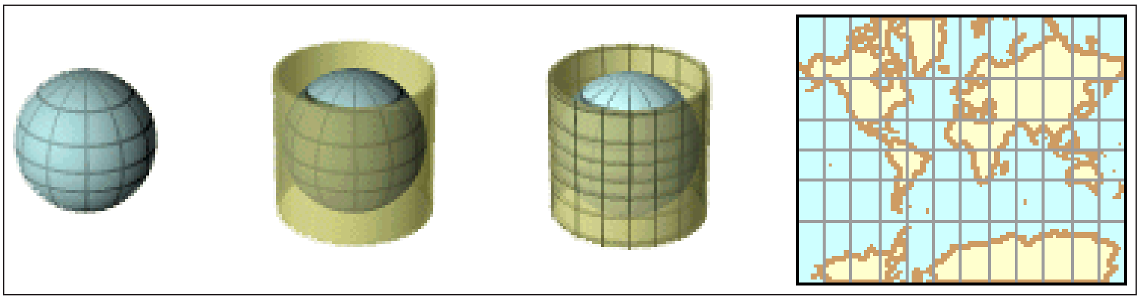
i. The angles between three objects in the chart should be the same as the angles between the real objects which they represent.
ii. A straight course should appear as a straight line in the chart.

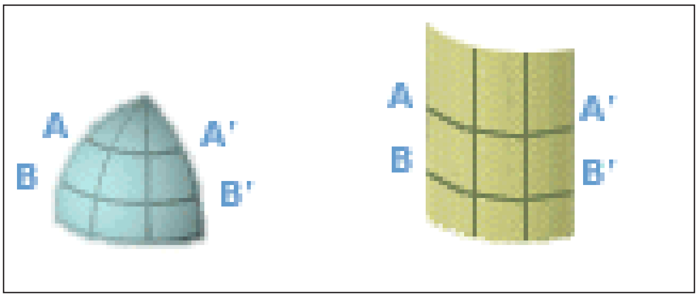
To fulfil these demands a nautical chart requires parallels and meridians that are both straight and parallel. Moreover, the meridians will need to be perpendicular to the parallels. Various methods and projections are in use for various purposes but the two most important for us to know, and are widely used on board merchant vessels, are detailed below.

A) Mercator projection

A well known method to create a chart satisfying the above two conditions is called the **Mercator projection** named after Gerard "**Mercator**" Kremer, a Flemish scholar who studied in the Netherlands and Leuven (now Belgium) and who invented his famous projection in 1569.

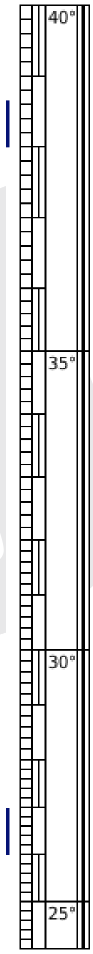
The mercator chart was designed for sailors and can be constructed by wrapping a cylinder around the planet so that it touches the equator. To a navigator, the most useful chart is where he can show the track of his ship by drawing a straight line between his starting point and his destination and the Mercator chart is constructed to allow for this requirement (Rhumb line course). On this cylinder the surface of the earth is projected and finally the cylinder is cut open to yield the 2-dimensional chart. But where the meridians converge on the globe they run parallel in the projection, indicating the distortion, for example, at a high parallel. The length of such a parallel on the globe is much smaller than the equator. Yet, on the chart they have exactly the same length creating a distortion which gets bigger nearer to the poles. Figure shows the construction of the mercator projection. From this it is clear that only the vertical scales should be used for measuring distances.





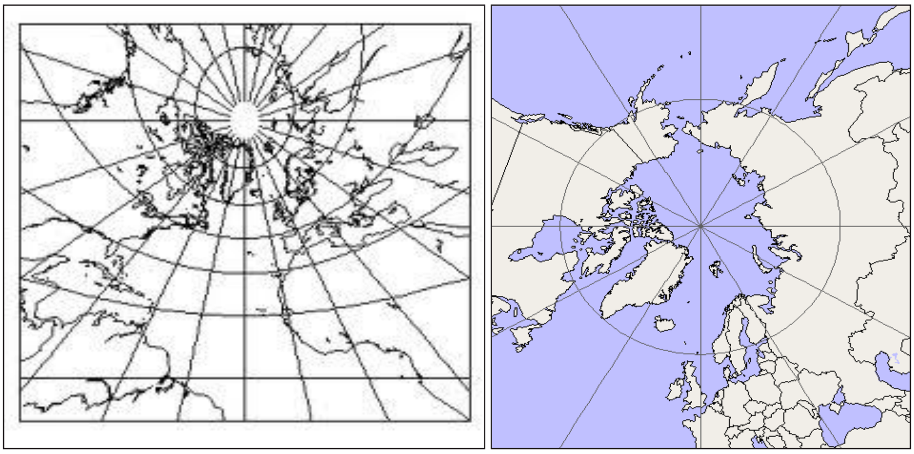
The vertical scale shown demonstrates the distortion. The two little lines drawn next to the scale are precisely of the same size. However, the upper one measures only 0.64 degrees (= 38.4 nm) while the other measures 1.00 degrees (= 60 nm). So, distances (in degrees or in miles and minutes) should not only be read on the vertical scale, but also at approximately the same height.

The **horizontal scale** is only valid for one latitude in the chart and can therefore only be used for the coordinates (a point, but not a line). If you divide the surface of the earth in eight pieces, and lift one out and project it, the result will be as shown in figure 4. The result is that both A-A' and B-B' are now as long as the bottom of the chart, which is not the case at all.



B) Gnomonic projection

Another important projection used on board ships is the gnomonic projection on which the meridians are converging. But most importantly, the parallels are arcs of a circle while great circles appear as straight lines. On a sphere the shortest route between A and B is not a straight line but an arc (part of a great circle). On a gnomonic chart, this shortest route (a great circle) ends up as a straight line. Hence, the gnomonic projection is particularly useful when sailing great circles (especially transoceanic voyages).



Gnomonic Projection

Ships fitted with ECDIS also have electronic charts, Vector or Raster scan charts, which have been described in detail in ECDIS module.

4) Chart folios

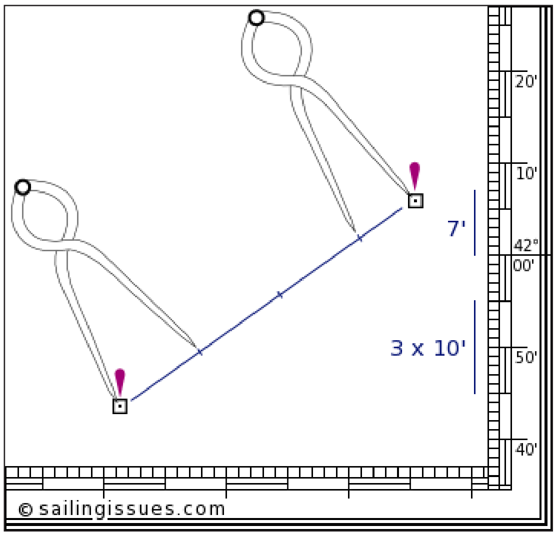
All navigational charts on board are generally grouped into folios that are divided in to three categories:

i. **Standard folio** which contains all navigational charts, including latticed charts, for the world. These may be grouped in one of the following manner:
   a) Each folio contains charts of a particular geographical location, in a serial order. These are given in Admiralty Chart Catalogue (NP 131) and in NP 133A (Chart correction Log and Folio Index).
   b) All charts are kept in a serial order and grouped in as per serial order e.g. BA 1000 to BA 1500 etc.

ii. **Local folios** which contain charts for local services and for particular requirement, not met by standard folios, such as U.S. or Canadian charts.

iii. **Special folios** which contain Routeing charts, planning charts, etc.

5) Measuring distances on mercator charts



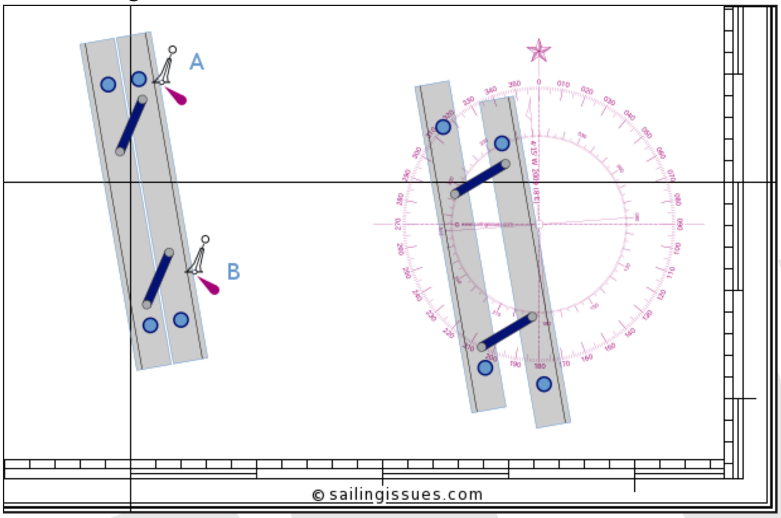
To measure the distance between, for example, these two oil rigs in the figure, we will need a set of dividers. It is very important to note that we can only use the vertical scale. We first take a convenient distance like 10' (10 nautical miles) on the vertical scale in this case, using the middle latitude. Then we start walking with the dividers from the southern oil rig to northern one. Finally, we adjust the dividers to measure the small remaining part at its own height, i.e. its own latitude. The figure shows that the total distance is 37 nautical miles.

6) Reading coordinates and positions on the chart

A pair of single handed nautical dividers can be used to obtain precise coordinates from a chart. This device enables us to take the distance between that particular position and the closest grid line (latitude/ longitude). Then the dividers are placed on to the scale on the side with one end on the same grid line, and letting us measure the coordinate on the other end. This way we can get both latitude and longitude at the scale given on the edge of the chart.

7) Measuring courses/ directions/ bearings on mercator charts

Moving further, we now come to obtain directions and bearings on the charts. For example, if we need to find the bearing/ course from safe-water buoy A to safe-water buoy B in the figure, we can use parallel ruler as shown in the figure. To begin with, we need to line up the parallel ruler with the two buoys. Then move the instrument to the compass rose without losing its alignment (You need to practise this). Finally, when one of the rules is aligned with the centre dot of the compass rose, the bearing can be read. In this example: 170°.
Besides the parallel rules, we can also use other instruments available, like the Portland or Breton plotter, two 45^0 triangles, etc.



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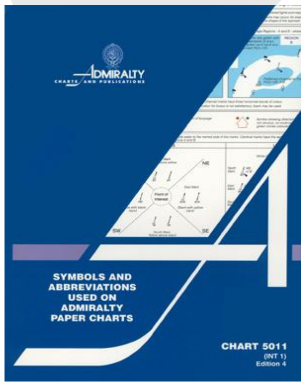
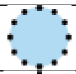
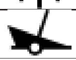
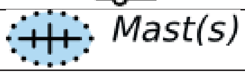
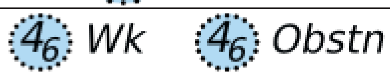
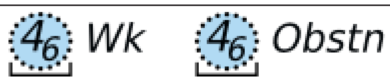
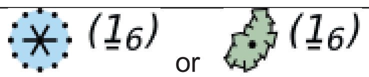
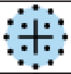
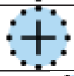
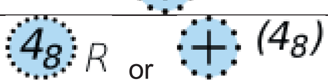
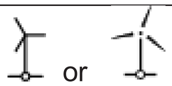
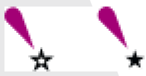
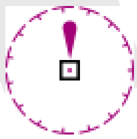
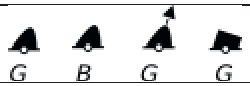
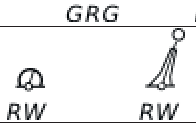
8) Chart symbols and interpretation of information on charts



Now we can see so many symbols and abbreviations on the chart. How do we interpret these correctly? We have already seen few symbols and meanings by way of our example to find the coordinates on the charts. What about the rest?
To get the details, hydro graphic offices generally publish a list of symbols and abbreviations used on their charts. For example, British Admiralty has Chart 5011 which gives a list of symbols and abbreviations used on British Admiralty and International paper charts. This publication is actually a booklet and is available on board all ships. This gives us symbols and abbreviations for general topographic and hydrographic markings used in charts and also for aids and services used. Familiarize yourself with this publication “CHART 5011” and refer to it when using chart. Below are few examples:

	Danger line in general
	Wreck, least depth unknown but usually deeper than 20 metres
	Visible wreck
	Wreck of which the mast(s) only are visible at Chart Datum
	Wreck, least depth known obtained by sounding only
	Wreck, least depth known, swept by wire drag or diver
	Rock which covers and uncovers, height above Chart Datum

	Rock awash at the level of Chart Datum
	Underwater rock of unknown depth, dangerous to surface navigation
	Underwater rock of known depth, dangerous to surface navigation
#	Remains of a wreck, or other foul area, non-dangerous to navigation but to be avoided by vessels anchoring, trawling etc.
	Depth unknown, but considered to have a safe clearance to the depth shown
SD ED Rep	Sounding of doubtful depth; Existence doubtful; Reported, but not confirmed
PA PD	Position approximate; Position doubtful
	Wind turbine
	Chimney
	Tower; radio/television tower
	Monument
	Marina - boat harbour
	Mosque, minaret
	Silo
	Tanks
⊙ Ch ⊙ Tr ⊙ Hotel ⊙ Cu ⊙ Chy ⊙ HOTEL	Placeholder examples: Church (Ch) Tower (Tr) Hotel Cupola (Cu) Chimney (Chy). CAPITALS indicate that the landmark is conspicuous.
	Quarrie, mine
	Major light; minor light
	Limit of safety zone around offshore installation
	Position of tabulated tidal stream data with designation “A”; Tidal levels data “a”
	Green or black buoys (symbols filled black): *G* = Green ; *B* = Black
	Single coloured buoys other than green and black: *Y* = Yellow ; *R* = Red
	Multiple colours in horizontal bands, the colour sequence is from top to bottom
	Multiple colours in vertical or diagonal stripes, the darker colour is given first. *W* = White

	Lighted marks on multicoloured charts, GPS displays and chart plotters. A yellow coloured lobe indicates a White light. Beacons (here the rightmost symbol with the green light) has an upright G, instead of a *G (in Italics)*

9) Tools for chart work

As a professional navigator, you should be able to use the charts accurately. To do this, you must use the correct tools. Following is a general list of tools required for chart work:

- A suitably large and adequately lit (with dimmer controls) chart table to use all charts conveniently.
- 2B lead pencils. Scale wise, 1B is hard and 3B is soft, and pencils with an H grading are even harder. If a hard pencil is used, it is difficult to erase and it leaves a mark on the chart making it difficult to reuse them. If the pencil is too soft like 3B, it blackens out the chart making it appear untidy. 2B pencils are therefore recommended.
- If you are not using a mechanical or a clutch pencil, then good pencil sharpeners, usually fixed on the table top, should be available.
- Parallel rulers of at least 21 inches length.
- Good quality marine dividers (8 inches, single handed) and compasses.
- Good quality erasers to rub off courses and other markings plotted on the charts for re use.

Apply Your Knowledge

1. Record the following details of the two navigational charts (one metric and one fathom chart).
   a. Chart number
   b. Basic colour difference between metric chart and fathom chart
   c. Title of chart
   d. Reference datum used
   e. Natural scale of chart
   f. Date of edition of chart
   g. Last correction made to the chart

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task Reference No: A1.2

Sub task Reference Nos.: A1.2.2

Topic: Terrestrial & Coastal Navigation

Task Heading

- Demonstrate understanding of identifying characteristics of lights and of the 'rising' and 'dipping' of lights and compare the observed and charted characteristics of lights.

Objectives

- Familiarize with various characteristics of lights on lighthouses, buoys, beacons, etc and understand rising and dipping of lights. Identify lights and compare them with the charted characteristics.

Index

1) Introduction
2) Some important definitions
3) Rising and dipping of lights

Description

1) Introduction

When approaching a harbour or a port or a road stead you generally see various lights some of which are on aids to navigation, such as lighthouses, lightships, beacons, buoys, etc. To distinguish these different lights and from the shore lights, they are assigned different characteristics like fixed lights, flashing lights, occulting lights, isophase, alternating, etc. All lights other than fixed lights exhibit a sequence of intervals of light and darkness, the whole sequence being repeated identically at regular intervals. Such lights are called rhythmic lights, and the time taken to exhibit one complete sequence is called the period of the light. Each element of the sequence (e.g. a flash, an eclipse) is called a phase. Now let us try to understand these different characteristics in details so that you can identify these lights next time you approach a port.

Following three features are used to describe a light

- **Colour**:

Usually for marking aids to navigation, white, red, green or yellow colour is used. If no colour is stated in the chart, it means the colour is white.

- **Period**:

Period is the time, in seconds, required for a complete cycle being used. The arrow below the figure indicates that the period of this flashing light is 10 seconds.

“Fl (3) 10s”

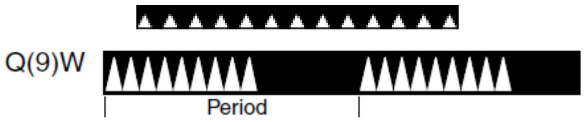
- **Phase characteristic**:

Phase characteristic is the particular pattern of changes within one complete cycle or one period. The phase characteristics can be:

- **Fixed F**: A Fixed light shines without blinking and with a steady intensity and is always on. Below example shows a yellow fixed light.

- **Flashing Fl**: In case of a Flashing light, the duration of light is always less than the duration of darkness. The frequency does not exceed 30 times per minute.

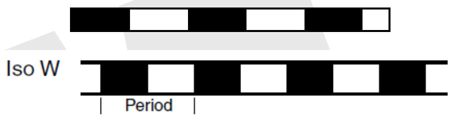
❖ **Quick Flashing or Group Quick Flashing Q**: In case of a Quick Flashing light also, the duration of quick flash is less than darkness. The frequency is at least 60 times per minute.



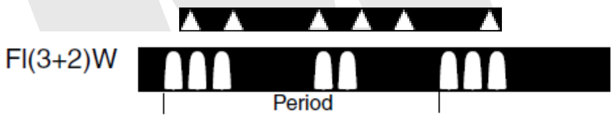
❖ **Very Quick Flashing or Group Very Quick VQ**: In this case also, the duration of very quick flash is less than darkness. The frequency is at least 100 times per minute.

❖ **Interrupted Quick Flashing IQ**: This light is similar to Quick Flashing but with one moment of darkness in one period.

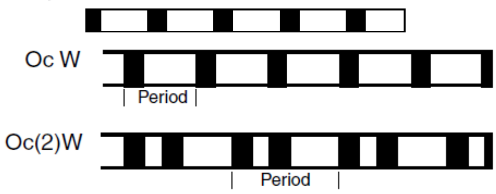
❖ **Isophase Iso**: An Isophase light has an equal duration between light and darkness. The period consists of both light and dark interval. This is also known as Equal Interval



❖ **Group Flashing or Composite Group Flashing Gp Fl(x+x)**: Group flashing is a combination of two patterns in one period. Below example shows the first 2 flashes followed by the pattern of 3 flashes: Gp Fl (2+3).



❖ **Occulting or Group Occulting Occ**: Occulting is the opposite of flashing, and hence in this case, the light is more on then off, i.e., the period of light is more than the period of darkness.

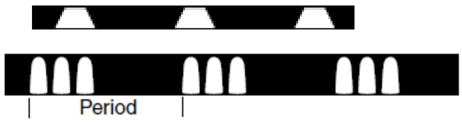


❖ **Alternating AL**: An alternating light changes colour. This is a special purpose light and is typically used for special applications which require exercise of great caution. Below example shows ALT.WG, alternating between green and white.

❖ **Morse Light, Mo (XX)**: This light shows flashes as per the number letter or alphabet mentioned in brackets.

❖ **Long-Flashing LFl**: Long Flashing light has one long flash in a period. A long flash is at least 2 seconds long.

Fl(3)W



❖ **Below are a few more examples for your practise:**

Fl (4) 8s

Oc (2+3) 10s

Iso G 4s

Depending upon the need and requirements, the intensity, range and reliability of the lights are decided. For example, very strong and long range lights are used for the purpose of making landfalls or coastal passages, and shorter range lights are used for harbour and river entrances. Further details of lights, especially structure of lighted navigational aids can be found in "**List of lights"** available on board. You must select a few lights on the chart, get further details of the structures (Lighthouses, lightships, etc) of these lighted navigational aids from the list of lights taking help of an officer on watch and then identify these light and landmarks during an approach.

2) Some important definitions

Elevation: is the vertical distance between the focal plane of the light and the level of Mean High Water Springs or Mean Higher High Water, whichever is given in Admiralty Tide Tables. However, charted elevations of lights are sometimes referred to mean sea level but the height datum is always clearly annotated on all nautical charts. For vertical lights, the elevation listed is for the uppermost light.

Luminous range: of a light is the maximum distance at which a light can be seen under existing visibility conditions. This luminous range takes no account of the elevation of the light, the observer's height of eye, the curvature of the earth, or interference from background lighting. This luminous range, sometimes also referred to as meteorological range, depends on the intensity of the lights expressed in candelas and is determined from the known nominal luminous range, called the nominal range, and the existing visibility conditions. The luminous range diagram is used to convert the nominal range to the luminous range.

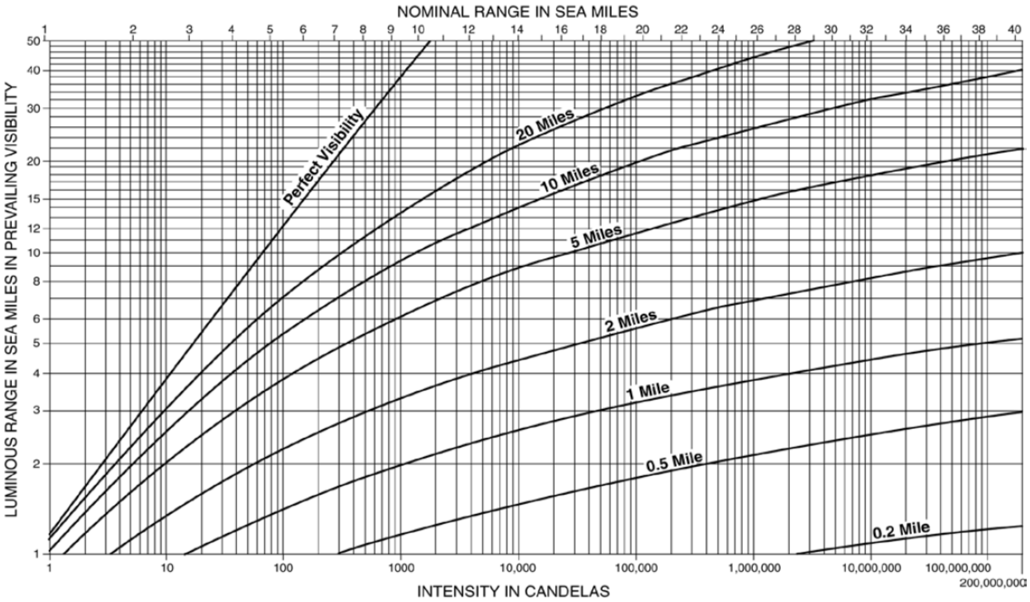
Nominal range: of light is the maximum distance at which a light can be seen in clear weather. Clear weather is defined by the international visibility code as having a meteorological visibility of 10 nautical miles. So basically, nominal range is the luminous range when the meteorological visibility is 10 nautical miles.

Geographical range: of light is the maximum distance at which the curvature of the earth permits a light to be seen from a particular height of eye without regard to the luminous intensity of the light. The range mentioned in the chart or tabulated in the list of lights is the maximum distance at which the curvature of the earth permits a light to be seen from a height of eye of 15 feet (5 metres) above the water. The geographic range therefore depends on both the height of light and the height of eye of the observer.

Loom: The diffused glow observed from a light below the horizon or hidden by an obstacle, due to atmospheric scattering.

Sector light: A light presenting different appearances, either of colour or character, over various parts of the horizon of interest to maritime navigation. Where no sector limits or arcs of visibility are marked on the charts, then the light is assumed to be visible all around.

Leading lights: Two or more lights associated so as to form a leading line to be followed, for example in a channel. The direction and bearing line of such lights are marked on the charts.



Luminous Range Diagram

Important points to consider while using the luminous range diagram:

1. The diagram gives luminous range i.e., the range at which a light may be sighted, irrespective of its elevation and of the observer's height of eye.
2. Ranges are approximate.
3. The transparency of the atmosphere is not necessarily consistent between the observer and the light.
4. Glare from background lighting will reduce considerably the range at which lights are sighted.

GEOGRAPHICAL RANGE TABLE

ELEVATION	HEIGHT OF EYE OF OBSERVER IN METRES														
m	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20
	RANGE IN SEA MILES														
0	2.0	2.9	3.5	4.1	4.5	5.0	5.4	5.7	6.1	6.4	7.0	7.6	8.1	8.6	9.1
1	4.1	4.9	5.5	6.1	6.6	7.0	7.4	7.8	8.1	8.5	9.1	9.6	10.2	10.6	11.1
2	4.9	5.7	6.4	6.9	7.4	7.8	8.2	8.6	9.0	9.3	9.9	10.5	11.0	11.5	12.0
3	5.5	6.4	7.0	7.6	8.1	8.5	8.9	9.3	9.6	9.9	10.6	11.1	11.6	12.1	12.6
4	6.1	6.9	7.6	8.1	8.6	9.0	9.4	9.8	10.2	10.5	11.1	11.7	12.2	12.7	13.1
5	6.6	7.4	8.1	8.6	9.1	9.5	9.9	10.3	10.6	11.0	11.6	12.1	12.7	13.2	13.6
6	7.0	7.8	8.5	9.0	9.5	9.9	10.3	10.7	11.1	11.4	12.0	12.6	13.1	13.6	14.1
7	7.4	8.2	8.9	9.4	9.9	10.3	10.7	11.1	11.5	11.8	12.4	13.0	13.5	14.0	14.5
8	7.8	8.6	9.3	9.8	10.3	10.7	11.1	11.5	11.8	12.2	12.8	13.3	13.9	14.4	14.8
9	8.1	9.0	9.6	10.2	10.6	11.1	11.5	11.8	12.2	12.5	13.1	13.7	14.2	14.7	15.2
10	8.5	9.3	9.9	10.5	11.0	11.4	11.8	12.2	12.5	12.8	13.5	14.0	14.5	15.0	15.5
11	8.8	9.6	10.3	10.8	11.3	11.7	12.1	12.5	12.8	13.2	13.8	14.3	14.9	15.4	15.8
12	9.1	9.9	10.6	11.1	11.6	12.0	12.4	12.8	13.1	13.5	14.1	14.6	15.2	15.7	16.1
13	9.4	10.2	10.8	11.4	11.9	12.3	12.7	13.1	13.4	13.7	14.4	14.9	15.4	15.9	16.4
14	9.6	10.5	11.1	11.7	12.1	12.6	13.0	13.3	13.7	14.0	14.6	15.2	15.7	16.2	16.7

3) Rising and dipping of lights

Rising and dipping of lights can be used to determine the position of the vessel as it normally gives two position lines. The first position line is the bearing of the light and the second position line is the range off, as calculated. The range of the lighthouse is approximate only and should be used **WITH EXTREME CAUTION.**

1. Dipping ranges can only be used in clear weather when the loom of the light is visible before or after the light dips on the horizon.
2. Some lights whose charted range is less than their geographical range may be observed to dip on the horizon in conditions of excellent visibility.
3. Conditions of abnormal refraction may cause the dipping ranges to increase and consequently ranges obtained by this method should be used with **extreme caution**.

In short, once again:
Luminous range – is the maximum distance at which a light can be seen under existing visibility conditions.

Nominal range – is the maximum distance at which a light can be seen in clear weather as defined by international visibility code (meteorological visibility of ten nautical miles).
Geographical range – takes into account the observer's height of eye, the curvature of the earth, the elevation of the light etc and is the maximum distance (theoretical) at which the curvature of the earth permits the light to be seen.

A light is said to be **"Raised"** when it is first sighted by a ship as it approaches the light and it is said to be **"Dipped"** when it is sighted last.

Calculation of the rising and dipping range of light:

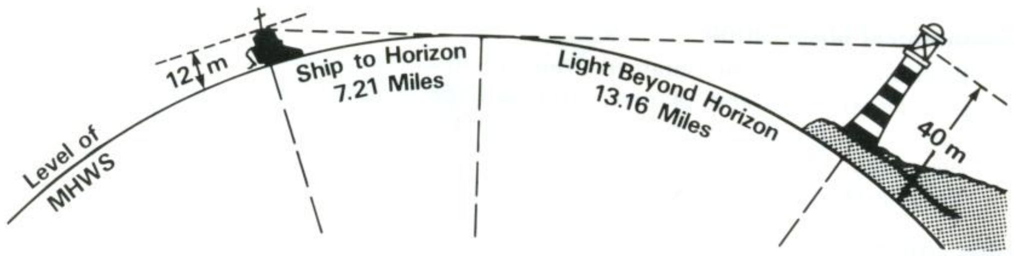
The theoretical distance of the sea horizon for a height of h metres is 1.92$\sqrt{h}$ nautical miles, but the effect of normal atmospheric refraction increases this by 8%. Hence the distance of the sea horizon can be found by the following formulae:

Distance = 2.08$\sqrt{h}$ nautical miles (where h is in meters)
OR
Distance = 1.15$\sqrt{h}$ nautical miles (where h is in feet)

Hence the Rising or Dipping range of the light can be calculated by the following formula:

Range = 2.08$\sqrt{h}$ + 2.08$\sqrt{H}$ nautical miles (where both h and H are in Meters)
OR
Range = 1.15$\sqrt{h}$ + 1.15$\sqrt{H}$ nautical miles (where both h and H are in feet)

Where,
h is the height of the observer's eye above sea level,
H is the height of the light above MSL



Factors to be taken in to account when finding range

- The charted ranges of lights are normally luminous ranges and hence it is important to find the geographical range and the **lower of the two** should be taken.
- The ranges of lights are calculated for conditions of normal refraction.
- The ranges obtained by rising and dipping of lights are **approximate** only and hence to be used with caution.
- The list of lights shows the intensity of light when nominal range is shown and this is referred to in the light characteristic column. Not all of them have the intensity written.
- During ice conditions the windows of the lights may be covered with frost or ice which will greatly reduce the sighting range.
- Using the above formula and various nautical tables – there may be slight differences in the ranges calculated as the nautical tables use a slightly different factor.

Apply Your Knowledge

- Use the List of Lights to find details of the lights given in the table below. Also list the details of seven other lighthouses found on your present voyage. Calculate the rising and dipping distance of all these lights. Consider visibility to be excellent and your ship to be at her summer draft marks.

Light house	**Light characteristics**	**Daytime identification**	**Luminous range**	**Geographical range**	**Nominal range**	**Rising / dipping distance**
Europa Point						
Prongs reef						
Nab Tower						

Function: Navigation

Competence: Plan and conduct a passage and determine position.

Task Reference No: A1.2

Sub task Reference Nos.: A1.2.4

Topic: Terrestrial & Coastal Navigation

Task Heading

- Determine the ship's dead reckoning position and estimated position, taking into account winds, tides, currents and estimated speed.

Objectives

- To gain knowledge on the effects of wind and current on ship's position and familiarize with various calculations involved in calculating courses and distances.

Index

1) Introduction
2) Wind and its effects
3) Current and its effects
4) Practice calculations for distance, average speed and course made good
5) Plane and parallel sailing (without traverse tables)
6) Parallel sailing calculations
7) Plane sailing calculations
8) Calculations using traverse tables
9) Mercator sailing calculations

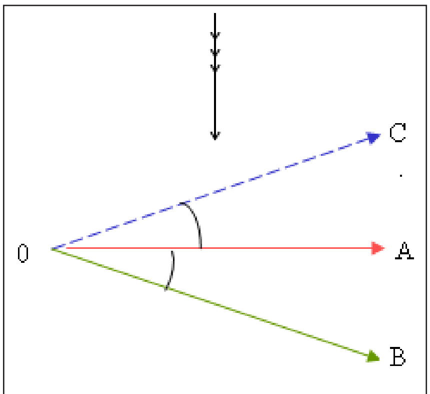
Description

1) Introduction

In this module we will learn about the effect of wind and current on navigation and how to counteract the same. Winds, currents and hence their effects are variable and may change very quickly. We shall also learn to calculate the distance travelled, the course made good and the set and drift experienced by the vessel.

2) Wind and its effects

Leeway is the leeward motion of the vessel due to the effect of wind. It may be expressed as a distance, speed or angular difference between course steered and course made good through the water. Look at the figure below.



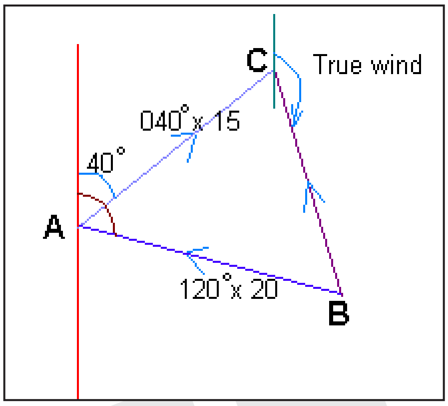
Effect of wind

In the adjoining figure, say your vessel is steering the direction OA (090°). The effect of the wind from north is to cause the vessel to make good the course OB. To counteract this effect of wind, the vessel must steer a course OC to make good the course OA.

On board a merchant ship as most of the above factors vary considerably, it is impractical to formulate a table to accurately tabulate the amount of leeway that should be given. This allowance is usually done on board on a 'trial and error' basis gaining knowledge with experience. In practice, it is impossible to calculate the effect of wind alone on the ship's course and speed. It is usually a combination of both wind and current and the state of sea along with other factors.

When a vessel is underway, the wind that is experienced is the **relative wind** and not the **TRUE WIND**. For purpose of other calculations, it is important to know the true direction and speed of wind. This can be calculated using the wind triangle as follows:

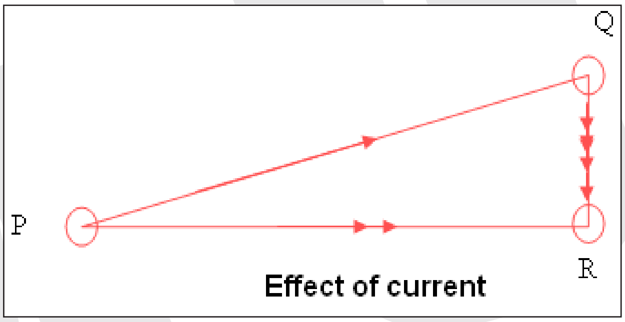
Example I: A ship is on course of 040° T at a speed of 15 knots. The apparent wind is 120°T at a speed of 20kts. Find the direction and speed of True wind.



Draw a line representing the N-S direction and mark any point A on it. Mark off an angle 040° (T) at A and lay off the distance of 15 knots (AC) being the course and speed of the vessel.

Again at A, mark off an angle of 120° and lay off a distance of 20 knots (using the same scale - AB). BA will represent the apparent wind direction and speed. Join the points B & C. The direction BC will represent the true wind direction (For finding the direction, draw a N-S line through C and read off the angle at C between North and B) and length of vector BC will give you the true wind speed.

3) Current and its effects



The horizontal motion of water over the surface of the earth is called **current**. The direction in which the water is moving is called the **set** and the rate at which it is moving is called the **drift**.

In the adjoining figure, PQ is the course and distance steered by the vessel. Expecting the vessel to be in position Q, a fix obtained showed the vessel to be at position R. Therefore the set and drift of the vessel is therefore from Q towards R. As the vessel has reached position R instead of Q, PR is the course and distance made good.

Some important points to remember

> **REMEMBER!**
> **Wind** is named by the direction it **COMES FROM**.
> **Current** is named by the direction it **GOES TO**.

a) The set and drift of the current is always from D.R. position towards the fix. (i.e. it is always in the direction that it sets the ship).
b) Beam bearings are **always on the course steered** and never on the course made good; while **DISTANCE OFF** when abeam is **ALWAYS ON THE COURSE MADE GOOD.**
c) Always calculate the rate of set and drift using the same time interval as that used for calculating the distance covered whether it is steered or made good.
d) Drift is always expressed in miles.
e) If required the rate of current can be obtained in knots by dividing the drift by the number of hours during which the drift occurred.

4) Practice calculations for distance, average speed and course made good

In this section of the module we will briefly run through the methods of calculating distances between two observed positions. These methods will be demonstrated by means of example.

Calculation of course & distance:

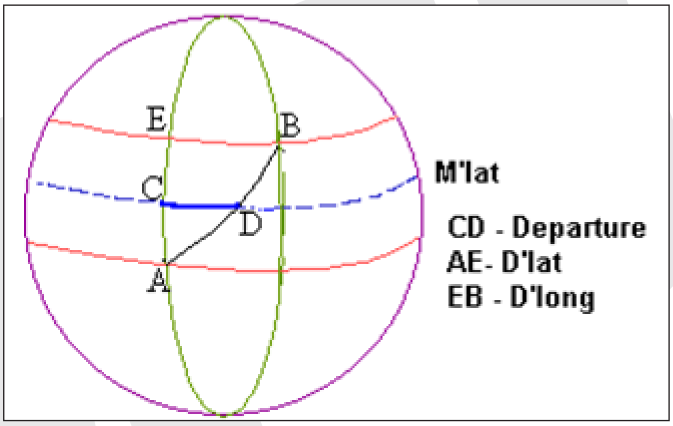
- Sailing between two positions on the earth's surface involves calculating the course and distance between them.

- We all know that Earth is spherical in shape and hence the shortest distance traversed between two points on the Earth's surface is the shorter arc of the great circle through those points.
- For practical purposes, where the distance between two places is less than 600 miles or so, it is considered to be a straight line and plane trigonometry can used to:
  - Compute the course and distance between the two positions.
  - Calculate the position arrived given the starting position, course and distance steamed.
- To facilitate easy calculation, the nautical tables gives you a set of tables known as the 'Traverse Tables' which gives ready solution of right angled triangles. We will solve one of the examples using this method also.
- When distances between two positions on earth's surface exceed 600 nautical miles better accuracy will be obtained using the mercator sailing.
- For ocean voyages when the ship is travelling from one end of the ocean to the other the shortest distance between the two points will be a great circle and a brief on how to calculate the same is also given in this module.

5) Plane and parallel sailing (without traverse tables)

Some important definitions:

Rhumb line: is a line on the earth's surface, crossing all meridians at the same angle. It is the most convenient track to follow as the course of the ship remains constant for the entire passage.



Departure: The departure between two places is the east-west distance between them in nautical miles.

- If the two places are on the same latitude, the departure is the distance between them in nautical miles.
- When the two places are in different latitudes, the departure between them is taken as the east west distance between their meridians measured along the mean latitude. This will hold good if the latitudes of both the places are fairly close to each other and this concept is used without any appreciable loss of accuracy in mean latitude problems.
- When the latitudes of two places are widely separated, the mean latitude concept will be technically incorrect and in this case the departure is taken as the east west distance measure along the middle – latitude. Here, the middle latitude is defined as the latitude on which the true departure lies. This concept is used in middle latitude sailing calculations, which are generally discouraged for the purpose of practical navigation.

6) Parallel sailing calculations

Example II: A vessel in latitude 50°N longitude 004°W steers a course of 090° (T) for a distance of 90 miles. Find the position arrived.

To convert departure in to D'long or vice versa, the parallel sailing formula is used which is

Dep / D'long = Cos M'lat
∴ D'long = Dep / Cos M'lat = Dep x Sec M'lat

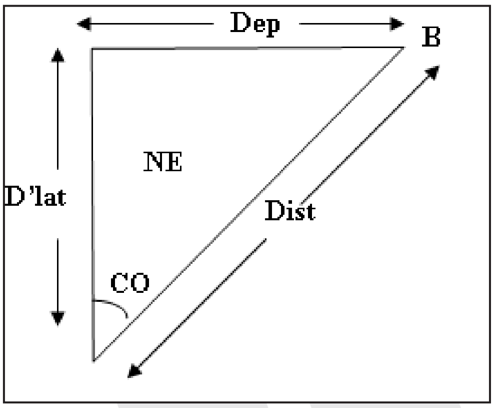
Since the vessel is travelling east – departure is the same as distance travelled which is 90 miles
D'long = 90 x sec 50
= 90 x 1.55 57
= 140.02' East
= 2°20'E
Longitude arrived = 004°W + (2°20'E)

= 004°00'W – 2°20' = 01° 40'W

Position arrived:
50°00'N, 001°40'W

7) Plane sailing calculations

Example III: Find the course and distance from
Position A : 49^0 35'N $004^0$00'W to
Position B : 50^0 10'N 002^0 55'W



Solution:

Position A	49^0 35'N	004^0 00'W
Position B	50^0 10'N	002^0 55'W
D'lat	00^0 35'N	D'long 1^0 05'E

D' lat = 35'N D'long =65' E
M' Lat = 49^0 52.5
Dep = D'long x cos M'lat
= 65 x cos $49^0$52.5
= 41.89'
Tan course = Dep / D'lat = 41.89 / 35 =1.19686
$\therefore$Course = N 50° E

Distance = D'lat x sec co.
= 35 x sec 50
= 35 x 1.55 57
= 54.5 N miles

Course and distance:
050°(T) distance 54.5'

We will now work out another example on plane sailing where by the initial position, the course and distance travelled is given and we will have to find out the arrival position.

Example IV: Your vessel was in position 04°20'S 040°50'E. She sailed on a Rhumb line course of 185°T for a distance of 260 miles. Assuming there has been no effect of wind and current, what will be your arrived position?

Distance = 260 M
Course = 185° T i.e. S05°W
D'lat = Distance x Cos course.
= 260 x cos 05
= 259.01 ≈ 259'
D'lat = 259 = 4°19.0'S

Dep Latitude:	04° 20'S
D'lat:	04° 19'S
Arrived Latitude:(Add)	08° 39'S
Mean Latitude:	06° 29.5' S

Dep = Distance x sin co = 260 x sin 05 = 22.66'
D'long = dep x sec M'lat = 22.66 x sec 06° 29.5' = 22.8' W

Departure Longitude:	040° 50' E
D'long:	0° 22.8' W
Arrival longitude:	040° 27.2' E

Position Arrived:
08°39' S, 040° 27.2' E

8) Calculations using traverse tables

The above examples were worked out without the use of the traverse tables. Now let us solve few examples using traverse tables:

Some notes regarding use of traverse tables:

a) Traverse tables are made for calculations for distances only up to 600 nautical miles. If the distance exceeds 600 miles, calculations are to be done by mercator sailing method.

b) All three-figure courses are to be converted into quadrantal ones for e.g. 165°(T) should be converted to S15°E.

c) When entering courses and mean latitudes in the traverse tables – if the value is less than 45° then the table is entered from the top of the page and if the value is more than 45° then the table is entered from the bottom of the page.

d) An example of how the table looks like is given below:

Traverse table- Format of a page of table:

22°

D.Lon	**Dep.**	
Dist	**D.Lat**	**Dep.**

68°

Dist	**Dep.**	**D.Lat**
D.Lon		***Dep.***

Example V: (using Traverse Tables)
Find the course and distance from
Position A : 49° 35'N 004°00'W to
Position B : 50° 10'N 002° 55'W

Solution

Position A 49^0 35'N 004^0 00'W
Position B 50^0 10'N 002^0 55'W
D'lat 00^0 35'N D'long 1^0 05'E
D' lat = 35'N D'long =65' E
M' Lat = 49^0 52.5

Entering T.T. using the M'lat in place we have the following results:
For 49° M'lat with D'long = 65' we have departure = 42.6
For 50° M'lat with D'long = 65' we have departure = 41.8

We need the departure for M'lat 49°52.5'. Interpolating the above values obtained for M'lat 49° and 50° we get:
For M'lat 49° 52.5' departure = 41.9'

For the above example we have departure = 41.9' and D'lat = 35'. Now we have to find a page in the Traverse table where both these values match or are as close to the above result as possible.
Reviewing the T.T we find that for course of 50° we have
For Distance 54.5 & D'lat = 35.03 and Departure = 41.8 which is very close to what we need.
Hence the course and distance travelled by the vessel is as follows:
Course N50°E and distance = 54.5 nautical miles, which is the same as we got when working this example using plane sailing calculations.

Important things to note:

1. When departure = d'lat then the course will be 45°.
2. When dep > d'lat then the quadrantal course is more than 45°.
3. When dep < d'lat then the quadrantal course is less than 45°

Example VI (using traverse tables)
Your vessel was in position 04°20’S 040°50’E. She sailed on a Rhumb line course of 185°T for a distance of 260 miles. Assuming there has been no effect of wind and current, what will be your arrived position?

Course = 185° (T) = S05°W
Distance = 260 n. miles.
Look up the traverse tables on the 5° page entering from top and enter the distance of 260’ on the same. We get the following result:

Dist	D.Lat	Dep
260	259.0	22.7

We get the D’lat as 259.0’ which is 4°19.0’S

Dep Latitude:	04° 20’S
D’lat:	04° 19’S
Arrived Latitude:(Add)	08° 39’S
Mean Latitude:	06° 29.5’ S

Now with the Mean latitude of 6°29.5’S and departure of 22.7’ W we have to enter the traverse table to find the D’long. In this case the column in the traverse tables to be used are marked in Italics. Interpolation may be necessary like in this case.
On page for 6° and departure of 22.7’ we get the D’long of 22.8’
On page for 7° and departure of 22.7’ we get the D’long of 22.9’
∴ For mean latitude of 6°29.5’ (close to 6 1/2°) we can take D’long of 22.8’

Departure Longitude:	040° 50’ E
D’long:	0° 22.8’ W
Arrival longitude:	040° 27.2’ E

Position Arrived:
08°39’ S, 040° 27.2’ E

9) Mercator sailing calculations

Mercator charts have been described in the module for chart projections. Here, we will shortly discuss some principles involved in the construction of the mercator chart and then learn the calculations involving mercator sailing.

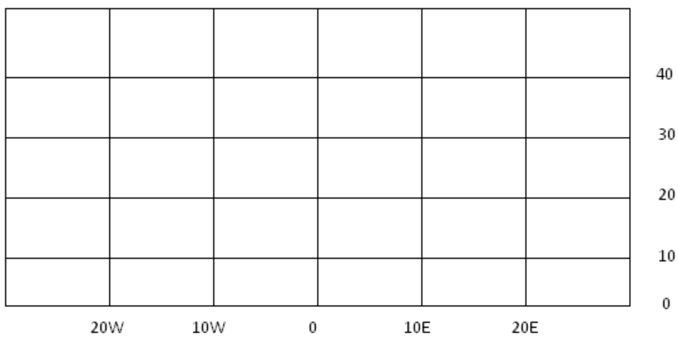
Some Principles involved in calculation of Mercator chart:

→ Mercator chart is based on “Cylindrical Orthomorphic Projection”.

→ Latitudes appear as parallel horizontal straight lines to the equator.

→ In actuality, we know that the longitudes coverage at the poles. Hence, the distance between the longitudes is maximum at the equator and reduces as latitude increases towards the poles.

→ In the mercator chart, meridians are represented by equidistant parallel straight lines. Therefore the east-west distortion on chart increases as the latitude increases.



Mercator Chart

→ To maintain the orthomorphic property of the chart, it is therefore necessary to deliberately introduce an equal north-south distortion, which is just like the east-west distortion and should increase towards the pole.

→ Due to the reason mentioned above, the distance between successive parallels of latitude on Mercator chart will increase towards the pole.

→ As the nautical mile is defined as the length of the meridian between two geographic latitudes which differ by 1' (i.e. 1' of d'lat) – on the mercator chart, the length of a nautical mile on increases pole ward – as nautical miles are measured on the latitude scale.

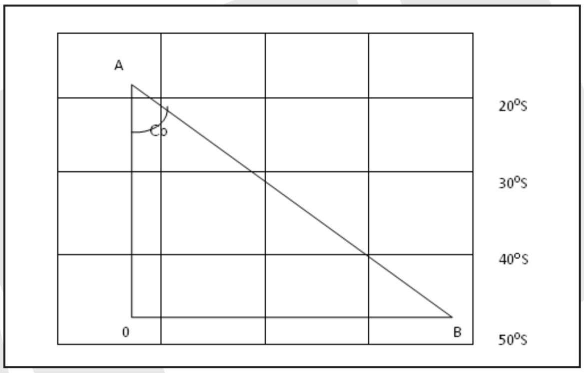
→ As seen earlier, on a Mercator chart, since the length of the meridian between two parallel of latitude increases towards the pole a concept of Meridional part has been introduced.

Definition of a "Meridional Part"

The "Meridional parts" for any latitude is the length of the meridian between the equator and that latitude on a mercator chart measured in units of longitude scale, i.e. the number of times one minute of longitude can be laid along a meridian between the equator and that latitude, on a Mercator chart. This value is tabulated in the nautical tables, assuming the earth to be a spheroid in shape.

Calculations

Look at the figure which shows a Mercator chart.



→ Mercator sailing is recommended to be used when the distance between two positions exceeds 600 nautical miles, in order to get more accurate results than by plane and parallel sailing methods.

→ Mercator sailing method is used to find the rhumb line course and distance between two positions, the latitudes and longitudes of which are known.

→ Refer to the Figure above
  → The Rhumb line course is laid from A to B
  → AB is the distance from A to B
  → Angle OAB is the course
  → AO is the D'lat and OB is the D'long

Note that the units of OB (D'long) and OA (D'lat) are different. Hence (D'long/D'lat) cannot be said as tangent course. However, if OA is also measured in terms of longitude scale, then OB/OA would be equal to tan of course.

Hence the difference in Meridional parts (DMP) is taken between the two latitudes and are required for calculations of distance and course.

Formulas used:

D'long / DMP = tan course
Distance = D'lat x sec course.

Examples using Meridional parts table (from in the nautical tables):

Example VII: Find the course and distance from position A in latitude 04° 10'S, longitude 040° 50'E, to position B in latitude 18° 50' N, longitude 072° 30'E.

Lat.	04°10'S	Long.	040°50'E	MP	0248.52
Lat.	18°50'N	Long.	072°30'E	MP	1143.36
d'lat	23°00'N	d'long	31°40'E	DMP	1391.88

Therefore, d'lat =1380' d'long = 1900'

(In this case, both d'lat and DMP are added as vessel is going from Southern Hemisphere to Northern Hemisphere. If both are in the same hemisphere, then the values should be subtracted).

D'long / DMP = tan co. = 1900 / 1391.88 = 1.36506
Course = N53°46.5'E

Distance = d'lat x sec co. = 1380 x sec 53°46.5' = 2335.17 miles.

Course and Distance between the above 2 positions is
Course: N53°46.5'E Distance = 2335.17 nautical miles.

Example VIII: ***A vessel sails on a course of 260°(T) from latitude 48° 35'N and makes a d'long of 63° 38'. Find the distance covered and the latitude reached.***

Lat left = 48° 35'	MP	=	3326.57 (N)
DMP = d'long x cot co. = 3818 x cot 260° (S 80° W)		=	673.22 (S)
MP of latitude arrived	=	2653.35 (S)	
Latitude arrived		=	40° 35'N
Latitude left		=	48° 35'N
D'lat		=	8° 00'S
Distance = d'lat x sec co.		=	480 x sec 80°
		=	2764.2 Miles

Distance covered: 2764.2 miles
Latitude arrived: 40° 35' N

Apply Your Knowledge

Perform the following calculations:

1) A ship in position latitude 37°50.0'N longitude 018° 36.0' W sails due west for 1181.5 miles. Use the parallel sailing method to find the position reached.

2) The DR position of a ship was estimated to be latitude 30°16.8'S longitude 057° 49.3'E. A fix obtained by the ship showed 31° 00.7'S 058° 20.4' E. Find the set and drift.

3) Calculate the course and distance between position 29° 20.0'N, 125° 35.0'E and 25° 40.0' N, 120° 50.0'E.

4) A ship in position 25° 47.0'S 163° 48.0'E steered 038° (T) for 2,475 miles. Calculate by mercator sailing the position arrived at.

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task Reference No: A1.2

Sub task Reference Nos.: A1.2.5

Topic: Terrestrial & Coastal Navigation

Task Heading

- Demonstrate understanding of the IALA Maritime Buoyage System for Region A and Region B including the emergency wreck marking buoy.

Objectives

- Understand IALA Maritime Buoyage System.

Index

1) Introduction
2) Lateral marks
3) Cardinal marks
4) Isolated danger marks
5) Safe water marks
6) Special marks
7) Emergency wreck marking buoy
8) Marking/ symbols of buoys and lights on navigational charts

Description

1) Introduction

Until mid seventies there were more than thirty different buoyage systems in use worldwide with many of these system having rules in complete conflict with one another. This created a lot of confusion among mariners particularly at night where he could unexpectedly be confronted by a light, the meaning of which was not clear. Such confusion was especially dangerous when an unidentified light was marking a new and as yet uncharted danger, such as a recent wreck. This left the mariner in doubt as to his proper course of action leading him to make a wrong and perhaps disastrous decision.

To avoid such confusions, and to standardize the buoyage system around the world, the technical committee of the International Association of Lighthouse Authorities (IALA) attempted to provide a worldwide buoyage system. The major challenges for the committee were:

a) The need to retain the existing equipment as far as possible to avoid undue expenses.
b) How to use the colours red and green when marking channels.
c) The need to combine the lateral and cardinal rules.

Keeping all the above in mind it was not possible to agree on a single system and eventually an alternative double system ‘A’ and ‘B’ was accepted in 1977. Keeping the rules governing the two systems very similar, it was possible to combine them to form the IALA Maritime Buoyage System, as we know it now. This single set of rules allows the lighthouse authorities the choice of using red to port or red to starboard on a regional basis, the two regions being known as **Region A** and **Region B**

Each of the ‘A’ and ‘B’ system comprises of simplified lateral marks (port and starboard marks) and cardinal marks to be used in conjunction with the mariner’s compass. Five types of shapes of buoys are used that are common to both the systems, i.e. can, conical, pillar, spherical and spar. The shapes of can, cone and spherical indicate the side on which the buoy has to be passed but the pillar and spar buoys provides indication to the mariner by their colour and top mark and not by shape. Under the IALA Buoyage System, only the lateral marks differ in Buoyage regions A and B. All the other type of marks are common to both the regions.

For the purpose of this system conventional direction of buoyage which must be indicated in appropriate nautical document may be either.

a) The general direction taken by the mariner when approaching a harbour, river, estuary, or other waterway from seaward OR
b) The direction determined by the proper authority in consultation, where appropriate, with neighboring countries. In principle it should follow a clockwise direction around landmasses.

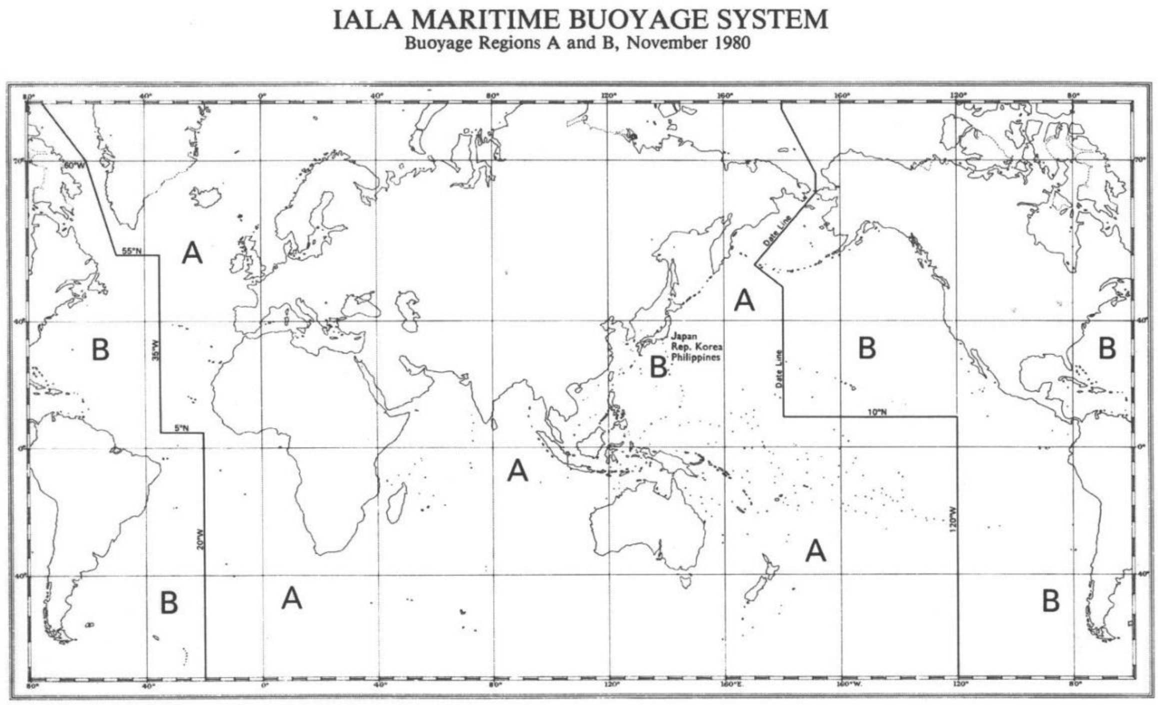
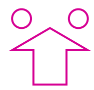


Figure 1: Areas covered under system A and B

On a chart, where not obvious, the conventional direction of Buoyage is indicated by: 

There are following six types of navigational buoys/ marks

- Lateral
- Cardinal
- Isolated danger
- Safe water
- Special
- Emergency/ New wreck

2) Lateral marks

- Generally used for defining the navigable channel in and out of harbour.
- Port and starboard buoys are used in conjunction with the conventional direction of buoyage.
- Where a channel divides, a modified lateral mark may be used to indicate the preferred route.
- **Port hand marks** are generally cylinder (can), pillar or spar. The pillar and spar has a top mark of a single red cylinder, if fitted.
- **Starboard hand marks** are generally conical, pillar or spar. Top mark if any, is generally a single cone pointing upwards.
- In **system 'A'** the colour of port hand marks are red and starboard hand marks are green. Light if fitted will show any other rhythm except group (2+1) as used for preferred channel marks. Colour of the light will be red for port hand marks and green for stbd hand marks.

- In **system 'B'** the colour scheme will be opposite of that of 'A' i.e. red to starboard and green to port.
- Preferred channel marks if fitted with light – the rhythm should be composite group flashing (2+1).

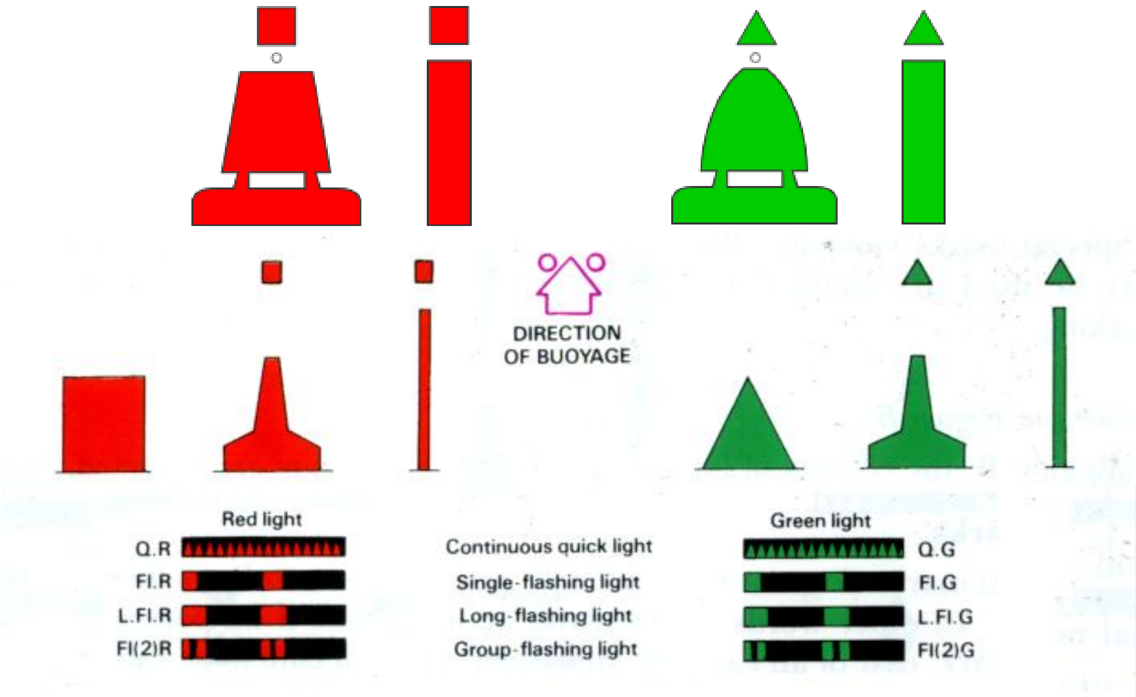


Figure 2a: IALA Region A: Port side buoys (Red), Starboard Side buoys (Green)

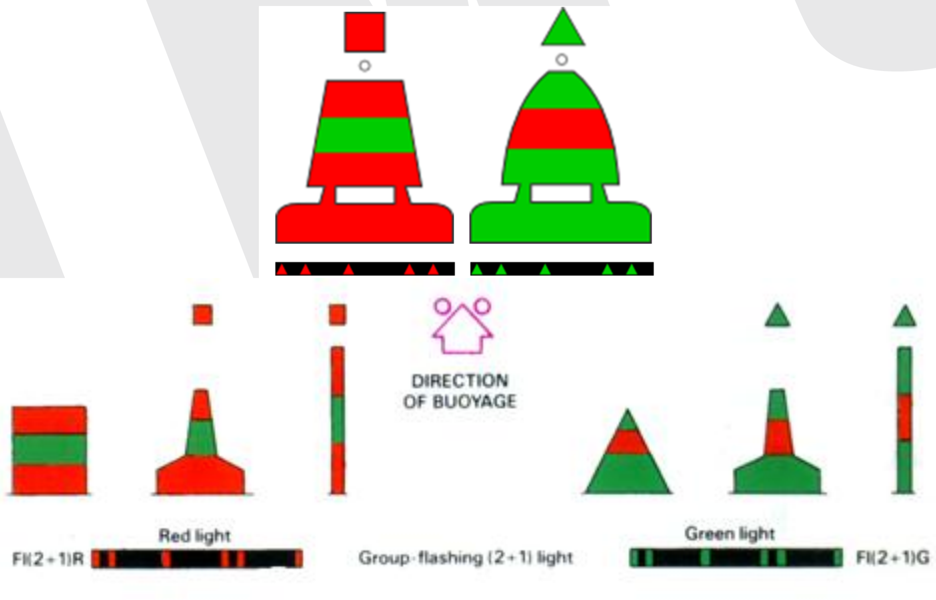


Figure 2b: IALA Region A:
Preferred channel to Starboard (Red/Green/Red),
Preferred channel to Port (Green/Red/Green)

3) Cardinal marks

- Are used in conjunction with the mariner's compass to indicate where the best navigable water may be encountered. For example, the west cardinal buoy has safe water on its west and the danger on its east side.
- Are the same in both system 'A' and 'B'
- Do not have distinctive shape but are normally pillar or spar.

- Are always painted in yellow and black and have a top mark of 2 cones.

An aid to their identification is by way of their top marks as pointers to the positions of the black band (s):-

Marks	**Top marks**	**Colour**	**Light Details**
North Cardinal	Cones pointing upwards	Black Band above Yellow band	VQ –Very Quick OR Q – Quick flashing
East Cardinal	Cones pointing away from each other	Black bands above and below Yellow band	VQ (3) 5 sec OR Q(3) 10 sec
South Cardinal	Cones pointing downwards	Black band below yellow band	VQ (6) + 1 long flash 10 s Q(6) + 1 long flash 15 s
West Cardinal	Cones pointing towards each other	Black band with yellow bands above and below	VQ (9) 10 sec Q(9) 15 sec

Colour of the light: White

The long flash for the South cardinal buoy is defined as a light appearance of not less than 2 seconds is merely a devise to ensure that three or nine “very quick” or “quick” flashes cannot be mistaken for six.

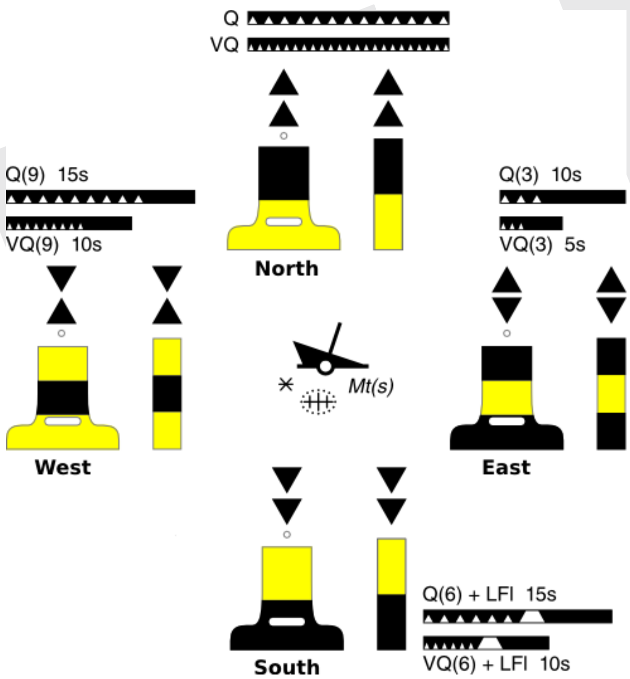


Figure 3: Cardinal Marks

4) Isolated danger marks

This mark is used to indicate isolated dangers of limited size that have navigable waters all around them. Isolated danger marks:

- Normally have a top mark of 2 black spheres in a vertical line.
- Are black in colour with one or more Red colored broad horizontal bands
- Preferred shape: pillar or spar
- Light if fitted will be group flashing (2) white.

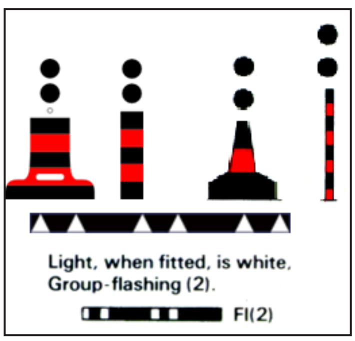


Figure 4: Isolated danger marks

5) Safe water marks

- Indicates that there is navigable water all around the mark.
- Are seawards of all other buoys and used for making landfall, centre line marks, mid-channel marks, etc.
- Shape usually spherical, pillar or spar. Top mark, if any, a single red sphere.
- Colour of the mark: red and white vertical stripes.
- Light: Typically calm and white, like one long flash every 10s or Morse (A).

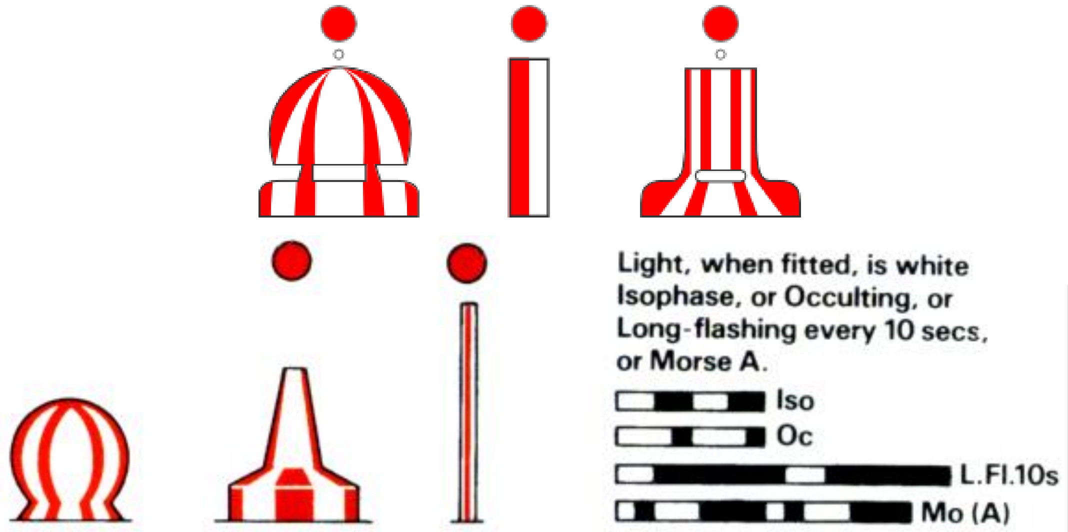
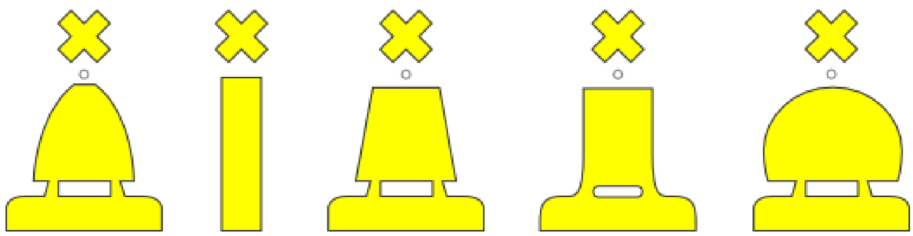


Figure 5: Safe water marks

6) Special marks

- Not intended to assist in navigation
- Used to indicate a special area or features such as:
  - ➢ Ocean Data Acquisition System (ODAS) marks.
  - ➢ Traffic separation marks where use of conventional channel marking may cause confusion.
  - ➢ Spoil ground marks
  - ➢ Military exercise zone marks
  - ➢ Cable or pipeline marks
  - ➢ Recreation zone marks
- Colour is yellow and shape is optional, but not conflicting with a navigation mark.
- Top mark if any will be a single yellow "X"
- Light if fitted will be yellow – characteristic will be different from those described in the other marks.



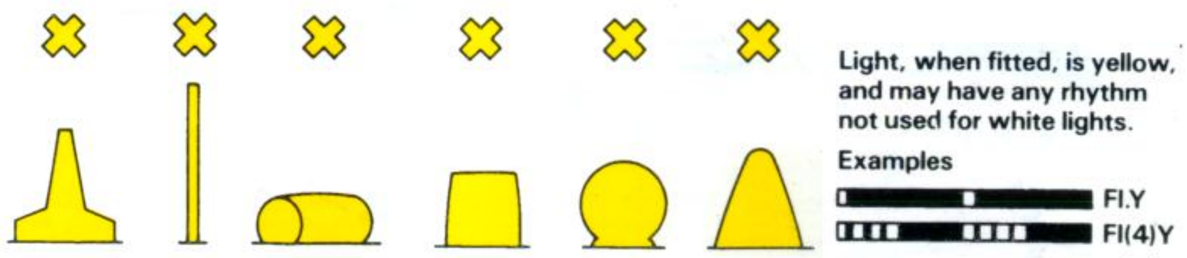


Figure 6: Special Marks

7) Emergency wreck marking buoy

In year 2002, when the “Tricolor” sank in the Dover Straits, several other vessels hit the wreck despite numerous radio navigational warnings, three guard ships on scene and a lighted buoy. This led to the introduction of a new type of buoy, the emergency wreck marking buoy, which is placed as close as possible to a new dangerous wreck. The emergency wreck marking buoy is to be kept in position until:

a) the wreck is well known and has been promulgated in nautical publications;
b) the wreck has been fully surveyed and exact details such as position and least depth above the wreck are known; and
c) a permanent form of marking of the wreck has been carried out.

Emergency wreck marking buoys has the following characteristics:

- Shape: pillar or a spar buoy
- Colour: Equal number and dimensions of blue and yellow vertical stripes (minimum of 4 stripes and maximum of 8 stripes).
- Top mark, if fitted, is a standing/upright yellow cross.
- Fitted with an alternating blue and yellow flashing light with a nominal range of 4 nautical miles where the blue and yellow 1 second flashes are alternated with an interval of 0.5 seconds. B1.0s + 0.5s + Y1.0s + 0.5s = 3.0s
- If multiple buoys are deployed then the lights have to be synchronized.
- A Racon morse code “D” and/or AIS transponder can be used.

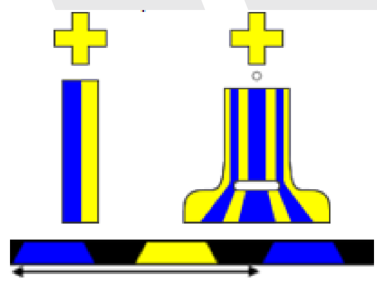
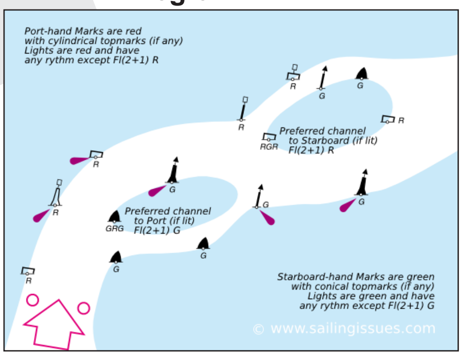


Figure 7: Emergency Wreck Marking Buoy

8) Marking/ symbols of buoys and lights on navigational charts

IALA Region A



IALA Region B

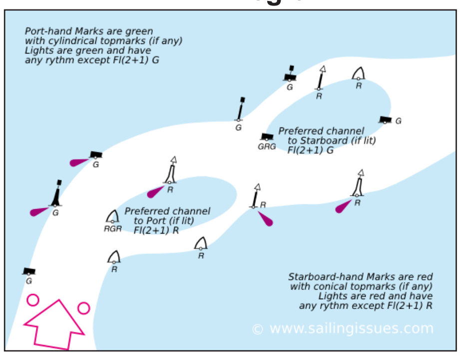
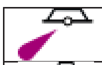
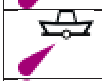
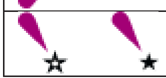
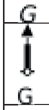
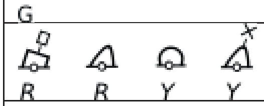
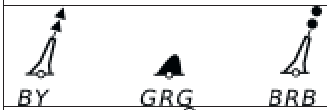
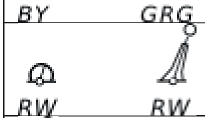
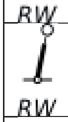
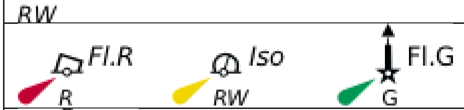
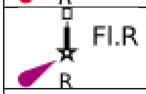
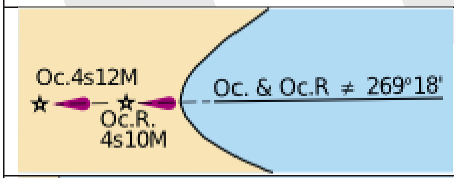
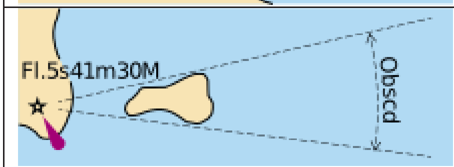
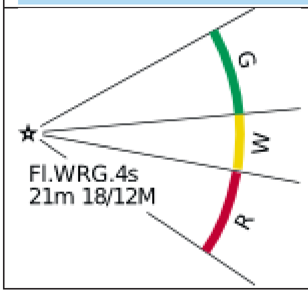
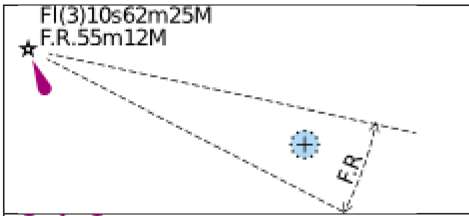
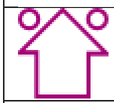
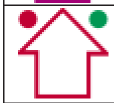


Figure 8- IALA Region A and B (Courtesy: www.sailingissues.com)

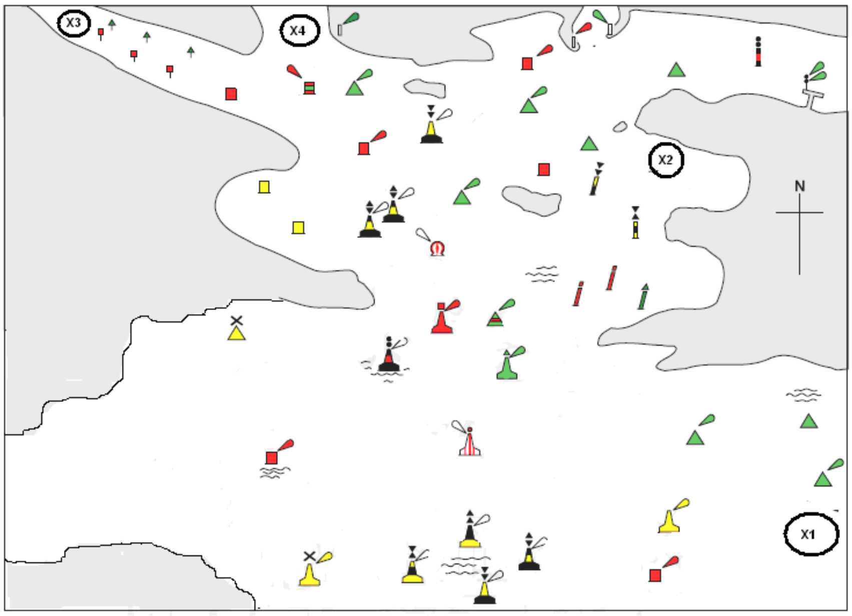
	Major floating light (light-vessel, major light-float, LANBY)
	Light-vessel
	Major light; minor light

	Green or black buoys (symbols filled black): *G* = Green ; *B* = Black
	Green or black beacon (symbol filled black). Note the upright G, instead of an oblique *G*
	Single coloured buoys other than green and black: *Y* = Yellow ; *R* = Red
	Coloured beacon other than green and black, the symbol is again filled black so only the shape of the top mark is of navigational significance.
	Multiple colours in horizontal bands, the colour sequence is from top to bottom
	Multiple colours in vertical or diagonal stripes, the darker colour is given first. *W* = White
	Spar buoy (here a safe water mark)
	Lighted marks on multi-coloured charts, GPS displays and chart plotters.
	Lighted red beacon on standard charts.
	Red beacon and green buoy with top mark, colour, radar reflector and designation. Red buoys and marks are given even numbers, green buoys and marks are given odd numbers.
	Wave-actuated bell buoy to the left, and to the right a Light buoy, with a horn giving a single blast every 15 seconds, in conjunction with a wave-actuated whistle. Other sounds include “Gong”, “Siren”, “Diaphone” (Dia). The fog signal symbol  may be omitted when a description of the signal is given.
	Leading beacons - Leading line (firm line is the track to be followed)
	Leading lights (≠: any two objects in line under each other). Bearing given in degrees and minutes. The lights are synchronized. The red light has a shorter nominal range (the distance from which the light can be seen): 10 nautical miles.
	All-round light with obscured sector
	Sector light on multi-coloured charts. The elevation is 21 metres (height of the light structure above chart datum). The nominal range of the white light is 18 nautical miles. The range of the green and red light is 12 nautical miles.

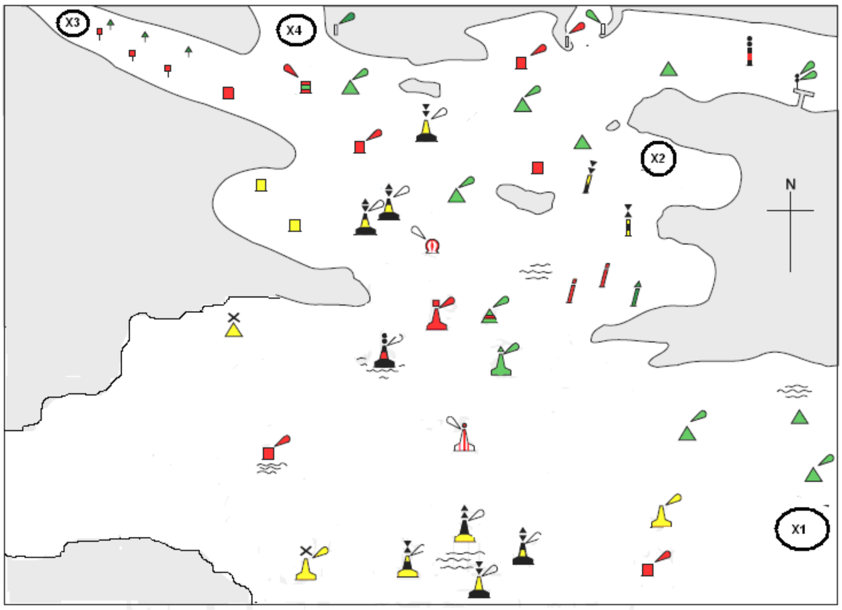
	Main light visible all-round with red subsidiary light seen over danger. The fixed red light has an elevation of 55 metres and a nominal range of 12 nautical miles. The flashing light is white, with three flashes in a period of 10 seconds. The elevation is higher than the red light: 62 metres and the range of the white light is 25 nautical miles.
	Symbol showing direction of buoyage (where not obvious)
	Symbol showing direction of buoyage (where not obvious), on multi-coloured charts (red and green circles coloured as appropriate), here IALA A

Apply Your Knowledge

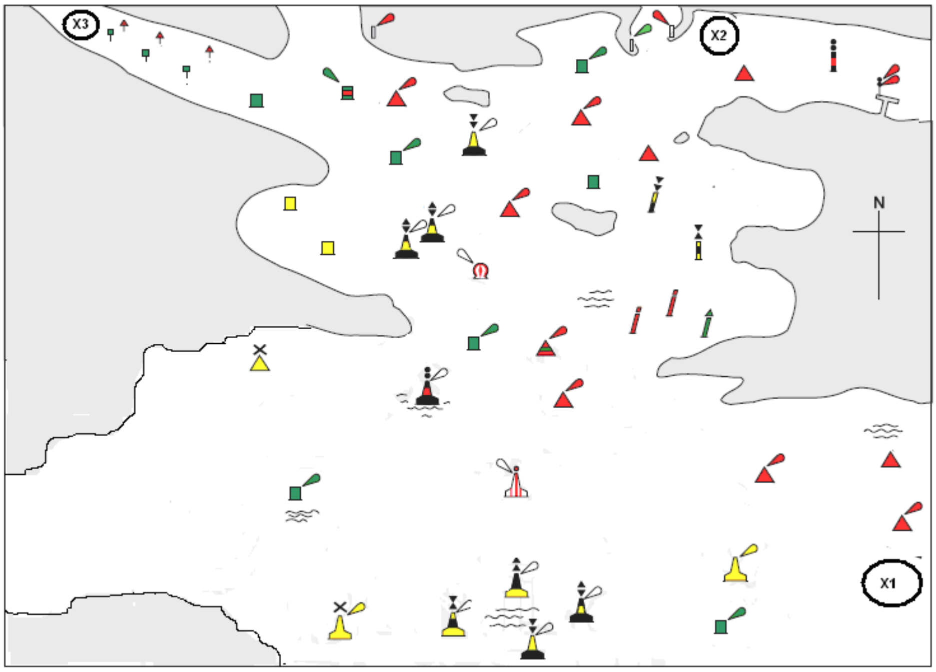
1. You are in Region A- Using the buoys to keep away from shallows and dangers, draw the course inbound (from position X1 to position X2) and course outbound (from position X4 to position X1) in the following buoyage plan.



2. You are in Region A- Using the buoys to keep away from shallows and dangers, draw the course outbound from position X3 to position X1 in the following buoyage plan.



3. You are in Region B- Using the buoys to keep away from shallows and dangers, draw the course inbound from position X1 to position X3 in the following buoyage plan.



Function: Navigation

Competence: Plan and conduct a passage and determine position

Task Reference No: A1.3

Sub task Reference Nos.: A1.3.3

Topic: Charts and Publications

Task Heading

- Make inventory of publications available on bridge.

Objectives

- Familiarize with various publications on bridge.

Index

I. List of mandatory and recommended publications (other than nautical publications) required to be carried onboard
A. Publications for all types of vessels
B. Additional publications for bulk carriers
C. Additional publications for oil/ product tankers
D. Additional publications for chemical tankers
E. Additional publications for gas carriers
F. Additional publications for LNG carriers
G. Additional publications for off-shore/ research vessels
H. Additional publications for Ro-Ro vessels
I. Additional publications for pure car carriers
J. Additional publications for timber carriers

Description

I. List of mandatory and recommended publications (other than nautical publications) required to be carried onboard

A) Publications for all types of vessels

1. International Convention for the Safety of Life at Sea, SOLAS, latest edition and edition applicable to vessel.
2. MARPOL Consolidated Edition
3. Convention on the International Regulations for Preventing Collisions at Sea 1972
4. International Conference on Training and Certification of Seafarers, 1995 (STCW 95), with latest amendments
5. Load Lines Consolidated
6. I.S.M. Code
7. International Ship and Port Facility security Code (ISPS code)
8. International Aeronautical and Maritime Search and rescue Manual Vol III (IAMSAR – Manual) (IMO-962E-2008)
9. International Maritime Dangerous Goods Code (IMDG Code) (Excluding Bulk Carriers)
10. IMDG Code and Supplement (including EMS and MFAG) (IMDG Code – Not required on Bulk Carriers)
11. Ships Routing with Amendments (IMO-927E)
12. International Code of Signals
13. Provisions Concerning the Reporting of Incidents Involving Harmful Substances under MARPOL-73/78
14. International Safety NET Manual
15. IMO Standard Marine Communication Phrases (Replaces IMO 985E)
16. Procedures for Port State Control
17. International Life saving Appliances Code (LSA Code)

18. International Code for Fire Safety Systems (FSS Code)
19. Code on Alarms and Indicators
20. Wall Chart: IMO Dangerous Goods Labels, Placards and Mark
21. Graphical Symbols for Fire Control Plans
22. Pocket Guide to Cold Water Survival
23. Life Saving Appliance Symbols
24. International Health Regulations
25. Maritime Labour Convention
26. ITU – List of Call Signs and Numerical Identities of Stations Used by the Maritime Mobile and Maritime Mobile Satellite Services (Including Supplements)
27. ITU – List of Coast Station (Including Supplements)
28. ITU – List of Radio Determination and Special Service Stations
29. ITU – List of Ship Stations (Including Supplements)
30. ITU – Manual for use by the Maritime Mobile and Maritime Mobile Satellite Services
31. Flag State Circular Letters (if available from Flag State)
32. MET Publication 515 – (Book or electronic CG-515) or USCG CFR 33 Parts 1-199 and CFR 46 Parts 1-40 (Rules and Regs. for Foreign Vessels Operating on the Navigable Waters of the United States)
33. Code of Safe Working Practices for Merchant Seamen (DOT) (4 copies) (Ships with Chinese Crew to also have Chinese Translation)
34. Merchant Shipping "M" notices (Mandatory for UK flagged vessels)
35. Ship Captains Medical Guide
36. Personal Survival at Sea (MSA)
37. Leading for Safety
38. Reef Guide – 5th edition
39. St. Lawrence Seaway Handbook (Available on the net – free) {only for Ships going to St. Lawrence Seaway}
40. Bridge Team Management (Nautical Institute)
41. Mariner's Role in Collecting Evidence (Nautical Institute)
42. The Ship-handler's Guide
43. Partner Ship Command Scheme
44. Commercial Management for Ship Masters (Nautical Institute)
45. Bridge Procedure Guide - ICS
46. Perils of Sea and Salvage (I.C.S.)
47. Guide to Helicopter Ship Operation (I.C.S.)
48. Drug Trafficking and Drug Abuse (I.C.S.)
49. Guidelines for the Control of Drugs and Alcohol Onboard Ship
50. Marine Injury Reporting Guidelines – (Sent on board in 'OCIMF' papers file)
51. Straits of Malacca and Singapore Guide to Planned Transits by Deep Draught Vessels (Only Cape Sizers /Large Vessels)
52. Guide for Passage Planning for Transit of the Straits of Malacca and Singapore for Vessels of Draughts less than 12m
53. Institute Warranties Map (To be posted on the bridge)
54. Pirates and Armed Robberies – Guidelines on Prevention for Masters and Ship Security Officers (ISF)
55. Mariner's Handbook, NP 100
56. How to keep your Admiralty Charts Up-to-date (NP 294)
57. Guide to Port Entry (Shipping Guides Ltd.) or LR Fairplay Port Guides CD (As equivalent to above)
58. P and I Publication/ Rules and List of Correspondents
59. P & I Guidelines – W.O.E.
60. Bills of Lading
61. Stay Safe – Don't Be a Statistic
62. Parallel Indexing Techniques
63. A 10 Minute Guide on the IMO's ISPS Code
64. A 10 Minute Guide to ISM – This is a very handy booklet to explain the ISM code to ratings
65. A Guide to the Collision Avoidance Rules

66. Business and Law for the Ship Master

B) Additional publications for bulk carriers

1. Code of Safe Practice for Solid Bulk Cargoes (BC Code)
2. International Code for the Safe Carriage of Grain in Bulk [International Grain Code]
3. Code of Safe Practice for Cargo Stowage and Securing
4. Code of Practice for the Safe Loading and Unloading of Bulk Carriers (BLU Code)
5. Thomas Stowage (Only Dry Cargo Vessels)
6. Bulk Carriers: Guidelines for Surveys, Assessment and Repair of Hull Structures (IACS)
7. Bulk Carrier Practice

C) Additional publications for oil/ product tankers

1. International Maritime Dangerous Goods Code (IMDG Code) (Excluding Bulk Carriers)
2. Control of Ships and Discharges
3. Inert Gas System {Tankers, OBO's, Gas Carriers Only}
4. Crude Oil Washing System
5. Mooring Equipment Guidelines
6. Effective Mooring (OCIMF)
7. Recommendations for ships fittings for use with Tugs with particular reference to escorting and other high load operations
8. International Safety Guide for Oil Tankers and Terminals (ISGOTT)
9. Ship to Ship Transfer Guide (Petroleum)
10. Recommendations for Oil Tanker Manifolds and Associated Equipment
11. Prevention of Oil Spillages through Cargo Pump Room Sea Valves
12. Clean Seas Guide for Oil Tankers
13. Anchoring Systems and Procedures for Large Tankers (OCIMF) {Required only for Ships with Length Greater than 240m LBP}
14. Guide for handling, storage, inspection and testing of hoses in the field
15. Recommendations for Equipment Employed in the Mooring of Ships at Single at Single Point Moorings
16. OCIMF Recommendations for Equipment for Towing of Disabled Tankers
17. Only for Ships Larger than 150,000 DWT
18. Vessel Inspection Questionnaire for Bulk Oil/Chemical Carriers and Gas Carriers
19. Vessel Particulars questionnaire for Bulk Oil/Chemical Carriers and Gas Carriers
20. Vessel Particulars questionnaire for Bulk Oil/Chemical Carriers and Gas Carriers {Sent as CD-ROM)
21. Tanker Management and Self Assessment 2: A Best Practice Guide for Ship Operations
22. Guidance Manual for the Inspection and Condition Assessment of Tanker Structures
23. Condition Evaluation and Maintenance of Tanker Structures ICS / OCIMF (Tanker Structure Co-op Forum)
24. Guidelines for the Inspection and Maintenance of Double Hull Tanker Structures
25. {Required only for Vessels with Double Hull Construction}
26. Guidance Manual for Tanker Structures
27. Safety in Oil Tankers
28. A Guide to Vetting Process
29. A.S.T.M. Petroleum Measurement Tables
    a. Vol 1 (TAB 5A, 6A)
    b. Vol 2 (TAB 5B, 6B)
    c. Vol 3 (TAB 6C)
30. Petroleum Measurement Tables, Volume V: Volume Correction Factors
31. Petroleum Measurement Tables – Volume Correction Factors Volume VII
32. Petroleum Measurement Tables – Volumes XI and XII Intraconversion between Volume Measures and Density Measures (ASTM)

D) Additional publications for chemical tankers

1. Medical First Aid guide for Use in Accidents involving Dangerous goods (MFAG)

2. IBC Code: International Code for the Construction and Equipment of Ships Carrying Dangerous chemicals in Bulk, Including Index of Dangerous Chemicals Carried in Bulk
3. {Required only for Chemical Carriers and Gas Carriers capable of carrying Chemical, built on or after 01 July 1986}
4. BCH Code: Code for the Construction and Equipment of Ships Carrying dangerous Chemicals in Bulk (IMO)
5. {Required only on Chemical Carriers and Gas Carriers capable of carrying Chemical, built before 01 July 1986} with Amendments
6. Guidance Manual for Tanker Structures
7. Tanker Safety Guide (Chemicals)
8. Mooring Equipment Guidelines
9. Effective Mooring (OCIMF)
10. Recommendations for ships fittings for use with Tugs with particular reference to escorting and other high load operations
11. International Safety Guide for Oil Tankers and Terminals (ISGOTT)
12. Clean Seas Guide for Oil Tankers
13. Vessel Particulars questionnaire for Bulk Oil/Chemical Carriers and Gas Carriers) {Sent as CD-ROM)
14. Tanker Management and Self Assessment: A Best Practice Guide for Ship Operations
15. Cargo Record Book for Ships Carrying Noxious Liquid Substances in Bulk
16. Hazardous Chemical Data Manual
17. Tank Cleaning Guide (CLS. Co)
18. Condensed Chemical Dictionary

E) Additional publications for gas carriers

1. IBC Code: International Code for the Construction and Equipment of Ships Carrying Dangerous chemicals in Bulk, Including Index of Dangerous Chemicals Carried in Bulk
2. {Required only vessels carrying dual code cargoes, built on or after 01 July 1986}
3. BCH Code: Code for the Construction and Equipment of Ships Carrying dangerous Chemicals in Bulk
4. {Required for vessels carrying dual code cargoes, built before 01 July 1986} with Amendments
5. International Code for the Constructions and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) {Gas Carriers Only} with 1994 and 1996 Amendments
6. Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk {Gas Carriers Only}
7. (For Ships Built between 31 December 1976 - 01 July 1986)
8. Code for Existing Ships Carrying Liquefied Gases in Bulk {For Ship Built Before 31 December, 1976}
9. BCH/LA/15 Amendments and Interpretations of the GC and IGC Codes Regarding Filling Limits
10. International Maritime Dangerous Goods Code (IMDG Code) (Excluding Bulk Carriers)
11. Inert Gas System {Tankers, OBO's, Gas Carriers Only}
12. Mooring Equipment Guidelines
13. Effective Mooring (OCIMF)
14. Recommendations for ships fittings for use with Tugs with particular reference to escorting and other high load operations
15. International Safety Guide for Oil Tankers and Terminals (ISGOTT)
16. Inspection Guidelines for Ships Carrying Liquefied Gases in Bulk
17. Ship Information Questionnaire for Gas Carriers (OCIMF/SIGTTO)
18. Ship to Ship Transfer Guide (Liquefied Gases)
19. Clean Seas Guide for Oil Tankers
20. Recommendations for ships fittings for use with Tugs with particular reference to escorting and other high load operations
21. Guide to Contingency Planning for the Gas Carrier Alongside and Within Port Limits
22. Contingency Planning and Crew Response Guide for Gas Carrier Damage at Sea and in Port Approaches

23. Recommendations for Manifolds for Refrigerated Liquefied Gas Carriers for Cargoes from 0o C to Minus 104o C
24. Vessel Inspection Questionnaire for Bulk Oil/Chemical Carriers and Gas Carriers
25. Vessel Particulars questionnaire for Bulk Oil/Chemical Carriers and Gas Carriers
26. OCIMF Recommendations on Equipment for the Towing of Disabled tankers {Required only for vessels exceeding 125,000 CBM capacity}
27. Vessel Particulars questionnaire for Bulk Oil/Chemical Carriers and Gas Carriers {Sent as CD-ROM)
28. Tanker Management and Self Assessment: A Best Practice Guide for Ship Operations
29. Cargo Firefighting on Liquefied Gas Carriers
30. Guidelines for the Alleviation of Excessive Surge Pressures on ESD
31. Introduction to the design and Maintenance of cargo System Pressure Relief Valves on board Gas Carriers (SIGTTO)
32. Liquefied Gas Handling Principles on Ships and in Terminals
33. Recommendations and Guidelines for Linked Ship/Shore Emergency Shut Down of Liquefied Gas Cargo Transfer
34. Quantity Calculations LPG and Chemical Gases
35. Guidelines on the Shipboard Odourisation of LPG
36. Liquefied Gas fire hazard management
37. Guide to Pressure Relief Valve Maintenance and Testing
38. Guidance Manual for Tanker Structures
39. Tanker Safety Guide (Liquefied Gas)
40. Safety in Liquefied Gas Tankers (ICS)
41. CDI Ship Inspection Report for Liquefied Gas Carrier
42. Gas Carrier Safety Handbook (BV/LLP)
43. Petroleum Measurement Tables – Volume XI and XII (Intraconversion between Volume Measures and Density Measures)

F) Additional publications for LNG carriers

1. Liquefied Gas Carriers – Your Personal Safety Guide
2. Guidelines for Automatic Cargo Tank Overfill Protection Aboard Gas Carriers
3. Recommendations for the Installation of Cargo Strainers on LNG Carriers
4. Safety Havens for Disabled Gas Carriers
5. Fire Prevention in the Cargo Containment Systems of Liquefied Gas Carriers in Shipyards
6. Rollover Prevention – A Review of Causes, Methods for Prevention and Damage Limitation Measures
7. The Ship/Shore Interface – Communications Necessary for Matching Ship to Berth
8. Cargo Fire fighting on Liquefied Gas Carriers (video)
9. Liquefied Gas Fire Hazard Management
10. The Chemistry of Liquefied Gases
11. The Physics of Liquefied Gases
12. LNG Carrier Steam Plant Tutor (Ver.4) – CD ROM
13. LNG Operations in Port Areas
14. Crew Safety Standards and Training for Large LNG Tankers
15. Clean Seas Guide for Oil Tankers
16. Vessel Particulars questionnaire for Bulk Oil/Chemical Carriers and Gas Carriers {Sent as CD-ROM)
17. Tanker Management and Self Assessment: A Best Practice Guide for Ship Operations
18. Recommendations for ships fittings for use with Tugs with particular reference to escorting and other high load operations

G) Additional publications for offshore/ research vessels

1. Lashing and Securing of Deck Cargoes including packaged timber, vehicles on Ro-Ro vessels and ISO Containers in Non-Purpose Built Ships

H) Additional publications for RO-RO vessels

1. Safe Working at Ro-Ro Terminals (ICHCA)
2. Roll- on/ Roll- off ships – Stowage and Securing of vehicles
3. Code of Safe Practice for Cargo Stowage and Securing

I) Additional publications for pure container carriers

1. Storck Guide Stowage and Segregation to IMDG Code

J) Additional publications for timber carriers

1. Code of Safe Practice for Ships Carrying Timber Deck Cargoes

Apply Your Knowledge

1. Check all mandatory publications on board your vessel.

Function: Navigation

Competence: Plan and conduct a passage and determine position.

Task Reference No: A1.3

Sub task Reference Nos.: A1.3.4, (A1.3.4.1, A1.3.4.2, A1.3.4.3, A1.3.4.4, A1.3.4.5, A1.3.4.6, A1.3.4.7, A1.3.4.8, A1.3.4.9, A1.3.4.10)

Topic: Charts and Publications

Task Heading

- Demonstrate understanding of the contents and use of relevant BA publications, including:
  - Weekly, Cumulative and Annual Notices to Mariners
  - Mariner's Handbook (NP 100)
  - Catalogue of Admiralty Charts and Publications (NP 131)
  - Sailing Directions
  - Ship's Routeing Information
  - Ocean Passages for the world
  - List of Lights & Fog Signals (including Digital list of lights)
  - Tide Tables, Tidal Stream Atlases
  - Admiralty List of Radio Signals
  - Routeing charts

Objectives

- Familiarize and understand the use of various BA publications on board.

Index

1) Admiralty Notices to Mariners
2) Mariner's Handbook (NP 100)
3) Catalogue of Admiralty Charts and Publications (NP 131)
4) Sailing Directions
5) Ship's Routeing Information
6) Ocean passages for the world
7) Admiralty List of Lights & Fog Signals
8) Admiralty Tide Tables
9) Admiralty Tidal Stream Atlases
10) Admiralty List of Radio Signals
11) Routeing charts

Description

1) Admiralty Notices to Mariners

All the admiralty charts and publications are required to be maintained so that they are fully up-to-date for the latest safety-critical navigational information. The admiralty notices to mariners contain all the corrections, alterations and amendments for the UKHO's (United Kingdom Hydrographic Office) worldwide series of admiralty charts and publications. These notices are published by way of weekly notices, cumulative notices and annual summary of notices to mariners for issue to ships. Notices, and the weekly editions containing such notices, are each numbered consecutively, commencing at the beginning of each year.

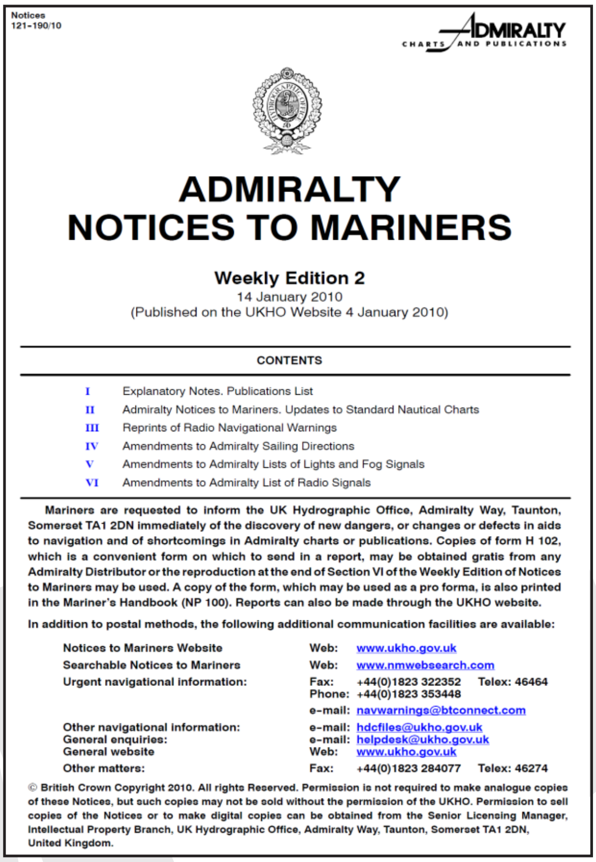
- **Weekly editions**

Each weekly edition consists of the following sections:

I. Explanatory Notes. Publications List
II. Admiralty Notices to Mariners. Updates to Standard Nautical Charts
III. Reprints of Radio Navigational Warnings

IV. Amendments to Admiralty Sailing Directions
V. Amendments to Admiralty Lists of Lights and Fog Signals
VI. Amendments to Admiralty List of Radio Signals

Each weekly edition is bound by staples to enable Temporary and Preliminary Notices and Sections III to VI to be detached for filing, or to facilitate the correction of Admiralty publications. In addition to the above information the Weekly edition contains the following information:


Notices
121-190/10

ADMIRALTY CHARTS AND PUBLICATIONS

ADMIRALTY NOTICES TO MARINERS

Weekly Edition 2
14 January 2010
(Published on the UKHO Website 4 January 2010)

CONTENTS

I	Explanatory Notes. Publications List
II	Admiralty Notices to Mariners. Updates to Standard Nautical Charts
III	Reprints of Radio Navigational Warnings
IV	Amendments to Admiralty Sailing Directions
V	Amendments to Admiralty Lists of Lights and Fog Signals
VI	Amendments to Admiralty List of Radio Signals

Mariners are requested to inform the UK Hydrographic Office, Admiralty Way, Taunton, Somerset TA1 2DN immediately of the discovery of new dangers, or changes or defects in aids to navigation and of shortcomings in Admiralty charts or publications. Copies of form H 102, which is a convenient form on which to send in a report, may be obtained gratis from any Admiralty Distributor or the reproduction at the end of Section VI of the Weekly Edition of Notices to Mariners may be used. A copy of the form, which may be used as a pro forma, is also printed in the Mariner's Handbook (NP 100). Reports can also be made through the UKHO website.

In addition to postal methods, the following additional communication facilities are available:

Notices to Mariners Website	Web:	www.ukho.gov.uk
Searchable Notices to Mariners	Web:	www.nmwebsearch.com
Urgent navigational information:	Fax:	+44(0)1823 322352 Telex: 46464
	Phone:	+44(0)1823 353448
	e-mail:	navwarnings@btconnect.com
Other navigational information:	e-mail:	hdcfiles@ukho.gov.uk
General enquiries:	e-mail:	helpdesk@ukho.gov.uk
General website	Web:	www.ukho.gov.uk
Other matters:	Fax:	+44(0)1823 284077 Telex: 46274

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a. New charts and publications - published during the week, information on forthcoming charts and publications (to be published), admiralty charts and publications permanently withdrawn, admiralty chart agent information, etc. A list of current hydrographic publications is published quarterly in the weekly Editions of ANM. A notice in Section II gives the dates of the latest editions of the various volumes of the sailing directions, list of lights, list of radio signals and certain other miscellaneous publications plus any supplements affecting them.

b. Temporary and preliminary notices are marked as (T) and (P) respectively, and an asterisk adjacent to the number of a notice indicates that the notice is one based on original information, as opposed to one that republishes information from another country. (T) And (P) notices which are in force at the end of the year are published in the annual summary of admiralty notices to mariners. A list of T & P notices and corrections to sailing directions in force is published monthly in the weekly editions of ANM.

➢ **Cumulative List of Admiralty Notices to Mariners (NP234 A/B)**

A Cumulative List of Admiralty Notice to Mariners was introduced in January 1986 and is published annually, with Part A in January and Part B in July. The Cumulative List of Admiralty Notices to Mariners (NP234 A/B) assists users who wish to identify outstanding Notices to Mariners and audit trails for a particular chart or charts. It records the date of issue of the current edition for each chart and of subsequent relevant Notices to Mariners issued during the previous two years. It also contains a list of current Hydrographic publications.

In this list, the chart numbers refer to navigational charts in the Admiralty series, including adopted Australian, New Zealand and Japanese charts (indicated by the prefixes AUS, NZ and JP respectively). The edition date quoted indicates the month and year of publication of the current edition (the relevant date is given in the bottom outside margin of the chart). This means that a chart carrying an earlier edition date than that quoted in this list is no longer valid and should be replaced. Newly published New Charts and New Editions are not included in this list until publication is announced in the Weekly Editions of Admiralty Notices to Mariners. The Notices to Mariners quoted for each chart are those which have been issued over the past 2 years. Figures in bold indicate the week the notice was issued. If no notice has been issued during the past 2 years, the most recent notice affecting the chart concerned is quoted. One of the pages showing the list is shown in the figure for your reference.

NP 234/10A

ADMIRALTY CHARTS AND PUBLICATIONS

CUMULATIVE LIST OF ADMIRALTY NOTICES TO MARINERS

January 2010

This publication records the date of issue of the current edition of each navigational chart and of subsequent relevant Notices to Mariners issued since **Weekly Edition 1 of 2008** dated 3 January 2008.

This list reflects promulgated information up to **Notice to Mariners Weekly Edition 53 of 2009** dated 31 December 2009 (last notice number 7026/09).

Users should keep it updated from the information given in Sections I and II of the subsequent Weekly Editions unless NP 133a is in use. The next list will be published in 6 months time.

This publication also includes details of current Hydrographic Publications correct to 26 December 2009.

It is hoped that this list will be useful to chart users. Users are reminded, however, that the authoritative listings of Admiralty Notices to Mariners are those given in the Weekly Editions.

PUBLISHED BY THE UNITED KINGDOM HYDROGRAPHIC OFFICE

2010

Chart No.	Edition	Notices to Mariners
735	Oct. 2008	**2008** **(52)** 7036 **2009** **(6)** 637 **(16)** 1977 **(30)** 3745 3852
736	Oct. 2008	**2009** **(30)** 3852
737	Oct. 2008	**2009** **(5)** 478 **(8)** 858 **(31)** 3905 **(42)** 5454 **(53)** 7010
740	May 2003	
741	Jan. 2006	**2008** **(39)** 5271 **(45)** 6033 6034 **2009** **(42)** 5454 **(53)** 7010

➢ Annual Summary of Admiralty Notices to Mariners (NP 247 - 1 & 2)

To supplement Weekly NMs, the UKHO produces an Annual Summary of Notices to Mariners (NP247), published annually in January. This publication now comes in two parts, i.e. NP 247 (1) and NP 247 (2).

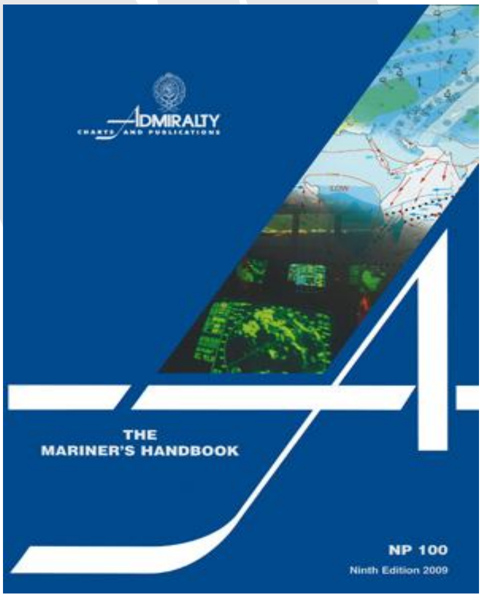
Part 1 contains the Annual Statutory Notices to Mariners Numbers 1-26 and a summary of Temporary and Preliminary Notices to Mariners still in force at the start of the year.

Part 2 contains a Cumulative Summary of Amendments to Admiralty Sailing Directions. It provides the text of all amendments to current editions of Admiralty Sailing Directions which have been published in Section IV of weekly Admiralty Notices to Mariners, and which remain in force at the start of the year.

2) The Mariner's Handbook (NP 100)

The Mariner's handbook is a compendium of essential maritime information on charts; operations and regulations; tides, currents and characteristics of the sea; basic meteorology; navigation in ice, hazards and restrictions to navigation; and the IALA Buoyage system.

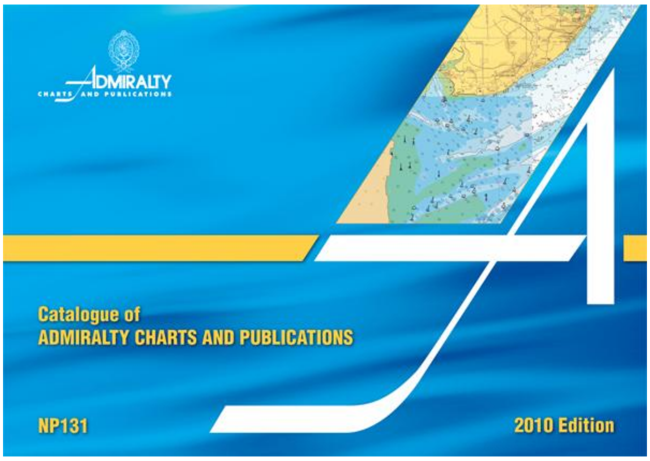
It is a very useful book for easy reference to a lot of topics like Surveying and charting, Admiralty charts, Admiralty publications (like Sailing directions, Ocean Passages for the world, Distance tables, List of lights and radio signals, Tide tables, explanation on the use of weekly notices to mariners, etc.), the sea, tides, tidal streams, chart datum, ice, Meteorology, international organizations, constraints on navigation, MARPOL, Navigation and aids to navigation, position fixing, GMDSS, etc. and many more.



3) Catalogue of Admiralty Charts and Publications (NP 131)

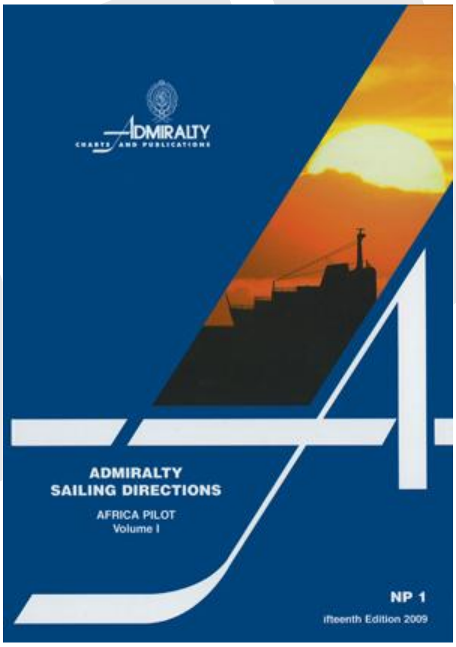
Catalogue of Admiralty Charts and Publications is a comprehensive reference in graphical and textual form of all Admiralty charts and publications worldwide, listed by region. The catalogue gives full details for each chart and publication, including details of all digital products and Admiralty distributors worldwide. This publication is updated and published annually. A loose addendum is supplied with each copy to bring the catalogue up to date for changes occurring during production. Any subsequent changes are announced each week in Section II of the weekly Admiralty Notices to Mariners. The first catalogue of charts was produced in 1825 by Hydrographic Department of the Admiralty.

Note that this catalogue does not cover the electronic charts. Full coverage of ENC electronic charts is listed separately in an online catalogue.



4) Admiralty Sailing Directions

Admiralty Sailing Directions, also commonly referred to as Pilots, are officially published books to complement Admiralty charts. Sailing Directions are designed for use by the merchant mariner on all classes of ocean-going vessels with essential information on all aspects of navigation. Sailing Directions provide worldwide coverage in 74 volumes. The areas covered under each volume are given in the Catalogue of Admiralty Charts and Publications (NP 131) and these publications are numbered as NP1, NP2 ….etc. Each publication contains quality colour photography and views, as well as information on navigational hazards, buoyage, meteorological data, details of pilotage, regulations, port facilities and guides to major port entry. New Editions of Admiralty Sailing Directions are published on a regular basis. Navigationally significant information/ corrections for these publications are issued via the Admiralty Notices to Mariners.



The sailing directions provide the mariner with comprehensive knowledge of an area he is unfamiliar with and is proceeding to. The Sailing Directions should be read in conjunction with the appropriate Admiralty chart quoted in the text. They are intended to aid the mariner in navigation at sea and are for all classes of vessels, from sea-going small craft up to the largest super-tankers. When consulting the Sailing Directions, the latest supplement in force should also be referred to for any corrections. Sailing directions are more useful for coastal passages than for ocean passages. For Ocean routeing, you may refer to routeing charts of various oceans which are published for every month of the year for each ocean along with Ocean Passages for the world.

Using the Sailing Directions

- Take out your chart catalogue and go to the section on sailing directions. Here you will find marked areas covered under each sailing direction and the sailing directions are numbered.
- Let us say we are going on a short voyage from Gibraltar to Bilbao (43º23'N, 003º05'W).
- From the chart catalogue on section on sailing directions – draw rough courses in pencil from Gibraltar to Bilbao and we can see that the areas are covered under sailing direction nos.: 67 (West Coast of Spain and Portugal Pilots) and 22 (Bay of Biscay Pilot).
- Chapter 1 & 2 of the sailing directions are general chapters containing details about Navigation & Regulations pertinent to the area, Country and port information, Natural

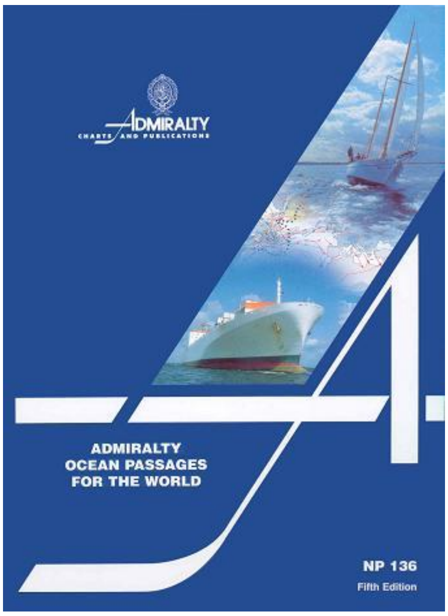
conditions like maritime topography, currents, tidal streams, Sea levels, Sea water characteristics, Ice conditions, climate, weather etc.

- Other chapters contain details of each section of the area they cover as shown in the index chart. These details include Topography of the area, harbours and anchorages, coastal routes, principal and useful marks, description of various conspicuous objects, tidal streams and currents experienced, recommended approach passages and port. You must refer to the relevant chapters pertinent to your voyage.

5) Ship's Routeing Information

Ship's Routeing information is an IMO publication. This publication, which comes in loose-leaf pattern, covers all ships' routeing, traffic separation schemes and mandatory reporting systems adopted by the International Maritime Organization and includes representational maps as well as full coordinates of all schemes. It provides areas to be avoided by ships and is intended primarily for Administrations responsible for planning and supporting routeing systems for use by international shipping. This publication includes General provisions on ships' routeing, first adopted by IMO in 1973, and subsequently amended over the years, which are aimed at standardizing the design, development, charted presentation and use of routeing measures adopted by IMO. The provisions state that the objective of ships' routeing is to "improve the safety of navigation in converging areas and in areas where the density of traffic is great or where freedom of movement of shipping is inhibited by restricted sea room, the existence of obstructions to navigation, limited depths or unfavourable meteorological conditions".

There are two categories of routeing systems. The first category of routeing systems includes traffic separation schemes, two-way routes, recommended tracks, areas to be avoided, inshore traffic zones, roundabouts, precautionary areas and deep-water routes. The second category is archipelagic sea lanes.
Part A consists of General Provisions on Ships' Routeing which have been developed to ensure that all adopted routeing systems conform to the same general criteria and principles.
Parts B to F include descriptions of routeing systems and associated rules and recommendations on navigation which have been adopted by the Organization.
Part G includes descriptions of mandatory ship reporting systems and mandatory routeing measures which have been adopted by the Organization.
Part H takes into account the unique character of archipelagic sea lanes as a routeing system and provides guidance for the preparation, consideration and adoption of proposals for the adoption, designation and substitution of archipelagic sea lanes.

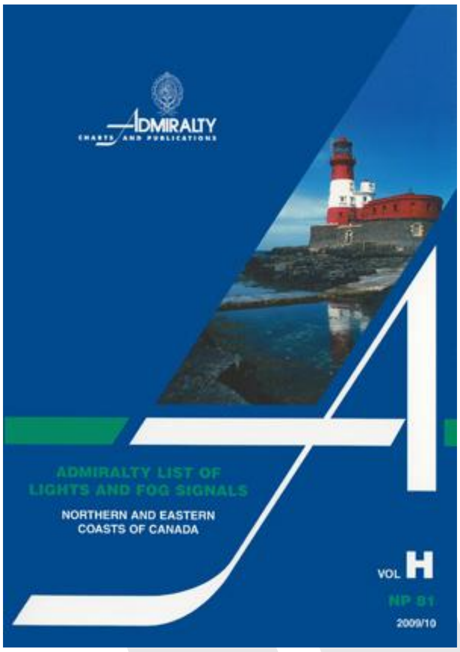


Rule 10 of the International Regulations for Preventing Collisions at Sea, 1972 (COLREG 1972), as amended, prescribes the conduct of vessels within or near traffic separation schemes adopted by IMO. The text of rule 10 is reproduced in part B.

6) Admiralty Ocean passages for the world (NP 136)

Ocean passages for the world is a classic volume on ocean voyage planning, has routeing details for powered and sailing vessels; individual chapters on each of the world's oceans; advice on winds, weather, climate, seasonal factors, currents, swell, ice hazards; and the shortest routes between ports and important positions. It gives numerous route diagrams and chartlets showing the effects of climate, wave heights and load line zones.

7) Admiralty List of Lights and Fog Signals (ALL)

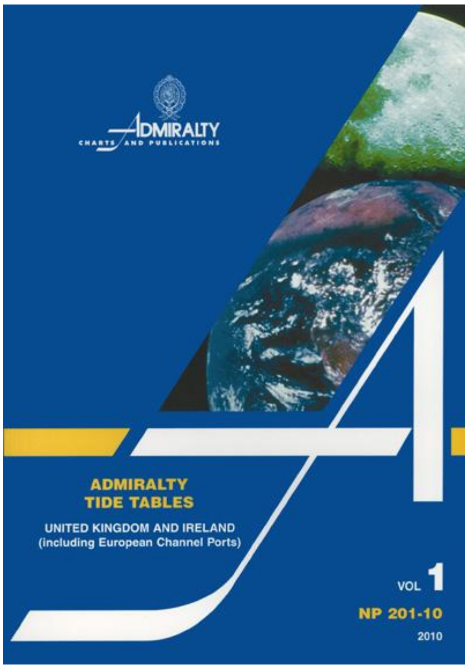


"Admiralty List of Lights and Fog Signals" provide extensive information on all lighthouses, lightships, lit floating marks (over 8m in height), fog signals and other lights of navigational significance in 12 volumes covering the whole world. Each publication also gives the characteristics of lights and fog signals, together with the equivalent foreign language light descriptions. Tables can be used to calculate the geographical and luminous ranges of lights. Details for all lights listed include the international number, location and/ or name, geographical co-ordinates, characteristics and intensity, elevation in metres, range in sea miles and description of structure.

ALL are published in 12 volumes giving a world-wide coverage. These volumes are listed alphabetically as Volume A, B, C, etc. Each volume covers different geographical locations of the globe (See figure). The corrections to ALL are printed in Section V of the Weekly Notices to Mariners.

For each light the following details are given which are tabulated in eight columns in the List of Lights.

a) Number, used for indexing.
b) Name and descriptive position.
c) Approximate latitude and longitude.
d) Characteristics and Intensity of lights (when nominal range is not used).
e) Elevation of the light in metres above Mean High Water Springs (MHWS) level.
f) Range of visibility in sea miles.
g) Description of the structure on which the light is situated and the height of the structure above the ground in metres.
h) Phases, sectors, arcs of visibility, period of illumination, important temporary information, and other relevant remarks – In addition any minor associated lights, which do not merit separate numbering is also listed under the main light.



In addition, each volume contains tables for the calculation of the geographical and luminous range of lights; definitions of, and general remarks on, the characteristics of lights and fog signals; and a list of foreign language equivalents of the abbreviations used in light descriptions. In some volumes, special comments are found on problems peculiar to the areas covered by them.

ADMIRALTY DIGITAL LIST OF LIGHTS (ADLL)

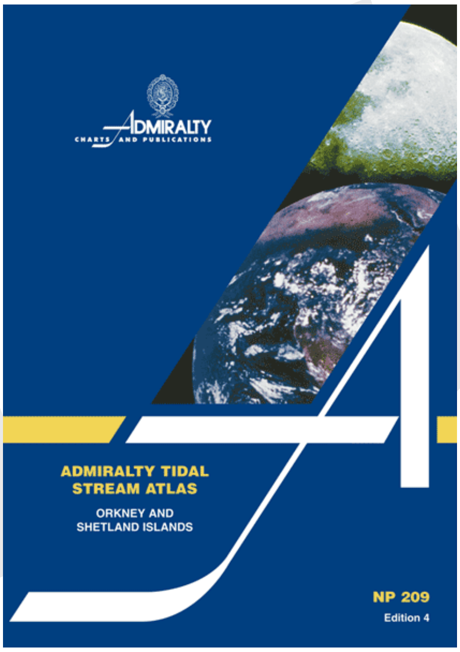
Instead of using paper based list of lights, vessels may be provided with digital list of lights. The Admiralty Digital List of Lights provides light and fog signal information for more than 70,000 unique light structures worldwide. These can be updated weekly by email or by CD or by accessing the information online as soon as it becomes available. ADLL is being accepted in place of the paper version by most of the flag states.

8) Admiralty Tide Tables

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)

Volume 3 & 4 also contain, in addition to tidal predictions, a number of predictions of tidal streams. Each volume is divided into three parts. Part I gives daily prediction of the times and heights of high and low water for a selected number of standard ports. Part II gives time and height differences for prediction of high and low water at a much larger number of secondary ports. Part III gives the harmonic constants for use with the Simplified Harmonic Method of Tidal Prediction for those ports, where they are known.

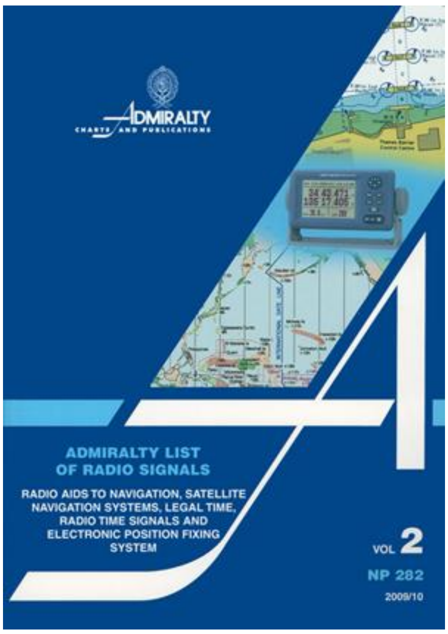
9) Admiralty Tidal Stream Atlases



The difference in tidal streams and currents are that tidal streams are **astronomical** in origin whereas currents are **meteorological** in origin. Tidal Streams are frequently referred to as Tidal Currents in the U.S.

Since Tidal streams are horizontal movements of water in response to tide-raising forces, they can be predicted for any period in future. Tidal streams which are semi-diurnal in character may be predicted by reference to a suitable standard port and are displayed in tables printed on the published chart. Since there is no necessity for daily predicted tidal streams to be published – these tables show the rate and direction of the predicted tidal stream of springs and neaps by reference to the time of high water at a suitable standard port. The area of prediction is indicated on the chart by means of a symbol ◇ with an alphabet – which can be referred to in the table.

Where the tidal streams may be related to a standard port and sufficient data is available, Tidal atlases are available showing rates and direction over a wide area. Such atlases showing the tidal streams in a pictorial form are available for all waters around the British Isles, West Coast of France and some other ports like Hong Kong. Each atlas contains 13 pairs of charts showing tidal streams at hourly intervals commencing 6 hours before HW at a standard port and ending 6 hours after HW at the same standard port. On the charts the directions of the tidal streams are shown by arrows which are graded in weight and, where possible, in length to indicate the approximate rate of the tidal stream.
⟶ Indicates weak stream ⟶ indicates strong stream.



The figures against the arrows give the mean neap and spring rates in tenths of a knot, thus 19,34 indicates a mean neap rate of 1.9 knots and a mean spring rate of 3.4 knots. The comma indicates the approximate position at which the observations were obtained.

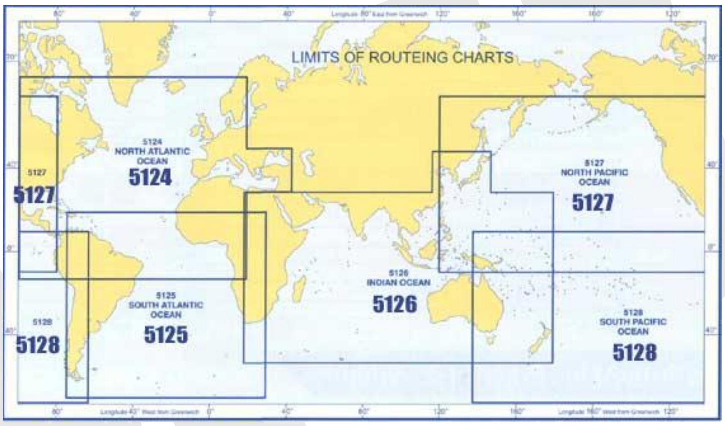
10) Admiralty List of Radio Signal (ALRS)

The Admiralty List of Radio Signals series provides comprehensive information on all aspects of Maritime

Radio Communications. The data is organised into six volumes, some divided into several parts for ease of handling. Each of the six volumes is presented in a user-friendly format with full colour photographs and diagrams. The contents range from a complete listing of stations handling Maritime Public Correspondence to a full range of products and services essential for compliance with the GMDSS (Global Maritime Distress and Safety System). The volumes also feature radio stations broadcasting weather services and forecasts and a detailed explanation of the complexities of Global Satellite Position Fixing Systems. ALRS publications are updated through Section VI of the weekly editions of Admiralty Notices to Mariners. New Editions are published annually. The main features of each of the volumes are listed below:

- NP281 (Parts 1 and 2) – Volume 1- Maritime Radio Stations
- NP282 – Volume 2 – Radio Aids to navigation, Satellite Navigations Systems, Legal Time, Radio Time Signals and Electronic Position Fixing System
- NP283 (Parts 1 and 2) – Volume 3 – Maritime Safety Information Services
- NP284 – Volume 4 – Meteorological Observation Stations
- NP 285 – Volume 5 – Global Maritime Distress and Safety System (GMDSS)
- NP286 (Parts 1, 2, 3, 4 and 5) – Volume 6 – Pilot Services, Vessel Traffic Services and Port Operations

11) Routeing charts



The British Admiralty publishes routeing charts covering the whole world. Each chart has 12 volumes, with one volume for each month of the year. The charts provide meteorological information for passage planning through oceans and other areas of major traffic as mentioned below:

a. Major Shipping Routes
b. Load Line Zone Boundaries
c. Ocean Currents
d. Ice Limits
e. Wind Roses
f. Other Information

Apply Your Knowledge

1. You are to make a voyage from Rio de Janeiro to Dakar. Note down the details relevant to the passage from the following publications:
   - Admiralty Notices to Mariners
   - Mariner’s Handbook (NP 100)
   - Catalogue of Admiralty Charts and Publications (NP 131)
   - Sailing Directions
   - Ship’s Routeing Information
   - Ocean passages for the world
   - Admiralty List of Lights & Fog Signals and Digital list of lights
   - Admiralty Tide Tables
   - Admiralty Tidal Stream Atlases
   - Admiralty List of Radio Signals
   - Routeing charts

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task Reference No: A1.5

Sub task Reference Nos.: A1.5.1

Topic: Electronic systems of position fixing and Navigation

Task Heading

- Use GPS fix to plot vessel's position, after applying applicable datum errors.

Objectives

- Familiarize with the principle and operation of GPS and Errors and limitations of GPS.

Index

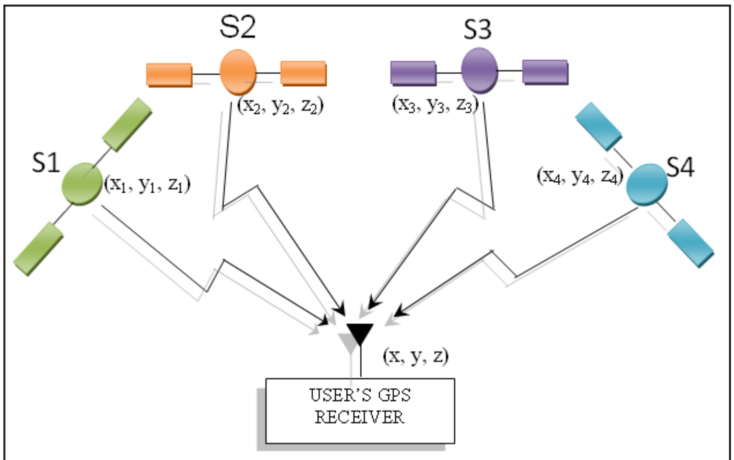
1) Introduction
2) GPS, principle & operation
3) Accuracy and reliability of GPS
4) Errors of GPS and their sources
5) Settings, navigation, alarms and other functions of GPS
6) Chart datum and allowing for datum corrections on GPS positions

Description

1) Introduction

Use of space satellites started way back in 1957 when the first satellite "Sputnik 1" was launched by Soviet Union. This was followed by United States satellite system called the NAVSAT (Navy NAVigation SATellite system) which worked on the principle of the doppler effect i.e. the frequency shifts which takes place due to the motion of an orbiting satellite transmitter relative to a receiver. This system is also obsolete now and is no longer in use. By late 1970s, the NAVSTAR (NAVigation Satellite Timing And Ranging) system was developed which is the today's GPS (Global Positioning System).

2) GPS, principle & operation



GPS Satellites in use (S1, S2, S3, S4) for position fixing

The GPS system works on the same basic principle of celestial or terrestrial navigation. A fix is obtained by the 'Ranging' of 3 or 4 satellites in orbits, similar to obtaining a radar fix using the distances of 3 or 4 identified fixed targets like lighthouses or landmarks, or by obtaining 3 star sights. So, instead of using 3 or 4 heavenly bodies, whose position is known to us, the GPS uses man-made satellites, whose position is also accurately known to the equipment. The basic formula, "Speed x Time = Distance" is applied. The speed at which the satellite signal travels is the same as the speed of light, ie 3 x

10^8 metres per second (299,792,458 m/sec to be more precise). This way the receiver calculates the range from the satellite, which is known as the pseudo range. This gives us a position circle on the surface of earth.

Now one pseudo-range provides one position circle. Since a good radar fix requires at least three ranges, three position circles are required to find position using GPS signals. Therefore, at least three satellites are used to obtain a confirmed fix. This seems to be a fairly simple principle. But technically, there are a few problems and errors which lead to position inaccuracy. We shall discuss them later in our module.

The GPS system is a military satellite navigation system owned by the United States Department of Defence. The system consists of two segments: a 'space segment' and a 'control segment'. The space segment consists of at least 24 operational satellites at all times which are evenly distributed between 6 orbital planes. These satellites keep orbiting in their geostationary orbits at an altitude of about 20,200 kilometres. Each orbit is spaced about 60° apart and is at an inclination of 55° to the equator. All the GPS satellites circle the earth twice a day. This configuration ensures that any user can use between four and eight satellites at any given time from any point on the earth, therefore, providing continuous, all weather and worldwide position fixing, accurate time and velocity information.

Each GPS satellite is equipped with atomic clocks which maintain very accurate times. These satellites transmit on two frequencies, L1-1575.42 MHz and L2–1227.6 MHz. The L1 frequency carries the precision code (P code) and the course/acquisition code (C/A code). The L2 frequency carries the P code only. The satellite transmits signals on low power (50 watts) and travel by line of sight. They can pass through ionosphere, clouds and even plastic materials or glass but they cannot pass through solid materials such as mountains or buildings. This explains why the GPS antenna should have a clear view of the sky and the horizon for better satellite signals and this is also the reason why the portable GPS like the ones in mobile phones does not work inside a house or a building.

The "control segment" on earth consists of five shore-based stations that monitor performance and the tracking position of the satellites in their orbits. The stations are located in Hawaii, Kwajalein (in Pacific Ocean), Ascension Island (Atlantic Ocean), Diego Garcia (Indian Ocean) and Colorado Springs (USA). A master control station is located in Schriever Air Force base in Colorado.

The master control station processes its own observations as well as the observations of satellites sent from the other five monitoring stations. Based on this processing, the master control station sends updates to the satellites in the form of a navigation message. Each navigation message contains the information regarding clock correction, position of satellites and past and future satellite positions.

The "user segment" consists of a GPS receiver that decodes the signals received from satellites to determine position, speed and accurate time. The satellite sends a signal that includes the time at which it was generated. The GPS receiver generates its own signal. The satellite signal received is then compared with the generated signal. The time difference between the two is the time taken for the satellite signal to travel to the receiver. But this time taken by satellite signal to travel to the receiver may not be measured accurately due to:

a) Lack of synchronisation of satellite clocks and the receiver clocks.
b) The satellites are fitted with atomic clocks to maintain time precision. However, the receivers do not have atomic clocks as then it would be too expensive. Instead they are fitted with a quartz clock that is less expensive but does not provide the same accuracy. This results in an error.
c) Errors caused due to atmospheric delay when the signal travels through the earth's atmospheric layers, i.e. ionosphere and troposphere.

Because of these errors, the range measured by the receiver is known as the pseudo-range and the technique is known as pseudo-ranging. The angle of cut between the position lines obtained by pseudo-ranging is also important in the same way as for the visual or radar position lines.

This angle depends upon the geometry of satellites and is known as the GDOP (Geometric dilution of precision). The higher the value of GDOP, the less accurate is the GPS position. GDOP is divided into the following categories:

a) PDOP - Position dilution of precision used for 3D (3 dimensional) fixes, i.e. (Latitude, longitude and altitude)
b) HDOP - Horizontal dilution of precision used for accuracy of 2D (2 dimensional) fixes (Latitude, Longitude). This is used on marine GPS receivers
c) VDOP - Vertical dilution of precision used for accuracy of height
d) TDOP - Time dilution of precision used for accuracy of time.

The default datum for GPS is WGS84. It is extremely important to check the datum on the chart. Some GPS receivers also have an option to change the datum within the receiver. This is given in the form of a list of datums from which you can select the one that matches with the chart. But be very careful in such case not to forget changing the datum settings on GPS each time you change the navigation chart.

The HDOP is a measure of accuracy of GPS's horizontal position fixes (latitude and longitude only) whereas the VDOP is the measure of accuracy of the GP's vertical position fixes, i.e. (latitude, longitude and altitude). The onboard GPS receiver calculates the value of HDOP and displays it to the user. An appropriate maximum HDOP value is to be selected at which the GPS receiver should give an alarm to alert the user and change to Dead Reckoning (DR) mode. In order to overcome the problem of satellite and receiver clock synchronisation error, an additional satellite is used to overcome the clock difference and provide a check for the error in each case.

Another method used for position fixing with GPS is called 'Carrier Phase Measurement'. The basic principle is similar to pseudo-ranging but instead of using only L1, both L1 and L2 are used. This is done using their wavelengths, which are 19 cm for L1 and 24 cm for L2. But this method is presently used for geodetic surveys and satellite compass.

You must understand that GPS is just electronic equipment which may fail. You may need to revert to traditional methods of navigation at any time. Do not over-rely on GPS positions, and especially when you are in coastal waters when primary means of position fixing, such as radar, are available.

3) Accuracy and reliability of GPS

The accuracy of GPS depends on the position service used. Two levels of positioning levels are provided, i.e. the Precise Positioning Service (PPS) and the Standard Positioning service (SPS). For GPS, the predicted accuracy in the worst case is within about 100 metres in the horizontal plane (latitude and longitude) with a 95% probability anywhere on the surface of the earth. However, the accuracy of the GPS position has been increased to within a range of 20 -25 metres in the horizontal plane with the switching off Selective Availability in 2001.

The GPS accuracy is further improved with the use of systems such as DGPS (Differential GPS), WADGPS (Wide Area DGPS), WAAS (Wide Area Augmentation System) and EGNOS (European Geostationary Navigation Overlay Service). These systems have been discussed in detail in other module.

GPS also provides us with speed measurements. Typical approach being used in most of the GPS receivers for speed measurement is to use a series of “track points” that record position estimates (latitude and longitude) determined by the GPS at regular time intervals. Since each GPS track point has some error, hence speed values computed from a series of track points also has some error component, but is considered fairly accurate for shipping and hence being used.

However, an alternative to measuring speed from series of track points is using the doppler effect. Modern GPS devices implement digital PLL (phase-lock loop) receivers to continuously track carrier frequencies of a number of satellites. Few models can even track carrier frequencies of up to 12 satellites simultaneously. The frequency tracking has to be continuous simply because each receiver has to be always ready to receive data from its satellite. The very fact that data is read from any given satellite is proof that its carrier frequency is tracked with high accuracy. The difference between the known satellite carrier frequency and the frequency determined at the receiver is known as a “Doppler shift”. This doppler shift is directly proportional to velocity of the receiver along the direction to the satellite, regardless of the distance to this satellite. With multiple satellites tracked it is possible to determine the 3D velocity vector of the receiver with high accuracy.

4) Errors of GPS and their sources

Errors of GPS can be divided into two categories:

a. **Natural and satellite errors**

- Ionospheric and atmospheric effects
- Solar activity
- Multipath error
- Satellite clock/ position errors
- Receiver errors.
- Geometry and availability of satellites, GDOP

b. **Deliberate errors**, such as selective availability were introduced by the US authorities deliberately to degrade the positional accuracy for civilian users in order to safeguard their national interests. This was done by dithering, i.e. manipulating the satellite clock frequency which varied the carrier wave and codes to cause an error. The second method used was to vary the satellite’s position information sent to the receiver in the navigation message. The combined error can cause about 100 metres of inaccuracy. The US government decided in May 2001 to turn selective availability off and promised it would not be switched on again. However, as providing the service is on their discretion, they may create errors and they also have plans to introduce regional degradation of the service.

5) Settings, navigation, alarms and other functions of GPS

Depending upon the GPS make and model, there are various features available on different equipment. You can create, edit and save waypoints and routes, calculate rhumb line and great circle distances between created waypoints and routes, and use the navigation mode of RL or GC, as selected. You can monitor your cross track error while en route and set alarms limits for cross track error. Other alarms may include Waypoint arrival alarm, Anchor watch alarm (setting up the turning circle limit) and no-fix alarms. Other features may include a devoted Man-Overboard (MOB) key which stores your present position as the MOB waypoint in the event of an accident, and automatically guides you to that point by showing its bearing, distance and estimated time of arrival. Since many of these functions like entering waypoints and creating routes varies from equipment to equipment, you must practice using all these functions of the GPS model on board under the supervision of an OOW.

6) Chart datum and allowing for datum corrections on GPS positions

A horizontal datum is a reference system for specifying positions on the earth’s surface. Each datum is associated with a particular reference spheroid that can be different in size, orientation and relative position from the spheroids associated with other horizontal datums. Positions referred to different datums can differ by several hundred metres. Chart datum and datum correction is mentioned on each navigational chart under the note for ‘Positions’. GPS positions are referenced to the World Geodetic System (WGS) datum. Datum shift has to be applied for plotting these positions received from GPS on navigation charts that use a different datum. These corrections are mentioned on the chart itself. It is necessary to apply the given correction. This is because each datum is shaped for use in a specific area of the earth. However, the World Geodetic System (WGS) can be used anywhere in the world for marine navigation because the

GPS system is based on WGS and it covers the entire earth. Also the correction to allow plotting of a WGS position onto a chart of a different datum is given on every such chart.

Apply Your Knowledge

1. Discuss the datum correction marked on the chart.
2. Discuss the circumstances when the GPS fix could be inaccurate.

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task Reference No: A1.6

Sub task Reference Nos.: A1.6.1

Topic: Echo Sounders

Task Heading

- Demonstrate operation of echo sounder and correctly apply the information obtained. Compare observed depth with charted depth after adjusting for tide, etc. Set depth alarm, where fitted.

Objectives

- Familiarize with the principle and operation of echo sounder.

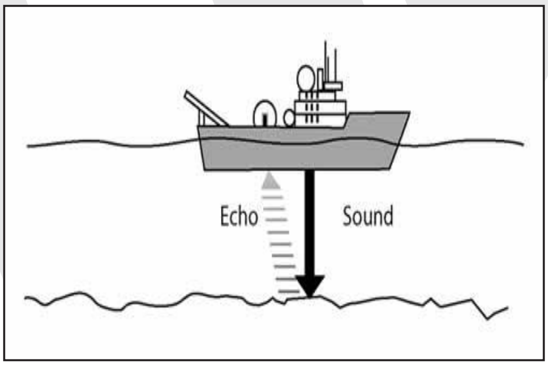
Index

1. Principle of echo sounder
2. Components
3. Errors
4. Controls
5. Alarms and comparison of observed depths

Description

1) Principle of echo sounder

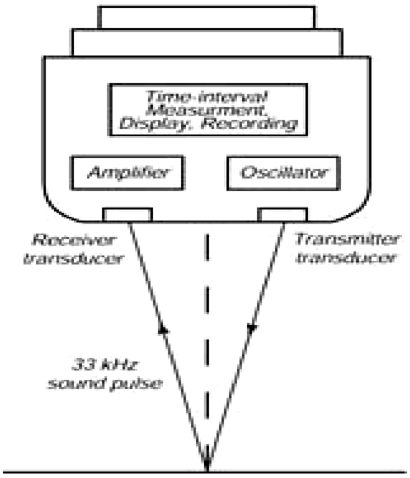
Short pulses of sound vibrations are transmitted from the bottom of the ship to the sea bed. These sound waves are reflected back by the sea bed and the time taken from transmission to reception of the reflected sound waves is measured. Since the speed of sound in water is known, 1500 m/sec, the depth of the sea bed is calculated which will be half the distance travelled by the sound waves.

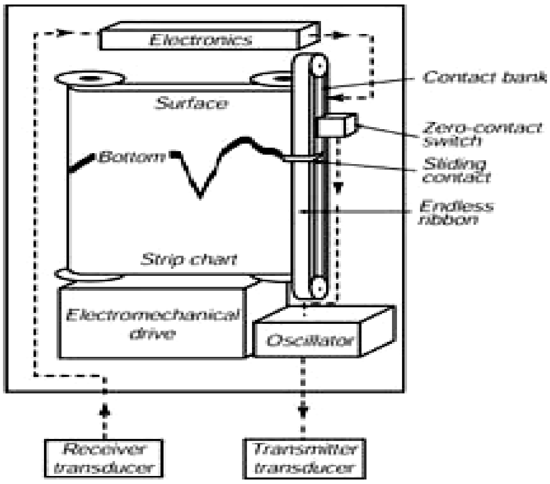


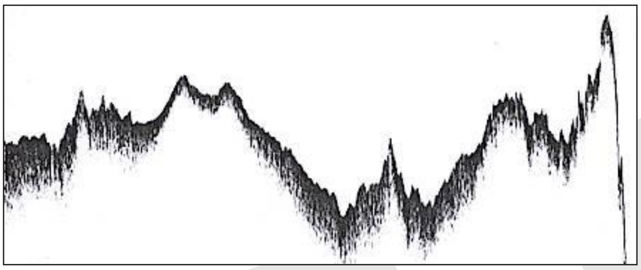
2) Components

Basically an echo sounder has following components:

- **Transducer** – to generate the sound vibrations and also receive the reflected sound vibrations.
- **Pulse generator** – to produce electrical oscillations for the transmitting transducer.
- **Amplifier** – to amplify the weak electrical oscillations that has been generated by the receiving transducer on reception of the reflected sound vibration.
- **Recorder** - for measuring and indicating depth.







Trace of an Echo sounder recorder paper

3) Errors

- **Velocity error** - Increase in temperature and salinity of water increases velocity of sound in water, thus giving rise to an error in the depth displayed.
- **Aeration** – Presence of air bubbles below the transducer gives rise to false echoes. Air bubbles are normally caused when a vessel goes astern or due to turbulence when rudder is put hard over or due to pitching in rough weather especially when vessel is in light condition.
- **Multiple echoes** – This is caused in shallow waters with a rocky bottom due to some of the sound pulses reflecting up and down between the ship's keel and the sea bottom before being recorded on the display. In such cases, the first echo is the correct reading.
- **False echoes** – In deep waters, by the time the sound pulse returns from the bottom, the stylus may have already finished more than one revolution and thus the echo which will be recorded will be a false one and the depth indicated will be much lower than the actual depth.
- **Pythagoras error** – If the vessel has one transducer for transmitting and one transducer for receiving, separated by some distance, the distance travelled by the pulse will be greater than the depth of the sea bed in shallow waters.

4) Controls

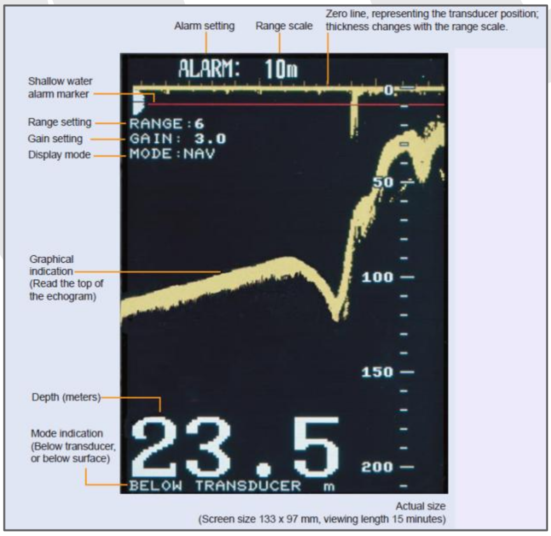
A standard echo sounder will normally have the following controls:

- **Range switch** – to select the range between which the depth is be checked e.g. 0- 50 m, 1 – 100 m, 100 – 200 m, etc., depending upon the make and model. Always check the lowest range first before shifting to a higher range.
- **Unit selector switch** – to select the unit feet, fathoms or meters, as required.
- **Gain switch** – to be adjusted such that the clearest echo line is recorded on the paper.
- **Paper speed control** – to select the speed of the paper – usually two speeds available.

- **Zero adjustment or draught setting control** – the echo sounder will normally display the depth below the keel. This switch can be used to feed the ship's draught such that the echo sounder will display the total sea depth. This switch is also used to adjust the start of the transmission of the sound pulse to be in line with the zero of the scale in use.
- **Fix or event marker** - this button is used to draw a line on the paper as a mark to indicate certain time e.g. passing a navigational mark, when a position is plotted on the chart, etc.
- **Transducer changeover switch** – in case vessel has more than one transducer, e.g. forward or aft transducer.
- **Dimmer** – to illuminate the display as required.

However, most of the modern echo sounders widely in use may not have all the above controls as they may not have paper, but only digital display and memory to store and playback past data. For example, listed below are few salient features/ advantages of one of the modern and completely digital echo sounder:

- Cost-effective; No paper, no consumables; high accuracy and high reliability
- Color LCD display featuring a wide viewing angle with adjustable brightness
- 15 minutes wide viewing window on any range setting with 1 min time marks
- Choice of system frequency - high-resolution shallow depth sounding with a 200 kHz transducer or deep water sounding with a 50 kHz transducer
- Compact display cabinet enabling installation at a conning position or any other convenient location
- Depth data for last 24 hours in memory to play back the past sounding information
- Digital interface for radar, VDR, ECDIS, and other navigational or radio communication equipment



Source: www.mackaycomm.com

5) Alarms and comparison of observed depths

Generally, the depth obtained from echo sounder is the depth below the keel, unless draft settings have been done. To compare the observed depth values with the charted depth, two more things need to be taken into consideration. One is vessel's draft allowing for squat, and another is the height of tide. Squat can be obtained from the displayed graphs/ tables attached to the passage plan. Charted depths are usually the depths at lowest astronomical tide. Height of tide at that particular time needs to be added to the charted depth to obtain the total depth.

Total calculated depth = Charted depth + Height of tide
Total observed depth = Vessel's draft + Squat + Observed value of Echo Sounder

Both the values should be comparable. It is also a good practice to check the accuracy of the echo sounder when the vessel is at berth by taking manual over side soundings. Most of the echo sounders with digital displays also have an alarm to alert the navigator when the sounding goes below the desired set limit.

Apply Your Knowledge

1. When approaching a port identify the depth contour of 50m on the echo sounder. Compare the depth as indicated by the echo sounder with the depth marked on the chart. Apply the tidal correction and find the accuracy of the echo-sounder. Observe the echo sounder trace when the vessel is running half to full astern. Why is accuracy impaired when running astern, especially if the transducer is located aft?

2. State the make and model of echo sounder you have on board and briefly describe its operation using a block diagram.

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task Reference No: A1.7

Sub task Reference Nos.: A1.7.1, A1.7.2, A1.7.3

Topic: Compass - Magnetic and Gyro

Task Heading

- Demonstrate boxing of compass.
- Apply magnetic variation and deviation to magnetic compass readings.
- Demonstrate the use of deviation card when using magnetic compass readings.

Objectives

- Familiarize with boxing of compass and understand the concept of variation and deviation

Index

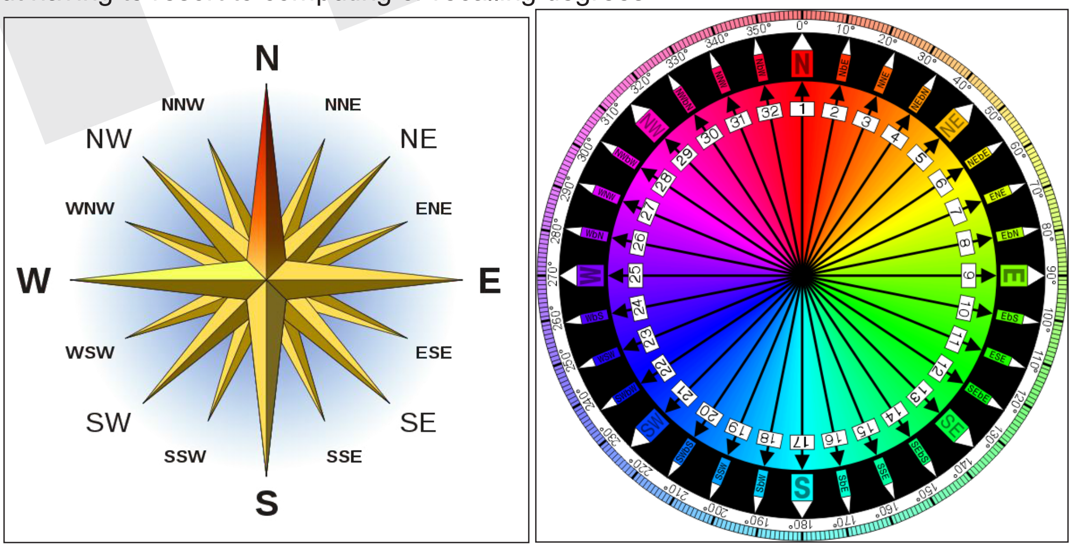
1) Boxing the compass
2) The 32 points of the compass in a tabular form
3) Earth's magnetism, magnetic variation and deviation
    a) Earth's magnetism
    b) Magnetic variation
    c) Magnetic deviation
    d) Magnetic and compass bearings
4) Deviation card

Description

1) Boxing the compass

Boxing the compass is the action of naming all thirty-two principal points of the compass in clockwise order. Such names, formed by the initials of the cardinal directions and their intermediate ordinal directions, are accepted internationally, even though they have their origin in the English language, and are very handy to refer to a heading (or course or azimuth) in a general or colloquial fashion, without having to resort to computing or recalling degrees.

The 32 points are simple bisections of the directions on the compass.



Compass Rose

2) The 32 points of the compass in a tabular form

1	**North**	N	0.00°
2	North by east	NbE	11.25°
3	North-northeast	NNE	22.50°
4	Northeast by north	NEbN	33.75°
5	**Northeast**	NE	45.00°
6	Northeast by east	NEbE	56.25°
7	East-northeast	ENE	67.50°
8	East by north	EbN	78.75°
9	**East**	E	90.00°
10	East by south	EbS	101.25°
11	East-southeast	ESE	112.50°
12	Southeast by east	SEbE	123.75°
13	**Southeast**	SE	135.00°
14	Southeast by south	SEbS	146.25°
15	South-southeast	SSE	157.50°
16	South by east	SbE	168.75°
17	**South**	S	180.00°
18	South by west	SbW	191.25°
19	South-southwest	SSW	202.50°
20	Southwest by south	SWbS	213.75°
21	**Southwest**	SW	225.00°
22	Southwest by west	SWbW	236.25°
23	West-southwest	WSW	247.50°
24	West by south	WbS	258.75°
25	**West**	W	270.00°
26	West by north	WbN	281.25°
27	West-northwest	WNW	292.50°
28	Northwest by west	NWbW	303.75°
29	**Northwest**	NW	315.00°
30	Northwest by north	NWbN	326.25°
31	North-northwest	NNW	337.50°
32	North by west	NbW	348.75°
1	**North**	N	360.00°

3) Earth's magnetism, magnetic variation and deviation

a) Earth's magnetism

Before we get to variation and deviation, you need to know the definitions of "True North" and "Magnetic North", and some description of earth's magnetism.

The earth is like a giant magnet, surrounded by a magnetic field. This magnetic field gradually keeps changing over the years. Figure shows the horizontal direction of the magnetic field lines at the surface of the earth. The magnetic north and south poles are shown as blue and red stars, respectively. Where the lines are blue, the magnetic field dips into the earth, where they are red it emerges from the earth. The transition from red to blue, where the field lines are horizontal, is called the magnetic equator.

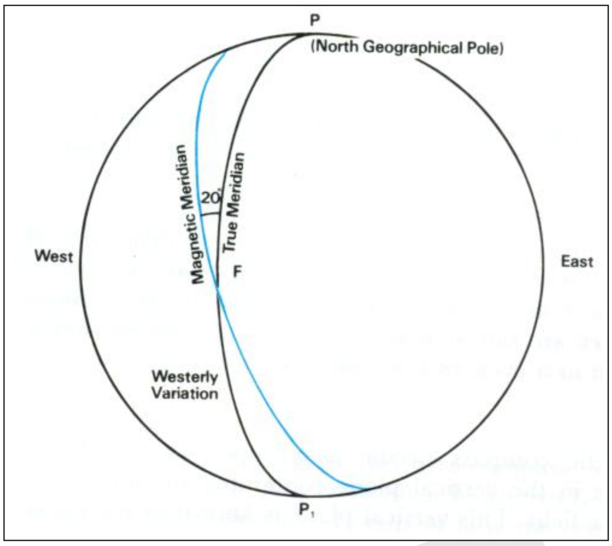
True North: is the northerly direction of the meridian and is the reference from which true bearings and courses are measured.

Magnetic North: is the name given to the direction in which the 'north' end of magnetic needle, suspended so as to remain horizontal, would point when subject only to the influence of the earth's magnetism. It is the northerly direction of the magnetic meridian.

b) Magnetic variation

Magnetic variation (sometimes also known as Magnetic declination) is the angle between the geographic (true) north and magnetic north at any given place. It is measured in degrees east (positive) or west (negative) of True North.

Variation has different values at different places and is gradually changing because the position of the magnetic poles of the earth is constantly changing. This change is also called the secular change in variation. The variation and the amount of yearly change in it are indicated on the compass roses on the charts. The navigator must allow for this annual change.

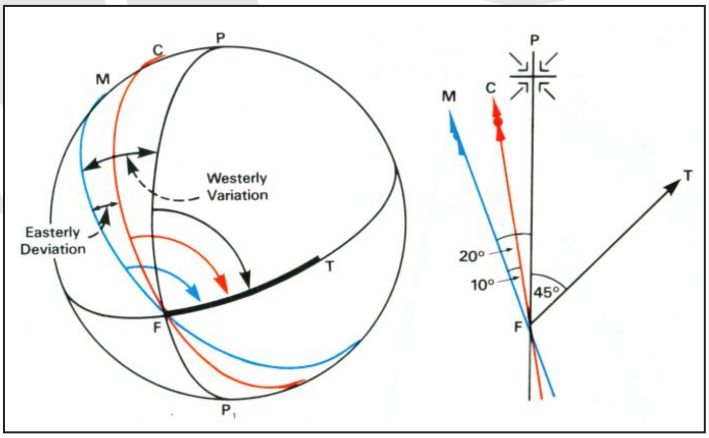


c) Magnetic deviation

A magnetic compass undisturbed by any other magnetic field will point towards the Magnetic North. In a ship made of steel, the magnetism of the ship's structure also creates a further magnetic field at the compass position. Due to this reason, the compass deviates from the direction of Magnetic North. The angle between the magnetic meridian and the north-south line of the compass card is known as **Deviation.** Deviation is termed “Easterly” if the compass North lies to the east or right of the Magnetic North and “Westerly” if the compass North lies to the west or left of Magnetic North. The deviation of a compass varies as the ship's head changes.

Factors affecting deviation

- Carriage of cargoes like Iron ore, concentrates, containers, or any steel cargo in large quantities.
- Any major steel repairs made on board ship (adding or removing steel).
- Any new antenna’s or aerials rigged.
- If the ship is alongside on the same heading for a long time in port. This causes a RETENTION error due to the induced magnetism on the compass needle.



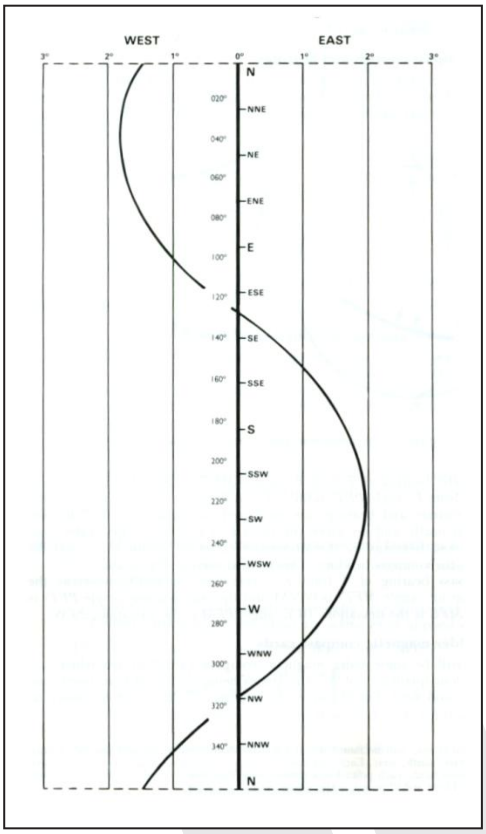
Magnetic Variation and Deviation
In the figure:
Blue: Magnetic Meridian
Red: Compass North
Black: True North

d) Magnetic and compass bearings

Compass error is the algebraic sum of deviation and variation. Deviation, variation and the error are to be applied as follows to courses and bearings.

True Course	(-)E (+)W Variation	=	Magnetic Course	(-)E (+)W Deviation	=	Compass Course
Compass Course	(+)E (-)W Deviation	=	Magnetic Course	(+)E (-)W Variation	=	True Course

4) Deviation curve



In practice, the deviation in a ship's magnetic compass is reduced to minimum by use of permanent magnets and soft-iron correctors by a compass adjuster. The residual deviation is found by swinging the ship through 360^o and tabulating that residual deviation for the various compass headings. It may also be shown in the form of a curve. It is preferable to tabulate deviation of the compass in a place which has the least variation or a zero variation for better accuracy.

It is recommended that the deviation curve be re-drawn by swinging the vessel, every year. In case deviation exceeds 5^o at more than two headings, then the compass needs to be adjusted. Compass adjustment is done by a qualified compass adjuster. In case a vessel is fitted with a transmitting magnetic heading device (TMHD), a separate deviation curve for TMHD needs to be drawn up and posted in the wheel house. This is due to difference in distance between the magnetic correctors from the standard compass card and the transmitting element of TMC resulting in some error (up to 2.5 degrees) in TMHD readings.

Why do we need to apply variation and deviation?

- All bearings and courses plotted on the charts are true bearings. Hence a bearing taken at the magnetic compass must be corrected for variation and deviation prior plotting on the chart.
- As the gyro compass is normally used for navigation and steering of courses, in case of a gyro failure, the vessel needs to be steered using the magnetic compass (or standard compass as it is known). In such case, variation and deviation has to be applied to the true course to steer the appropriate compass course.
- Hence it is also very important that compass error is obtained and deviation is calculated and logged at least once every watch and at each alteration of course, whilst at sea.

Apply Your Knowledge

1. List the 32 points of compass from “North” clockwise.
2. Compare the deviation obtained when taking compass error with the Deviation card.

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task Reference No.: A1.8

Sub task Reference Nos.: A1.8.1, A1.8.2, A1.8.3

Topic: Steering Control Systems

Task Heading

- Perform change-over from manual to automatic steering and vice versa under supervision. Test the system on all modes available, including NFU mode.
- Adjust various controls available in the steering control system for optimum performance.
- Identify various alarms associated with the steering control system. Demonstrate setting and testing of "off course" alarm under supervision

Objectives

- Understand basics of steering system
- Understand automatic steering
- Familiarise with various controls and alarms available on a steering system
- Understand change-over procedures from manual to automatic steering and vice versa.
- Understand setting and testing of “off course” alarm

Index

1) Introduction
2) Steering control system
3) Steering modes
4) Auto steering system
5) Steering system settings
6) Alarms
7) Change over auto steering/hand steering

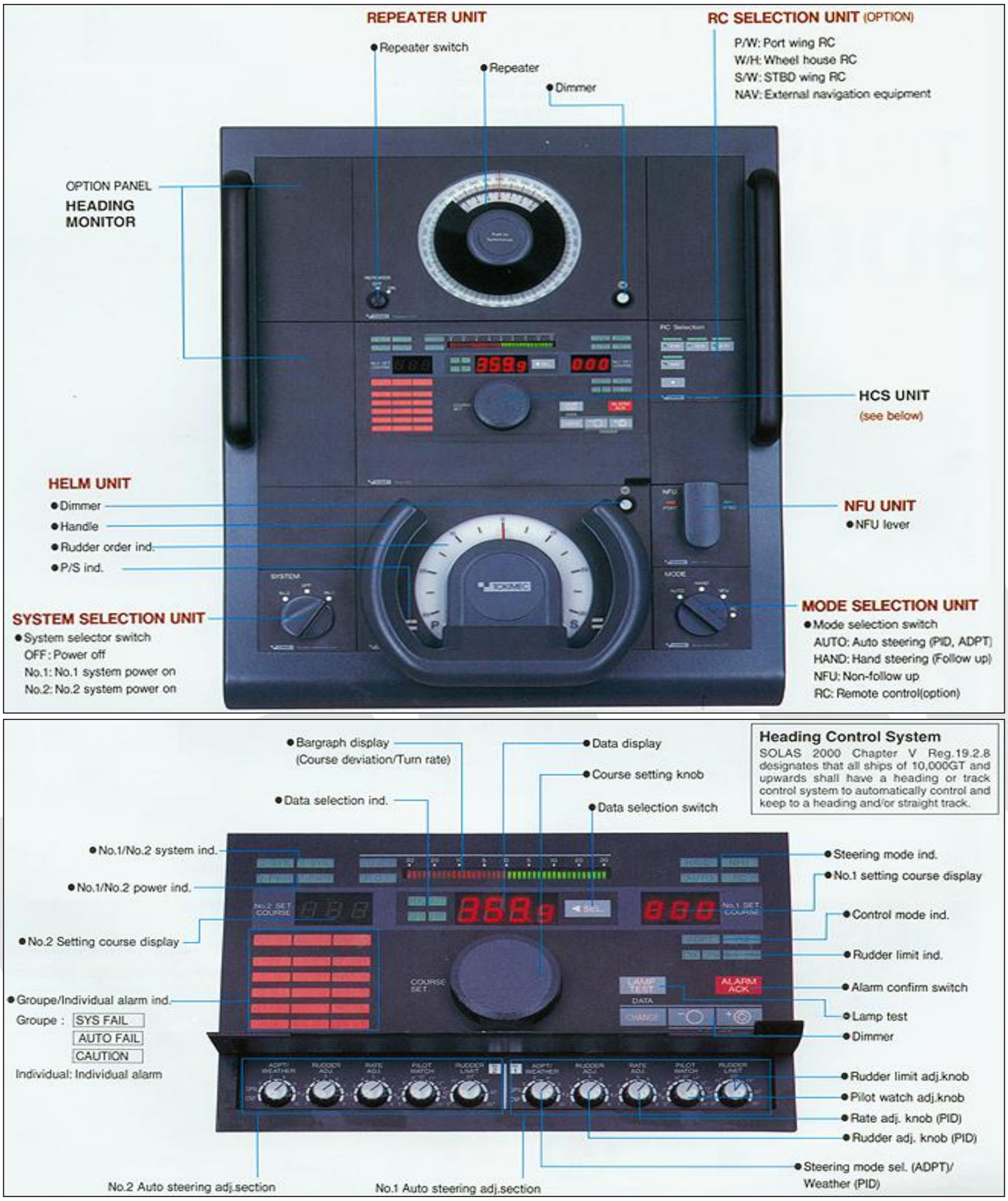
Description

1) Introduction

Steering is a very vital system on the ship. Vessel’s steering is controlled from the bridge but some ships may have more than one steering station. Off shore supply vessels can be steered from number of stations so that the officer having the ‘con’ can have a good view of the operations in which he is involved.

2) Steering control system

Electric signal from the steering unit on the bridge or from elsewhere is sent to the steering gear. In the steering gear the control units, transmit the signal to the steering power units, which may be hydraulic or electrically controlled. The complete steering transmission system from bridge to steering gear is duplicated with electric cables running on opposite sides and farthest away to avoid damage to both cables at same time due to fire or otherwise. These steering control systems in the steering gear have their controls on the bridge. They are switched over either daily or after a fixed interval by the ‘system selection switch’ to ensure even wear and tear. They are usually referred to as “System 1” and “System 2”. In case of failure of one system, alarm is activated and the duty officer must immediately change over to the ‘stand by’ system. Given below is a photograph of a typical steering stand of one make. Compare it with the steering stand provided on your ship and you will find that many controls are common.



(Photo: ‘Tokimec’ Model PR-6000)

3) Steering modes

Steering can be controlled by different modes viz, Hand, Non Follow up (NFU), Automatic, Remote. The changeover is done by the ‘mode’ selection switch.

a. **Manual (Hand) steering control:** Manual steering is done, using the wheel or joystick etc provided. Rudder is controlled by “follow up” steering – which means that when a command of say 10 degrees port is given and wheel held in place, the rudder goes to 10 degrees port and stays there.

b. **Non Follow Up steering:** In this steering mode, a lever is turned to port or starboard and the wheel responds accordingly but the lever must be returned to neutral position when the wheel has reached desired position. This is used if “follow up” steering fails.

c. **Automatic steering mode:** In this steering mode, the system steers the course set automatically. It senses the deviation and applies the helm accordingly. It uses the “follow up” system and is discussed below in another section in detail.

d. **Remote steering mode:** This mode is used when an auto track system is fitted. The system not only steers the ship automatically but also keeps the ship on selected track. Remote mode on some makes of auto pilot system may mean that the ‘remote’ steering control provided in the wings or elsewhere may be used.

4) Auto steering system

An auto-steering system senses the deviation of the vessel from the set course and automatically orders the rudder to move in desired direction to bring back the vessel to set course.

a. An adaptive auto pilot system automatically senses the deviation of course due to effect of weather and other factors affecting ship dynamics in hand and auto modes. In auto mode it automatically applies correction. This mode provides option of ‘open’ and ‘confined’ sea steering. The course keeping is more accurate in ‘confined sea’ option but it involves frequent rudder movements. Adjustments are provided for “rudder limit” and optionally for “off course” alarms. These are later explained.

b. The “proportional integral derivative” (PID) system senses the course deviation and applies rudder. Proportional control output of the controller is proportional to the course deviation. Integral control output is proportional to the summation of all instantaneous values of course deviation for as long as error persists. It takes duration of deviation into account. Derivative controller output is proportional to the rate of change of course deviation. The PID controller output is thus proportional to the deviation, persists as long as deviation persists and also depends on rate of change of deviation. Adjustments are provided for weather, rudder limit, rudder control, counter rudder, and optionally ‘off course alarms.

5) Steering system settings

Various settings as mentioned below are provided on the steering pedestal to ensure proper steering. The aim always must be to steer the desired course with least movement of rudder. Excessive use of rudder causes more drag on the ship resulting in loss of speed and also wear and tear of the steering system. The settings are

1) Rudder limit
2) Weather
3) Rudder control
4) Counter rudder

6) Alarms

Various alarms are provided in the system. Main alarms are:

a. Power failure: Alarms are provided for power failure of system units and control units.

b. Off course alarm: This alarm is optional and is actuated if ship deviates from set course by a pre-determined limit. Setting depends on Weather condition, open/coastal waters etc. It is desirable to keep this setting on the low side so that the officer is warned about excessive course deviation at the earliest. The off course alarm testing procedure is given in the manual and varies with different makes. The intention is to have the auto steering mode activated and the deviation between course setting and the actual course more than the alarm setting - the alarm should sound.

c. System alarms: Various caution and failure alarms are provided to indicate system health. Specific code characters indicate the alarms and details are given in the operating manual.

7) Changing over auto pilot /hand steering

Procedure for changing over from hand to auto and vice versa must be posted on the bridge. Before changing over to auto, the wheel must be mid-ships, the desired course selected and ship steady on its course. Change over is effected by turning the mode switch to ‘auto’ position. Changeover from auto to hand is done by having a helmsman on the wheel and turning the mode switch to “hand” position after confirming that the wheel is mid-ships. Any changeover from hand to auto or vice versa must be done under supervision of the officer on watch.

Apply Your Knowledge

1. Use bullet points to outline the procedure for setting and testing the off-course alarm on board your ship.
   List the various alarms associated with the steering control system.

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task Reference No.: A1.9

Sub task Reference Nos.: A1.9.1, A1.9.2, A1.9.3, A1.9.4, A1.9.5, A1.9.6

Topic: Meteorology

Task Heading

- Read barometer accurately and obtain corrected barometric pressure.
- Read barograph if fitted and obtain the barometric tendency.
- Read hygrometer/psychrometer and obtain dew point.
- Obtain and record sea and air temperatures.
- Estimate wind direction (by wave observation) and wind force using sea state (Beaufort scale).
- Estimate swell direction and wave height

Objectives

- Observe and record weather using available instruments
- Observe visually and record sea/ swell, state and condition

Index

8) Introduction
9) Weather forecast
10) Barometer
11) Barograph
12) Dew point
13) Wet and dry bulb thermometer
14) Sling/ whirling thermometer
15) Sea water temperature measurement
16) Wind observation
17) Swell observation

Description

1) Introduction

Weather forecast by shore stations are based on information obtained from large number of stations. There are stations based ashore and in the sea- special weather observation ships and buoys are deployed for this purpose. Satellites above the earth also provide vital information. Additionally merchant ships sailing the oceans also voluntarily send marine observations to shore stations. Actual observation made at any station is more valuable than that made remotely by a satellite and is used to validate remotely obtained data.

2) Weather forecast

A good weather forecast is very important for a mariner for planning the voyage. It helps in not only selecting a safe route and avoiding storms, ice etc but also allows planning for conditioning some type of cargoes. Some cargoes are very sensitive to condensation – ventilation of such cargo spaces is decided by determining dew point of the atmosphere and the cargo hold. Common instruments available on board for recording weather are barometer, thermometer/ hygrometer, sea thermometer, anemometer, barograph etc. The use and care of each of these equipments is detailed below. In addition to observing weather parameters by instruments, visual observation also plays an important part. State of sea, precipitation, cloud type, visibility etc is observed and estimated visually by experience.

3) Barometer

Before reading a barometer on the bridge, ensure that the door leading outside is opened to ensure that the pressure on the bridge is atmospheric.

A barometer is used for measuring the atmospheric pressure. Atmosphere pressure is a major factor that governs formation and movement of good and bad weather systems. There are basically two types of barometers used – Mercury and Aneroid, with the latter being more common on merchant ships. Barometer reading must be recorded to the nearest 0.1 hpa.

a. **Mercury barometer**

As the name suggests these barometers use mercury column to measure atmosphere pressure. These are not very common nowadays and generally the aneroid type barometers are used. A major disadvantage of the mercury barometer is its bulkiness and fragility. The long glass tube can break easily, and mercury levels may be difficult to read under unsteady conditions, as on board a ship at sea. Mercury barometers must be corrected for temperature, latitude and height. Any instrument error must be applied. Mercury barometers are provided with a vernier scale for accurate observations, to allow for accurate reading. Average reading must be taken from the upper meniscus of the mercury column.

When reading a mercury barometer, always allow for vessel's movement.

b. **Aneroid barometer**

Aneroid barometer is liquid free. It has a container that holds a sealed chamber from which some air has removed, creating a partial vacuum. An elastic disk covering the chamber is connected to a needle or pointer on the surface of the container by a chain, lever, and springs. As atmospheric pressure increases or decreases, the elastic disk contracts or expands, causing the pointer to move accordingly.

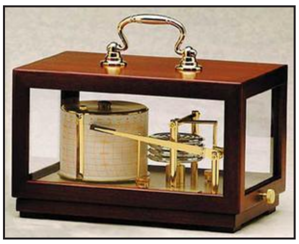
An aneroid barometer must be tapped before taking a reading. All barometers must be compared with standard barometers at least once a year and Index error obtained.

It has a pointer that moves from left to right in a semicircular motion over a dial, reflecting low or high pressure. It appears as a simple clock like instrument and is graduated in 'pressure' units – usually the 'hpa'. Aneroid barometers are compensated for temperature and do not require to be corrected for latitude. They require to be corrected for height above sea level and the index error. Electronic barometers working on 'aneroid' principle are also available. These give digital readings and have memory function.

4) Barograph

A barograph works on aneroid principle and instead of a pointer indicating the pressure against a dial, there is a pen that records the barometric pressure. It could be called a 'recording barometer'. The pen records on a paper fitted on a slowly rotating cylinder. The paper is graduated in days/hours and pressure unit. The cylinder takes a complete turn in 7 or 14 days depending upon the paper graduation.

A completed barograph paper must be kept safely for record purpose for at least 2 years.



Cylinder is either mechanically powered or run by battery power. To avoid excessive oscillation of the pen-arm, a damping mechanism is provided. Barograph trace is read to determine the barometric tendency i.e. – rising, falling, steady etc.

5) Dew point

The dew point is the temperature to which a given parcel of air must be cooled, at constant pressure for water vapour to condense into water. The condensed water is called dew. The dew point is a saturation point.

The dew point is associated with relative humidity. A high relative humidity indicates that the dew point is closer to the current air temperature. Relative humidity of 100% indicates the dew point is equal to the current temperature and the air is maximum saturated with water. When the dew point remains constant and temperature increases, relative humidity will decrease.

6) Wet and dry bulb thermometers

It consists of two identical thermometers fitted side by side. The bulb of one of the thermometer is wrapped with muslin cloth and other end of the cloth is immersed in a small water container. Due to capillary action, the thermometer bulb is kept wet and due to evaporation it shows a temperature which is usually less than the dry bulb thermometer. On a ship dry and wet bulb thermometer is fitted in a small wooden cabinet called “stevenson screen” in a shaded area.

7) Sling/ whirling psychrometer

Another simple hygrometer - a sling or whirling psychrometer - consists of two thermometers mounted together with a handle. One thermometer is ordinary. The other has a cloth wick over its bulb and is called a wet-bulb thermometer. The thermometers can be whirled round while holding the handle.

When a reading is to be taken, the wick is first wetted with water and then the instrument is whirled around. During the whirling, the water evaporates from the wick, cooling the wet-bulb thermometer. Then, the temperatures of both thermometers are read.

If the surrounding air is dry, more moisture evaporates from the wick, cooling the wet-bulb thermometer more so there is a greater difference between the temperatures of the two thermometers. If the surrounding air is holding as much moisture as possible - if the relative humidity is 100% - there is no difference between the two temperatures. Dew point and relative humidity are obtained using tables.

8) Sea water temperature measurement

On board measurement of seawater is normally done by reading the thermometer/s attached to the intake of sea water pump/s at sea. More accurate readings may be had by using a special rugged bucket type of container into which a thermometer is inserted before lowering in to the sea. The thermometer is protected with a rubber cushion. Reading must be taken as soon as the bucket is picked up. Few, if any ships have this type of bucket on board.

9) Wind observation

> 'Beaufort number' is often referred to as 'Wind force'

This consists of measurement of direction from which the wind is blowing and the speed of the wind. An anemometer is used for this measurement. An anemometer consists of a number of cups which rotate a shaft and the entire unit is shaped so as to take the direction of wind. The direction towards which the anemometer is pointing and the speed of shaft movement gives us direction and speed of apparent wind. Apparent wind is the vector sum of the true wind and the movement of the ship. The true wind is calculated by solving the triangle after applying apparent wind speed, direction, and own vessel's course and speed. In absence of an anemometer the wind speed is estimated using beaufort scale. This scale uses the sea state to give an estimate of the wind speed. It extends from Force 0 (Calm) to Force 12 (Hurricane). Against each beaufort number (Force), the expected sea state, description of sea, wave height expected is given.

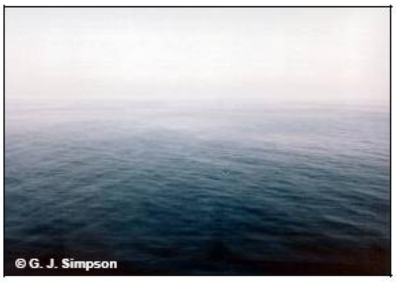
Waves follow the wind direction, thus in absence of the anemometer, direction of wind can be estimated by observing the wave direction. If the waves are breaking (white horses), the wind direction will be approximately perpendicular to the white horses.

10) Swell observation

Swell is wave motion caused by large meteorological disturbances at a distance. Swell persists even after the disturbance has disappeared and maintains its direction as long as it is in deep waters. Swell length is described as short (0-100m), average (100-200m) and long (over 200m). Swell height is described as low (0-2m), moderate (2-4m) and heavy (over 4m).

Sea States

Sea appearance in winds of Force 0.



Sea appearance in winds of Force 1.

Sea appearance in winds of Force 2.

Sea appearance in winds of Force 3.

Sea appearance in winds of Force 4.

Sea appearance in winds of Force 5.

Sea appearance in winds of Force 6.

Sea appearance in winds of Force 7.

Sea appearance in winds of Force 8.

Sea appearance in winds of Force 9.

Sea appearance in winds of Force 10.

Sea appearance in winds of Force 11.

Sea appearance in winds of Force 12.

(Source: Met office- UK)

Beaufort scale – specification and expected wind speed and wave height)

Force	Description	Specification for use at sea*	Equivalent speed at 10 metres above sea level				Description in forecast	State of sea	Probable height of waves* /metres
			Mean		Limits				
			/knots	/ms^{-1}	/knots	/ms^{-1}			
0	Calm	Sea like a mirror	0	0.0	<1	0.0 to 0.2	Calm	Calm	0.0
1	Light air	Ripples with the appearance of scales are formed, but without foam crests	2	0.8	1 to 3	0.3 to 1.5	Light	Calm	0.1 (0.1)
2	Light breeze	Small wavelets, still short but more pronounced. Crests have a glassy appearance and do not break	5	2.4	4 to 6	1.6 to 3.3	Light	Smooth	0.2 (0.3)
3	Gentle breeze	Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses	9	4.3	7 to 10	3.4 to 5.4	Light	Smooth	0.6 (1.0)
4	Moderate breeze	Small waves, becoming longer, fairly frequent white horses	13	6.7	11 to 16	5.5 to 7.9	Moderate	Slight	1.0 (1.5)
5	Fresh breeze	Moderate waves, taking a more pronounced long form; many white horses are formed. Chance of some spray	19	9.3	17 to 21	8.0 to 10.7	Fresh	Moderate	2.0 (2.5)
6	Strong breeze	Large waves begin to form; the white foam crests are more extensive everywhere. Probably some spray	24	12.3	22 to 27	10.8 to 13.8	Strong	Rough	3.0 (4.0)
7	Near gale	Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind	30	15.5	28 to 33	13.9 to 17.1	Strong	Very rough	4.0 (5.5)
8	Gale	Moderate high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind	37	18.9	34 to 40	17.2 to 20.7	Gale	High	5.5 (7.5)
9	Strong gale	High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility	44	22.6	41 to 47	20.8 to 24.4	Severe gale	Very high	7.0 (10.0)
10	Storm	Very high waves with long over-hanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The 'tumbling' of the sea becomes heavy and shock-like. Visibility affected	52	26.4	48 to 55	24.5 to 28.4	Storm	Very high	9.0 (12.5)
11	Violent storm	Exceptionally high waves (small and medium-sized ships might be for a time lost behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected	60	30.5	56 to 63	28.5 to 32.6	Violent storm	Phenomenal	11.5 (16.0)
12	Hurricane	The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected	-	-	64 and over	32.7 and over	Hurricane force	Phenomenal	14.0 (-)

*These columns are a guide to show roughly what may be expected in the open sea, remote from land. Figures in brackets indicate the probable maximum height of waves. In enclosed waters, or when near land with an offshore wind, wave heights will be smaller and the waves steeper.

Apply Your Knowledge

1. Record the following weather observations (barometric pressure, dew point, air and sea temperatures, wind direction, wind force, swell direction and wave height) on at least 10 different occasions.

Function: Navigation

Competence: Maintain a safe navigation watch

Task Reference No.: A2.1

Sub task Reference Nos.: A2.1.1, A2.1.2, A2.1.3

Topic: Watch Keeping

Task Heading

- Read and discuss with a senior officer "Watch keeping arrangements and principles to be observed" concerning navigation watch at sea and anchor as stated in STCW 2010.
- Keep a proper look-out by day and night. Report objects correctly, assess and determine risk of collision.
- Read Master's standing and bridge orders. Identify the circumstances for when to call the Master

Objectives

- Keep a safe navigational watch at sea and at anchor

Index

1) Introduction
2) Basic watch keeping principles
    a. Composition and role of bridge team
3) Principles to be observed in keeping a navigational watch
    a. Lookout
    b. Sole lookout
    c. Watch arrangements
    d. Handing/ taking over the watch
4) Performing the navigational watch
5) Calling master
6) Watch keeping under different conditions and in different areas
    a. Clear weather
    b. Restricted visibility
    c. In hours of darkness
    d. Coastal and congested waters
    e. Navigation with pilot on board
7) Watch keeping at anchor
8) Master's standing and bridge orders
9) Shipboard SMS, bridge procedures guide and checklists

Description

1) Introduction

Keeping a good watch on the bridge of a ship is essential for avoiding all navigation related accidents. Each deck officer must primarily consider himself firstly as a navigator. Other duties, though also very important are of secondary nature. It is primary duty of a navigator to take the ship safely between two ports and lie safely at anchorages/ ports. Navigation related accidents are mainly due to collision, allision, grounding and bad weather. Collision may involve one or more ships. Contact between a moving ship and a fixed object is called allision. The main reason for a ship coming in contact with any other vessel or object is keeping a bad lookout. Machinery and other failures constitute a very small percentage. Grounding refers to contact or stranding after contact with sea bottom. Main reason for grounding is improper or bad watch keeping. Bad weather can cause grave loss structurally to a ship which could eventually result in total loss. Main reason for bad weather damage is due to not monitoring weather changes and the weather reports and warnings issued by shore authorities. Bad ship handling at times of bad weather also is a big contributor towards weather related damages. All above accidents can cause major loss of life, damage to environment, and damage to ship, cargo and other property. Good bridge watch keeping is very important to avoid all navigation related accidents.

The International Maritime Organization came out with **Standards for Training, Certification and Watch keeping** as far back as 1978 in form of STCW convention 1978. The annex to the 1978 convention was amended in 1995 and now again in 2010. It is referred as the STCW code.

Collision Grounding

2) Basic watch keeping principles

The essence of good watch keeping is that all officers in charge of the navigational watch must appreciate that efficient performance of their duties is necessary in the interests of the safety of life and property at sea and of preventing pollution of the marine environment. In efficient watch keeping can lead to very serious accidents. Watch keeping is a dynamic procedure and must change depending on existing and foreseeable situations. Specific company and shipboard procedures concerning watch keeping must be followed at all times.

a) Composition and role of bridge team

A bridge watch may be kept by a single certified officer or more than one person may form the bridge team depending upon the circumstances as explained later. All watch keeping personnel are required to be fit and must form a cohesive team with effective communication.

The watch keeper must be available to interpret information from all available navaids and instruments. All information received from various navaids and otherwise by the watch keeping officer and other members of the team must be shared and acted upon as required. The watch keeping officer is referred to as the OOW and is responsible directly to the master for safety of life, environment, vessel and all cargo. As the OOW, he/she is said to “have the con”. The con may be taken over by the master at any time after clearly stating same and being

> The OOW continues to remain responsible for the safe navigation, even with the Master on the bridge, unless the Master specifically informs him that he has taken over the con of the vessel.

mutually understood by both the OOW and the master. There should never be any doubt as to who "has the con" at any time. Change of con must be recorded.

If ever in any doubt about what action to take in interest of safety, the master must be immediately informed. Informing master does not relieve OOW of his obligation to take immediate action in interest of safety. As an example, if the OOW sees an unexpected hazard/ danger right ahead and close by, it is obligatory to act and get away from the danger while also informing master.

The OOW shall be aware of the serious effects of operational or accidental pollution of the marine environment and shall take all possible precautions to prevent such pollution, particularly within the framework of relevant international and port regulations.

3) Principles to be observed in keeping a navigational watch

a) Lookout

Keeping a good and efficient lookout is a basic requirement of good watch keeping. It is obvious even to a layman that while walking on road if we do not keep a lookout we are bound to collide with other persons/objects.

Lookout must be kept by all available means at all times. This includes lookout - by visual means, sound, radar etc. Listening on VHF is one means of keeping a lookout.

Lookout, includes

- Appraisal of all traffic and developing risk of collision/s, if any.
- Detecting ships and aircraft in distress and other ship wrecked persons, debris and hazards

A person on lookout duty must be able to give full attention towards keeping a good lookout and must not be assigned other tasks.

Duty of helmsman and lookout is not the same. Thus a helmsman must not be treated as a lookout man.
The composition of watch should be such that a proper lookout can always be kept.

> The OOW can call an additional lookout whenever he wants

Besides all that is stated above, a lookout man has responsibility towards the OOW of reporting everything that he sees or hears that may be of concern to the OOW or may be of assistance to him. Any object sighted must be reported by stating its bearing in points or degrees and giving description of the object. Lookout must follow instructions of OOW with respect to place from where lookout is to be kept. An OOW may alert the lookout man to look for objects in particular direction/area. Once a lookout man reports sighting of an object, he must at regular intervals update the OOW about the object.

If at any time the lookout man feels or doubts that the officer is unable to perform his duty due to incapacitation or otherwise he must inform the master.

During hours of darkness it must be ensured that adequate measures are taken to support the night vision of the OOW and lookout man. Deck lighting should if required to be used carefully. It should be noted that even momentary exposure to bright light can completely destroy night vision and during the interim readjustment procedure the ability to keep an effective lookout could be impaired.

b) Sole lookout

In some circumstances, by daylight only, the D/O may be the sole lookout provided

- The situation has been carefully assessed and established that it is safe to do so.
- Full account has been taken of at least:
    - Prevailing and expected weather
    - Visibility
    - Traffic conditions

  - Proximity of navigational hazards
  - Attention necessary when navigating near and in Traffic separation schemes
- Assistance is available to be immediately summoned whenever required. There should be a clear well understood procedure for this.

c) Watch arrangements

Whenever the bridge is manned by more than the OOW it could consist of one or more officer and rating/s. In deciding the composition of the bridge team, following must be considered:

- The bridge must never be left unattended. One OOW must always be present.
- Weather conditions, visibility and state of the day (daylight or darkness)
- Proximity of hazards
- Operation of navigational aids including but not limited to radar, ECDIS, echo sounder, AIS etc
- Automatic steering available or not
- Any radio communication work to be performed
- Unmanned machinery space controls etc required to be attended
- Any unusual navigational demand

From above, it is obvious that number of people in the bridge team will be more when navigating near the coast, approaching port and when navigating **in restricted visibility.** It is often necessary to have more than one navigating officer on the bridge.

An OOW must never hesitate to summon extra help for the bridge team if he deems it necessary.

d) Handing/ taking over watch

An OOW must never hand over watch if the relieving officer is considered unfit for watch keeping. Such an instance must be reported to the master. Examples of an officer not being fit could be – being fatigued, under influence of alcohol, unwell etc. In such cases, master will make alternative arrangements.

A watch changeover of OOW should not take place:

- Till the relieving officer and entire bridge team is adjusted to night vision.
- When a manoeuvre or other action to avoid any hazard is taking place. In such a case, the relief of that officer shall be deferred until such action has been completed.

Relieving officers must satisfy themselves of:

- standing orders and other special instructions of the master relating to navigation of the ship
- position, course, speed and draught of the ship at time of take over and the expected track to be covered during the watch duration.
- prevailing and predicted tides, currents, weather, visibility and the effect of these factors upon course and speed
- procedures for the use of main engines to manoeuvre when the main engines are on bridge control
- navigational situation, including, but not limited to:
  - the operational condition of all navigational and safety equipment being used or likely to be used during the watch,
  - the errors of gyro- and magnetic compasses,
  - the presence and movement of ships in sight or known to be in the vicinity,
  - the conditions and hazards likely to be encountered during the watch, and
  - the possible effects of heel, trim, water density and squat on under-keel clearance.

> The relieving OOW must ensure that members of his watch are fully capable of performing their duties. If there is any doubt the OOW must arrange for that member of the watch to be replaced.

4) Performing the navigational watch

The OOW shall keep the watch on the bridge and in no circumstances leave the bridge until properly relieved and continue to be responsible for the safe navigation of the ship, despite the presence of the master on the bridge, until informed specifically that the master has assumed that responsibility and this is mutually understood.

During the watch, the course steered, position and speed shall be checked at sufficiently frequent intervals, using any available navigational aids necessary, to ensure that the ship follows the planned course.

The OOW must have full knowledge of the location and operation of all safety and navigational equipment on board the ship and shall be aware and take account of the operating limitations of such equipment. This is for his safety and safety of other bridge team members.

The OOW shall not be assigned or undertake any duties which would interfere with the safe navigation of the ship.

When using radar, the officer OOW shall bear in mind the necessity to comply at all times with the provisions on the use of radar contained in the International Regulations for Preventing Collisions at Sea, 1972 (Colregs) in force.

In cases of need, the OOW shall not hesitate to use the helm, engines and sound signalling apparatus. However, timely notice of intended variations of engine speed shall be given where possible or effective use shall be made of UMS engine controls provided on the bridge in accordance with the applicable procedures.

OOW shall know the handling characteristics of the ship, including its stopping distances, and should appreciate that other ships may have different handling characteristics. Vessel's important manoeuvring characteristics are displayed on the bridge, which each OOW must be familiar with.

A proper record shall be kept during the watch of the movements and activities relating to the navigation of the ship. This is kept in various log books as required by the company.

It is of special importance that at all times the OOW ensures that a proper lookout is maintained.

Operational tests of shipboard navigational equipment shall be carried out at sea as frequently as practicable and as circumstances permit, in particular before hazardous conditions affecting navigation are expected. Whenever appropriate, these tests shall be recorded. Such tests shall also be carried out prior to port arrival and departure. Specific checklists must be followed.

The OOW shall make regular checks to ensure that:

- the person steering the ship or the automatic pilot is steering the correct course
- the standard compass error is determined at least once a watch and, when possible, after any major alteration of course; the standard and gyro-compasses are frequently compared and repeaters are synchronized with their master compass. Any difference in the repeaters must be rectified.
- the automatic pilot is tested manually at least once a watch;
- the navigation and signal lights and other navigational equipment are functioning properly;
- the radio equipment (GMDSS) is functioning properly
- the UMS controls, alarms and indicators are functioning properly.

The OOW shall take into account:

- the need to station a person to steer the ship and to put the steering into manual control in good time to allow any potentially hazardous situation to be dealt with in a safe manner e.g. in congested waters etc.
- that, with a ship under automatic steering, it is highly dangerous to allow a situation to develop to the point where the officer in charge of the navigational watch is without assistance and has to break the continuity of the lookout in order to take emergency action.

- OOW shall be thoroughly familiar with the use of all electronic navigational aids carried, including their capabilities and limitations, and shall use each of these aids when appropriate and shall bear in mind that the echo-sounder is a valuable navigational aid.
- The OOW shall use the radar whenever restricted visibility is encountered or expected, and at all times in congested waters, having due regard to its limitations. Some companies or Masters may require that one or more Radars be kept running at all times.

The OOW shall ensure that the radar range scales employed are changed at sufficiently frequent intervals so that echoes are detected as early as possible. It shall be borne in mind that small or poor echoes may escape detection.

Whenever radar is in use, the officer in charge of the navigational watch shall select an appropriate range scale and observe the display carefully, and shall ensure that plotting or systematic analysis is commenced in ample time.

5) Calling master

The OOW shall notify the master immediately:

- if restricted visibility is encountered or expected;
- if the traffic conditions or the movements of other ships are causing concern
- if difficulty is experienced in maintaining course
- on failure to sight land, or a navigation mark or to obtain soundings by the expected time
- if, unexpectedly, land or a navigation mark is sighted or a change in soundings occurs
- on breakdown of the engines, propulsion machinery remote control, steering gear or any essential navigational equipment, alarm or indicator
- if the radio equipment malfunctions
- in heavy weather, if in any doubt about the possibility of weather damage
- if the ship meets any hazard to navigation, such as ice or a derelict
- in any other emergency or if in any doubt

Call Master in ample time in case of any doubt about the situation.

As stated earlier, despite the requirement to notify the master immediately in the foregoing circumstances, the OOW shall, in addition, not hesitate to take immediate action for the safety of the ship, where circumstances so require.

Company's procedures and/ or master's standing and/ or bridge orders may have company and master specific conditions for calling/ notifying master.

6) Watch keeping under different conditions and in different areas

a) Clear weather

In clear weather the OOW must observe and take frequent compass bearings of all approaching ships to assess if risk of collision exists. OOW must bear in mind that in some circumstances such risk may also exist if there is change of bearings. Any action taken to avoid collision must be in compliance with Colregs (IRPCS) and must be taken early and be positive. It must be ensured that any action taken to avoid collision is having the desired effect.

In clear weather, whenever possible an OOW must carry out radar practice. This must include but not be limited to radar plotting. The OOW must realise that practice and working on radar and other navigational aids at times of clear weather in open sea with little traffic will make him confident of working with these aids in all weather, traffic and hazardous conditions. An example is familiarising with the "Trial Manoeuvre" function of ARPA which could be very useful in areas of heavy traffic density.

b) Restricted visibility

When restricted visibility is encountered or expected, the first responsibility of the OOW is to comply with the relevant Colregs

No Stand on vessel in restricted visibility

(IRPCS), with particular regard to the sounding of fog signals, proceeding at a safe speed and having the engines ready for immediate manoeuvre.

In addition, the officer in charge of the navigational watch shall:

- Inform the master
- Post a proper lookout/s
- Exhibit navigation lights
- Operate and use the radar

Company's instructions and master's orders may require some more actions to be taken in case of restricted visibility. Company's checklist for navigating in restricted visibility must be complied with.

It must be realized that many accidents have taken place in restricted visibility due to proceeding at excessive speed. Reduced speed, gives more time for assessment of the situation and the damage in case of contact will be lesser.

c) In hours of darkness

When arranging lookout duty, consideration shall be given to the bridge equipment and navigational aids available for use, their limitations, procedures and safeguards implemented.

d) Navigation with pilot on board

Despite the duties and obligations of pilots, their presence on board does not relieve the OOW from his duties and obligations for the safety of the ship. The master and the pilot shall exchange information regarding navigation procedures, local conditions and the ship's characteristics and this must be recorded. The OOW shall co-operate closely with the pilot and maintain an accurate check on the ship's position and movement.

The responsibility of the safe navigation of the ship remains with the Master and OOW, even with the pilot on board. The Pilots only assist in the capacity of an advisor.

If in any doubt as to the pilot's actions or intentions, the OOW shall seek clarification from the pilot and, if doubt still exists, shall notify the master immediately and take whatever action is necessary before the master arrives.

7) Watch keeping at anchor

If the master considers it necessary, a continuous navigational watch shall be maintained at anchor. While at anchor, the OOW shall:

- determine and plot the ship's position on the appropriate chart as soon as practicable after anchoring
- check at sufficiently frequent intervals whether the ship is remaining securely at anchor by taking bearings of fixed navigation marks or readily identifiable shore objects. Electronic navigational aids may also be used to supplement this
- ensure that proper lookout is maintained
- ensure that inspection rounds of the ship are made periodically
- observe and record meteorological and tidal conditions and the state of the sea
- notify the master and undertake all necessary measures if the ship drags anchor
- ensure that the state of readiness of the main engines and other machinery is in accordance with the master's instructions
- if visibility deteriorates, notify the master
- ensure that the ship exhibits the appropriate lights and shapes and that appropriate sound signals are made in accordance with all applicable regulations
- take measures to protect the environment from pollution by the ship and comply with applicable pollution regulations.

- In some ports security related extra precautions may be required to be taken while at anchor

Company's instructions and master's orders must be complied with.

8) Master's standing and bridge orders

a) Master's standing orders

In addition to company's bridge watch keeping procedures, Master must write his own specific standing orders. These orders must be read and understood by all watch keeping officers before keeping first watch. They must be signed and dated. OOW may seek clarification from the master if any content of Master's orders are not understood. These orders besides dealing with specific requirements of the master may also take care of any ship type specific requirement and experience of the bridge team. A copy of master's standing orders must be available on the bridge at all times

b) Bridge orders

These orders were earlier referred to as "Night orders" but as orders could be issued even during daytime the orders are now called "Bridge Orders".

In addition to the master's standing orders, specific instructions may be needed for special circumstances.

At daily intervals, the master must write in the bridge order book what is expected of the OOW, with particular reference to his requirements during hours of darkness. These orders must be signed by each OOW when going on watch. At time of writing the orders the OOW must understand the orders and clarify any doubt with the master. The OOW must then be able to subsequently explain the bridge orders to the next OOW.

9) Shipboard SMS, bridge procedures guide and checklists

Shipboard SMS provides checklist relating to various topics relating to watchkeeping and navigation. Same shall be used at different occasions of watchkeeping as applicable

- ❖ Checklist for taking over a navigational watch
- ❖ Checklist for steering gear checks
- ❖ Checklist for taking for pre-arrival/ pre-departure checks
- ❖ Checklist for taking for steering gear checks
- ❖ Checklist for taking for pre-arrival/ pre-departure checks
- ❖ Checklist for taking used for navigation in restricted visibility
- ❖ Checklist used for information given by pilot to master
- ❖ Checklist used for navigation under pilotage
- ❖ Checklist for anchoring
- ❖ Master's standing orders

Apply Your Knowledge

Read the Master's standing orders and identify the circumstances in which to call the Master.

Function: Navigation

Competence: Maintain a safe navigational watch

Task Reference No: A2.2

Sub task Reference Nos.: A2.2.1

Topic: Navigational Equipment

Task Heading

- Receive full bridge familiarization as per company's Safety Management System checklist from a navigating officer.

Objectives

- Familiarize with navigational equipment and be able to use same

Index

10) Introduction
11) Familiarization procedure
    a. Use of familiarization check list
    b. Use of various procedures to operate navigational equipment

Description

1) Introduction

All navigating officers must be well acquainted and familiarized with using all navigational equipment. Imagine an officer joining a vessel at 1000 hrs in the morning, ship sailing out at 1800 hrs and the officer taking over his first watch at 2000 hrs on same day with the bridge absolutely dark. Without previous familiarization with bridge equipment, he will not even know the layout of the bridge equipment. He will thus not be able to keep a proper watch. Each officer must thus be familiarized with all navigational equipment and other controls on the bridge before he is allowed to keep an independent navigational watch.

2) Familiarization procedure

> Refer to the Company's Bridge Familiarisation checklist during familiarisation with bridge equipments on joining the vessel.

For all navigating officers a reasonable period of time must be allowed to become acquainted with the equipment that they will be using and any associated shipboard procedures. The familiarization procedures must be covered in written shipboard procedures of the company. Familiarization for bridge equipment must be given by the officer responsible for bridge equipment and a check list must be used.

An officer must also read and understand Master's standing orders before keeping the first independent watch. He will be required to sign same with the date.

a) Use of familiarization check list

A copy of a typical checklist used for bridge equipment familiarization is attached. Familiarization should specifically include navigational aids as fitted on board, including but not limited to ECDIS, ARPA, AIS, radar, and echo sounder. Equipment manuals and CBTs etc. could also be used for training. The newly joined officer must also go through the passage plan and sign same before keeping first independent watch.

b) Use of various procedures to operate navigational equipment

A new joining officer must not hesitate to ask questions during the familiarization procedure. While basic function of all navigational equipment may be similar, the layout of various controls may be different and the officer must get used to same. Some equipment has functions additional to the minimum required by IMO standards – such functions must be understood and best advantage taken. All equipments must have the basic operating procedure posted near the equipment and this could be used at any time.

Besides navigational equipment, a newly joined officer must be familiarized with various controls and switches of other equipment. Navigation light control and alarm system needs to be well understood. The deck lighting switches must be known so that the correct light is switched off/ on whenever required.

01	Passage Plan, charts and publications for the voyage, including correction log.	☐	21	Steering gear modes, controls, alarms, change-over operations, including emergency steering from aft.	☐
02	All light switches including Nav, NUC, Anchor, X'mas tree, Deck lights, Strg. Light.	☐	22	Water Ingress Detection and Alarm System (WIDAS) operation.	☐
03	General alarms and emergency stops for hold and accommodation vents.	☐	23	Safety equipment, pyrotechnics, fog-horn, gong, NUC shapes, EPIRB, LTA, Aldis lamp, morse light and key, MOB signal release, lead-lines, survival craft radios.	☐
04	Communication facilities available.	☐	24	Sextants.	☐
05	Echo sounder operation, spare rolls	☐	25	Master / slave clocks and / or chronometer	☐
06	G.P.S. operation.	☐	26	Smoke detector system, fire detector system. Remote closing of hold vent flaps.	☐
07	ECDIS operation (if applicable) including updating procedures, back-up procedures, etc. Key alarms and critical parameters .	☐	27	Meteorological equipment, barometers, barograph, Stevenson Screen, anemometer, pschychrometer, Logs and reporting forms.	☐
08	Speed Log operation/error.	☐	28	Courtesy and signal flags.	☐
09	Course-recorder operation	☐	29	Binoculars and chart work instruments.	☐
10	Weather Fax recorder operation, spare rolls.	☐	30	Equipment operating from emergency power supply.	☐
11	Navtex receiver operation, spare rolls.	☐	31	All lighting and dimmer controls.	☐
12	Master-gyro, repeaters, azimuth rings.	☐	32	Charts and publications stowage.	☐
13	Magnetic compass, compass error book, deviation curve, spare compass, magnets.	☐	33	Location of all spares not already checked.	☐
14	Autopilot, changeover procedures to manual, NFU and emergency modes.	☐	34	Equipment operation manuals.	☐
15	VHF sets, operation	☐	35	Window wipers, clear view screens & heaters controls.	☐
16	DSC watch keeping receiver operation	☐	36	All other navigational Logs and records. Window wipers, clear view screens & heaters controls.	☐
17	Radars operation, inter- switching, performance monitor etc. ARPA, operation.	☐	37	Bridge publications.	☐
18	AIS operation.	☐	38	GMDSS equipment – operation & distress procedures using MF / HF DSC, Satcom-C, VHF DSC etc.	☐
19	Bow thruster operation (if applicable).	☐	39	Master's standing orders	☐
20	Bridge control system, console, emergency stop/cancel slowdown functions, change over procedures-especially alarms.	☐	40	Discussed Checklists D/EMRG/09 – Bridge Console/ Telegraph Failure and D/EMRG/10 – Gyro Failure	

Joining Officer's name:________________ **Rank:**__________ **Date:**________________

Joining Officer's Signature:

Master's verification:______________________________ **Date:**________________

Apply Your Knowledge

1. Check the bridge familiarization checklist and discuss with your Shipboard Training Officer the importance of getting familiarized.

Function: Navigation

Competence: Maintain a safe navigational watch

Task Reference No.: A2.3

Sub task Reference Nos.: A2.3.1

Topic: Ship Reporting Systems

Task Heading

- Assist duty officer in preparing and sending AMVER reports.

Objectives

- Understand principles of ship reporting systems
    - Understand working of AMVER
    - Understand the reporting system adopted by AMVER
- Making and sending AMVER reports

Index

12) Introduction
13) Various ship reporting systems
    a. AMVER ship reporting system
    b. Type and format of AMVER reports
14) Assisting duty officer in making and sending AMVER reports
    a. The AMVER message
    b. Formats for various AMVER reports
    c. Sending AMVER reports
15) What should not be reported to AMVER

Description

1) Introduction

Ship reporting systems have been introduced by number of states so that they can keep track of ships passing through and near their coastal waters. These systems are used to gather information regarding ships such as, position, course, speed, ETA's, cargo etc. In addition to monitoring traffic, the information may also be used for search and rescue operations and for protection of marine environment. Use of ship reporting system should form part of passage plan.

2) Various ship reporting systems

Some ship reporting systems must be used by all ships while some systems require only certain category of ships to report. The "Ship's Routeing Guide" has details of all IMO adopted reporting systems. List of Radio signals provide details of all ship reporting systems. Some common country specific systems are "**AUSREP**" (Australia), "**JASREP**" (Japan), "**INSPIRES"** (India). These all have well defined boundaries covering the ocean areas around their coast. Basic, format of reporting plans and messages is similar to all systems with slight difference in reporting duration etc.

a) AMVER ship reporting system

AMVER stands for **Automated Mutual Assistance Vessel Reporting system**. The system is managed by the US coast guard and has worldwide coverage. It is not compulsory but highly recommended for use to facilitate SAR operations. Information voluntarily provided by vessels to AMVER is kept strictly confidential and is protected by the USCG. It will be released only for safety purposes.

AMVER system is managed by USCG and has worldwide coverage.

AMVER's greatest use is in providing SURface PICtures – SURPICs – to RCCs. A SURPIC either lists latitude/longitude or provides a graphical display of vessels near the position of a distress. It is used by Rescue Coordination Centres (RCCs) to coordinate the efforts of merchant vessels and other resources to provide the best and most timely assistance possible to distressed vessels or persons at sea.

b) Type and format of AMVER reports:

After receipt, the AMVER computer automatically processes each report. Since the processing of AMVER reports is heavily automated, the AMVER center maintains only a small staff to verify the data and resolve errors or inconsistencies in the thousands of reports received daily. Therefore, it is imperative reports be received electronically at the AMVER center. All efforts must be made to send reports correct in content and format.

There are four types of AMVER reports: **Sailing Plan, Position Report, Deviation Report, and Arrival Report.** Detailed descriptions and examples of each report type are given in Admiralty list of radio signals and must be referred to at time of making the report.

A brief description is given below:

I. Sailing Plan – contains complete routing information and should be sent within a few hours before, upon, or within a few hours after departure.

II. Position Report – should be sent within 24 hours of departure and subsequently at least every 48 hours until arrival. The destination should also be included in Position Reports. It is very important that the position report of all reporting systems is updated within the time period allowed – otherwise, after allowing for some grace period a search operation may be initiated.

III. Deviation Report – should be sent as soon as any voyage information changes, which could affect AMVER's ability to accurately predict the vessel's position. Changes in course or speed due to weather, ice, change in destination, or any other deviations from the original sailing plan should be reported as soon as possible.

IV. Arrival Report – should be sent upon arrival at the sea buoy or port of destination. At the discretion of the master, reports may be sent more frequently than the above schedule, for example: during heavy weather or other adverse conditions. Complete, timely, and accurate reports are essential to keeping AMVER accurate and saving lives!

3) Assisting duty officer in making and sending AMVER reports

a) **The AMVER message**

Each AMVER message consists of number of lines and each line is prefixed with an alphabet which identifies the information contained in that line. The 'lines' are explained below.

All AMVER reports must begin with the "AMVER" line. Report type is one of the following two letter codes: SP – Sailing Plan, PR – Position Report, DR – Deviation Report, FR – Arrival (Final) Report.
AMVER/report type//
Example: AMVER/PR//

Each line identifier is explained below:

The "A" Line
The "A" line is required in all reports to identify the vessel submitting the report.

The "B" Line
The "B" line identifies the time associated with the position given in the "C" or "G" lines of the report. All times in "B", "I", "K", and "L" lines should be expressed in Universal Coordinated Time (Greenwich Mean Time, Time Zone "Z" Zulu) as a six-digit date-time group followed by the letters "Z", "GMT", or "UTC" and optionally by a three-letter abbreviation for the month.

The "C" Line
The "C" line is used in position and deviation reports to give the vessel's current position (as of the time given in the "B" line) in latitude and longitude. Latitudes are always expressed as a four-

digit group followed by “N” (for “North”) or “S” (for “South”). The first two digits are interpreted as degrees and the second two are interpreted as minutes. Similarly, longitudes are always expressed as a five-digit group followed by “E” (for “East”) or “W” (for “West”). The first three digits are interpreted as degrees and the last two are interpreted as minutes.

The “E” Line
The “E” line is used to report the vessel’s current course (as of the time in the “B” line) in degrees true as a three-digit number.

The “F” Line
The “F” line is used to report the vessel’s estimated average speed over the ground for the remainder of the voyage as a three-digit number representing tenths of knots. This is a very important line to report as this speed is used for AMVER’s dead reckoning computations unless a different speed is provided for a specific leg of the voyage (see the explanation of “L” lines below). If no speed is given, AMVER must use an assumed speed. Since an error of only one knot will produce a position error of 48 nautical miles between 48-hour position updates, it is vitally important AMVER participants report anticipated average speeds accurately. As with position data, it is important to use all digits when specifying a speed to ensure accurate interpretation.

The “G” Line
The “G” line is used to report the port of departure by name and position. It is important to give the position of the port as the name alone does not always uniquely identify the port.

The “I” Line
The “I” line is used to report the vessel’s next port and ETA. As with the “G” line above, it is important to include the port’s position as well as its name. The ETA at the next port is also important, especially when a U.S. port is the **destination**. In all cases, the ETA is compared with AMVER’s computed ETA as a check on the accuracy and consistency of all voyage route information.

The “K” Line
The “K” line is used to report a vessel’s actual arrival in the immediate vicinity of its destination. Arrival reports are very important to AMVER but very few ships send them. Failure to send arrival messages has at least two serious consequences. First, it leads to uncertainty about the vessel’s status (underway or in port), especially if regular position reports have not been sent. On more than one occasion, a vessel has been contacted and asked to divert to assist a distressed vessel at sea simply because the actual arrival of the vessel in port had not been reported. Second, failure to send an arrival report makes it difficult to maintain accurate statistics on the vessel’s participation in AMVER for purposes of the AMVER awards program.

The “L” Line
The “L” line is used to report route information. These lines are the most complex lines in an AMVER report, but they are critical to AMVER’s success. Complete route information should be provided in all sailing plans and also in deviation reports when the vessel’s route or destination changes. Every report containing insufficient routing information must be manually plotted and approximate turn points entered by AMVER Voyage Analysts. These estimates of the vessel’s intended route can lead to substantial errors. As many “L” lines as needed may be used to describe the vessel’s intended route. However, since AMVER’s primary purpose is to locate assistance for distressed vessels on the high seas, detailed route information caused by manoeuvring over short distances near coasts should not be included. Instead, an approximate route using fewer turn points and the “COASTAL” navigation method should be provided. All “L” lines except the last one in the report require the navigation method to the next turn point, latitude and longitude of the next turn point, and the ETA at the next turn point. The final “L” line in a sailing plan requires only the navigation method from the last turn point to the destination.

The “M” Line
The “M” line is optional and is used to provide information on the best way to contact the vessel quickly in the event of a distress at sea. Many lives have been saved because AMVER provided

information on vessels near a distress AND a RCC was able to contact them quickly, allowing them to proceed and assist in a timely fashion.

The "V" Line
The "V" line is an optional line used to report the medical capability aboard the vessel during the voyage. It is important to accurately report your vessel's medical resources EVERY VOYAGE. Medically trained personnel are very scarce on the high seas and this makes them extremely valuable in cases where a member of a vessel's crew becomes ill or injured. The codes used are "NONE" if no medically trained personnel are aboard, "NURSE" if a trained nurse is aboard, "PA" if a physician's assistant or paramedic is aboard and "MD" if a medical doctor or physician is aboard.

The "X" Line
The "X" line is used for any English language amplifying comments or remarks the vessel may wish to send AMVER regarding its current voyage. Any information provided in the "X" line will be stored in the AMVER automatic data processing system for later review. However, immediate action may not be taken, nor will the information be routinely passed to other organizations. The "X" line can NOT be used as a substitute for sending information to other SAR organizations However, AMVER will, at the request of other SAR authorities, provide "X" line information to those authorities.

The "Y" Line
The "Y" line is used to request relay of the AMVER report to certain other ship reporting systems. AMVER, in support and cooperation with regional reporting systems, will, upon specific request of a participating vessel, relay a copy of its AMVER report to selected reporting systems. AMVER will relay reports to other reporting systems ONLY when requested to do so via appropriate entry in the "Y" line.

JASREP, AUSREP, and CHILREP: Presently, AMVER and the Japanese, Australian, and Chilean Regional Reporting Systems (JASREP, AUSREP, and CHILREP) cooperate with each other by accepting and complying with relay requests.

The "Z" Line
The "Z" line must be the last line in every AMVER report as it is used by the AMVER computer to signal the end of the report. This line was found to be necessary and was added for two reasons.

First, miscellaneous communications data often follows the end of an AMVER report in a TELEX, EasyLink, or other teletype message. The AMVER computer sometimes tries to interpret this information as part of the AMVER report, causing unnecessary work for AMVER voyage analysts to correct the resulting errors. Second, some radio stations send multiple AMVER reports in a single message to reduce communications costs. An end-of-report line makes automatically separating these reports much easier and more reliable.

b) Formats for various AMVER reports

Sailing Plan: A sailing plan should be sent within a few hours before, upon, or within a few hours after departure. It must include enough information to predict the vessel's actual position within 25 nautical miles at any time during the voyage, assuming the sailing plan is followed exactly. Sailing plans require A, B, E, F, G, I, L, and Z lines. The M, V, X, and Y lines are optional. (Y line is required for U.S. vessels).

AMVER/SP//
A/SEALAND MARINER/KGJF//
B/240620Z MAR//
E/045//
F/198//
G/TOKYO/3536N/13946E//
I/LOS ANGELES/3343N/11817W/ 031300Z APR//
L/RL/190/3448N/13954E/ NOJIMASAKI/240850Z//
L/GC/210/4200N/18000E/280400Z//
L/RL/200/4200N/16000W/300030Z//

L/GC/188/3422N/12047W/030500Z APR//
L/RL/161//
M/JCS//
V/NONE//
X/NEXT REPORT 250800Z//
Y/JASREP/MAREP//
Z/EOR//

Position Reports: A position report should be sent within 24 hours of departing port and at least once every 48 hours thereafter. The destination should be included, at least in the first few reports, in case AMVER has not received the sailing plan information. In a small but still significant number of cases, AMVER does receive Position reports from vessels not already on plot. In such cases, position information alone is of very limited use. Position reports require A, B, C, E, F, and Z lines. The I line is strongly recommended. The M, X, and Y lines are optional. (Y line is required for US Flag vessels.)

AMVER/PR//
A/SEALAND MARINER/KGJF//
B/281330Z//
C/4200N/17544W//
E/090//
F/200//
I/LOS ANGELES/3343N/11817W/ 031300Z APR//
M/NMC//
Y/MAREP//
Z/EOR//

Deviation Reports: Deviation reports should be sent whenever the vessel deviates significantly from its Sailing Plan. The deviation reports below show changes due to encountering some adverse weather. Please note although the vessel stayed on its intended track, without the information given in these reports, AMVER's predicted position for the vessel would have been many miles, even hundreds of miles, in error during the second half of the voyage. Other situations in which deviation reports should be sent include, but are not limited to, change in destination, diverting to evacuate a sick or injured crewmember, diverting to assist another vessel, diverting to avoid heavy weather, any change of route, (for example, change based on recommendations from a vessel routing service), stopping to make repairs or await orders, change in anticipated average speed of one knot or more, and so forth. Deviation Reports require the A, B, C, E, F and Z lines. The I line and L lines are required if destination or route changes. The I line is always strongly recommended, even when not required. The M, X, and Y lines are optional. (Y line is required for U.S. vessels).

AMVER/DR//
A/SEALAND MARINER/KGJF//
B/291200Z//
C/4200N/16654W//
E/090//
F/175//
I/LOS ANGELES/3343N/12074W/040100Z APR//
X/REDUCED SPEED DUE TO WEATHER//
Y/MAREP//
Z/EOR//
AMVER/DR//
A/SEALAND MARINER/KGJF//
B/300830Z MAR//
C/4200N/16000W//
E/100//
F/185//
I/LOS ANGELES/3343N/12047W/ 032130Z APR//
Y/MAREP//

Z/EOR//

Arrival Report: Arrival reports should be sent upon arrival in the immediate vicinity of the destination port, such as at the sea buoy or pilot station. This report properly terminates the voyage in AMVER's computer, ensures the vessel will not appear on an AMVER SURPIC until its next voyage, and allows the number of days on plot to be correctly updated for future use in determining the vessel's eligibility for an AMVER award. Arrival reports require the A, K and Z line. The X and Y lines are optional. (Y line is required for U.S. vessels).

AMVER/FR//
A/SEALAND MARINER/KGJF//
K/LOS ANGELES/3343N/12074W/ 032200Z//
Y/MAREP//
Z/EOR//.

c) Sending AMVER reports

AMVER reports may be sent by email, telex, or through selected stations by HF radio. Some stations charge for these messages while some treat it as free traffic.

4) What should not be reported to AMVER?

AMVER frequently receives messages, which should have been sent to other agencies, not AMVER. AMVER is an information system maintained to aid RCCs in providing information for SAR incidents on the high seas. AMVER is NOT itself an RCC and it has NO facilities for coordination or providing assistance. AMVER is also NOT a general-purpose communications center. Some of the more common examples of messages, which should NOT be sent to AMVER, are listed below:

Request for assistance: ANY VESSEL REQUIRING ASSISTANCE SHOULD CONTACT THE APPROPRIATE RCC, NOT AMVER! Similarly, any vessel copying an SOS, MAYDAY or DSC Alert from a distressed vessel, or otherwise becoming aware that a distress incident has occurred, should contact the appropriate RCC, not AMVER. While AMVER will, of course, relay any message, which reports an emergency to the most appropriate USCG RCC (which may in turn have to relay the information to another RCC), it will cause a delay in the rescue response.

Sighting reports: Reports of sighting small sailing vessels on the high seas, derelict vessels, lifeboats, or life rafts, vessel or aircraft debris, and so forth, should be sent directly to the appropriate RCC, not AMVER. Similarly, sightings of hazards to navigation, oil slicks, and so forth, should also be reported directly to the appropriate RCC, not AMVER.

Weather observations: Weather observations should be sent directly to the appropriate meteorological organization, not AMVER.

Report of crew and vessel equipment status: It is sometimes necessary for vessels to report the status of the crew and certain equipment prior to arrival in port. This information should be sent directly to the appropriate port authority, not AMVER.

Apply Your Knowledge

1. Assist Duty Officer in preparing and sending AMVER Reports.

Function: Navigation

Competence: Maintain a safe navigational watch

Task Reference No.: A2.4

Sub task Reference No.: A2.4.1

Topic: Bridge Resource Management

Task Heading

- Practice the use of closed loop communications, particularly during navigation on the bridge and when communicating on walkie-talkies.

Objectives

- This module is an entirely practical module that is self-explanatory. Some notes are given for guidance purposes.

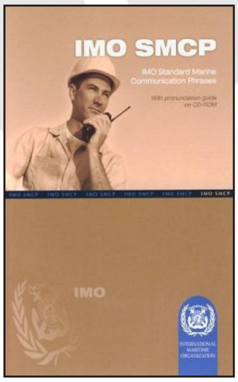
Index

1) Introduction
2) Closed loop communication
3) Standard marine communication phrases
4) Communication on bridge

Description

1) Introduction

Communication is the process of to impart information from a sender to a receiver with the use of a medium. The medium often is speech. On a ship the official language is used for conveying instructions. It is important that the receiver not only listens to the conversation but he must be able to understand same.



2) Closed loop communication

Closed loop communication ensures that a message that was sent is received and understood. This includes the sender sending the message, receiver receiving the message and interpreting it, acknowledging it and finally the sender following up to ensure that the intended message was received.

A typical communication between bridge and the officer on forward stations would be as follows:

Bridge: Forward, please come in
Forward: Sir
Bridge: The first mooring line to be passed will be the headline
Forward: Understood, Sir. The first mooring line will be the headline.
Bridge: Correct.

3) Standard marine communication phrases

Communications must be clear and well understood. If in doubt, do not hesitate to seek clarification.

The use of standard communication phrases (IMO SMCP) is strongly recommended. IMO SMCP has been developed as a comprehensive standardized safety language, taking into account changing conditions in modern seafaring and covers all major safety-related verbal communication. The IMO SMCP includes phrases which have been developed to cover the most important safety-related fields of verbal shore-to-ship (and vice-versa), ship-to-ship and on-board communications. The aim is to get around the problem of language barriers at sea and avoid misunderstandings which can cause accidents. The IMO SMCP builds on a basic knowledge of English and has been drafted in a simplified version of maritime English. It includes phrases for use in routine situations such as berthing as well as standard phrases and responses for use in emergency situations.

4) Communication on bridge

Communication on bridge at all times must be clear and well understood. Any doubts must be immediately cleared by seeking clarification. As far as possible SMCP phrases should be used. All orders must be repeated loudly and clearly so that the person giving the order understands that his instructions have been well received.

Apply Your Knowledge

1. You are transiting a strait and passing a VTS Reporting point. Listen to the phrases being used to communicate the required information to the VTS.

Function: Navigation

Competence: Use of Radar and ARPA to maintain safety of navigation

Task Reference No.: A3.1, A3.2

Sub task Reference No: A3.1.1, A3.1.2, A3.1.3, A3.1.4, A3.1.5, A3.1.6, A3.2.1

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

Task Heading

- Practice radar set-up procedure and carry out system tests.
- Identify conspicuous land marks on a radar picture.
- Plot fixes by radar using radar ranges and bearings. Check the accuracy of same with visual fixes.
- Demonstrate understanding of the methods of target acquisition (including auto-acquire) and their limitations.
- Perform optimum settings of anti-sea and rain clutter controls.
- Practice comparing and correlating the actual visual scenario with the radar picture.
- Demonstrate ability to determine range, bearing, course, speed, CPA and TCPA of targets.

Objectives

- Understand and demonstrate basic radar/ARPA functions
- Use radar for position fixing
- Use ARPA for target tracking

Index

1) Introduction
2) Radar basic controls
3) Radar set up
4) Suppressing sea clutter
5) Suppressing rain clutter
6) Picture interpretation
7) Identifying coastal objects
8) Plotting radar fixes
9) Acquiring targets for plotting
10) Obtaining information of acquired target on ARPA

Description

1) Introduction

Radar is an important navigational aid used for navigation and anti-collision purpose. Its use is simple but must be fully understood to make best of use of it. There have been many “radar assisted collisions” due to not interpreting the data properly. For making full use of radar, besides other things, we must understand the proper “set up” procedure and be able to interpret the radar picture fully.

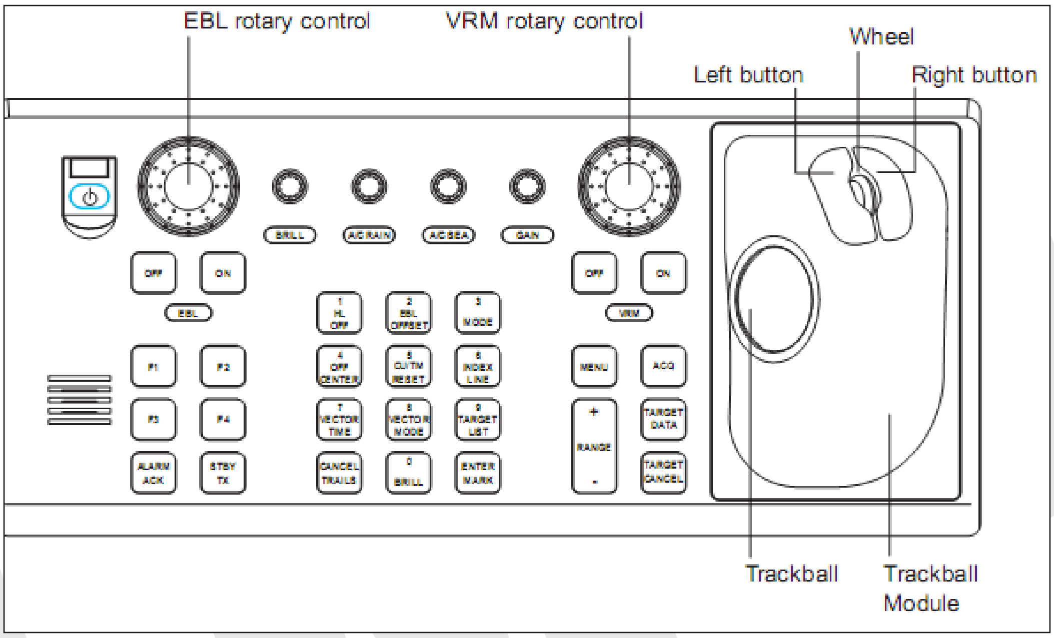
2) Radar basic controls

A radar unit is basically controlled from the display unit which has all the controls required for operation. Common controls are discussed below in brief:

- Power on/off: Controls power supply to antenna, transceiver and display units.
- Display brilliance, panel brilliance and contrast: The screen and control panel, brilliance/contrast is set up by these controls. These controls may have to be adjusted as the light in the bridge changes i.e. between day and darkness. There is also an independent day/night control provided.
- Tuning control: To adjust and allow for compatibility between the frequency of transmitted and received signal
- Gain control: For increasing receiver sensitivity for best reception of signals

- Range control: For selecting different range scales
- Display mode: For selecting various display modes i.e. head up, north up - relative, north up - true, course up etc.
- Sea clutter control: This is sometimes called STC or swept gain, and is used to remove the clutter caused by echoes from waves, that can otherwise form a bright circle in the centre of the screen and obscure target echoes.
- Rain clutter control: This control is sometimes known as FTC or differentiation and, as its name suggests, is used to remove the clutter caused by meteorological effects such as rain, snow or hail.
- EBL/VRM controls: These controls control the ‘electronic bearing line’ and the ‘variable range marker’. The display gives the digital EBL and VRM readout.

Given below is a keyboard of a modern radar, showing various controls



3) Radar set up

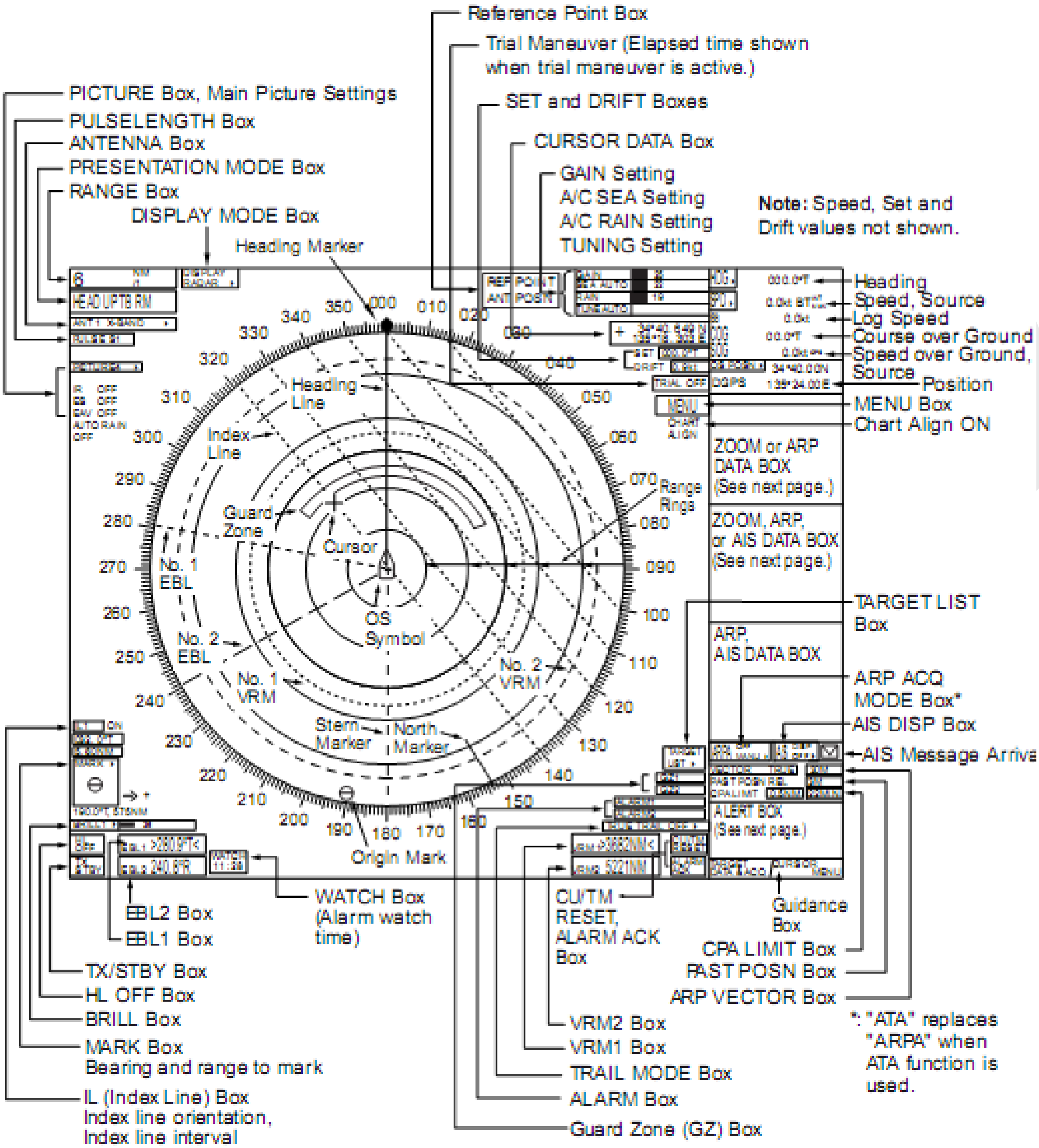
- **Power On:** On “power on” the Tx and display unit is switched on. The PPI screen outline is displayed with various Menus. During the first 2-3 mins, the Magnetron is warmed up, and Tx/RX circuit integrity test is carried out. Any defect/error detected is displayed. After 2-3 mins the radar is ready for operation and same is displayed on screen as “Radar St By”. Solid state radars, which do not use magnetrons, have recently been introduced in the market.
- **Tx On:** Once the radar is on ‘stand by’ the radar transmission can be started.
- **Tuning:** The tuning can be adjusted automatically on “auto” or manually. The set provides an indication to show that maximum tuning level has been reached.
- **Adjusting Picture:** With Tx on, and PPI ‘Brilliance” adjusted for optimum picture presentation the gain setting can be increased to obtain a speckled back ground or the best picture strength (quality). On LCD display, the gain needs to be adjusted for best picture output.
- **Adjusting Gyro Reading:** Compare heading marker line or the gyro read out on the radar with master gyro reading. If a difference is observed same can be adjusted.
- **Display Mode:** Select required display mode – Head up, Course Up or North up (relative or true).
- **Stabilisation:** Ground or sea stabilised picture may be selected. Sea stabilised is preferred for anti-collision purpose (Use of ARPA) as it conveys the correct aspect of

> Sea stabilized mode is preferred for anti-collision purpose.

the target which is important for application of Colregs.

- **Range Scale:** Select the desired range scale. In open sea long range scanning must be done. In restricted visibility, range scale should be changed so as to not miss out on targets nearby**.**
- **Pulse length selection:** Desired pulse length can be selected. A longer pulse length may assist in displaying a weak echo better but will elongate all echoes.

The picture below explains the information shown on a typical Display screen:



4) Suppressing sea clutter

Echoes from waves cover the area near 'own ship' of the display with random signals known as sea clutter. The higher the waves, and higher the antenna above the water, the further

> In case of no rain, snow or hail conditions, the A/C rain control must be kept to minimum.

the clutter will extend. When sea clutter masks the picture, suppress it by the A/C SEA control, either manually or automatically. It must be kept in mind that too much of clutter control will mask the weak echoes nearby while too little will cause the echoes nearby to be obscured by sea clutter. In case of excessive sea clutter, the A/C control must be periodically adjusted to ensure that targets nearby in clutter range are not missed out. Auto control of sea clutter may cause the weak echoes to disappear or at times cause too much suppression. The proper setting of the A/C SEA should be such that the clutter is broken up into small dots, and small targets become distinguishable.

5) Suppressing rain clutter

The vertical beam width of the antenna is designed to see surface targets even when the ship is rolling. However, by this design the unit will also detect rain clutter (rain, snow, or hail) in the same manner as normal targets. The A/C RAIN control adjusts the receiver sensitivity as the A/C SEA control does but rather in a longer time period (longer range). Auto control of anti-rain clutter may result in over suppression causing loss of targets or under suppression causing targets to be obscured. Both rain and sea a/c controls must be increased/ decreased as required so as to not miss out on small targets. In case of no rain, snow or hail conditions, the A/C rain control must be kept to minimum.

6) Picture interpretation

Once a target has been illuminated by the radar beam, its ability to produce an echo depends on its material, size, and shape and to some extent on its surface texture. Some materials (such as GRP) are almost transparent to the microwaves. Others (such as wood) absorb microwaves. This is why we should never assume that GRP, wooden or other small vessels will always be 'seen' by a ship's radar. Some materials, most significantly metal, rock and water are good reflectors of radar waves. The effect of size is fairly obvious. In general a large target can reflect more of the radar energy than a small one, so it stands a better chance of appearing as a contact on the radar screen. The effect of size, however, is masked to some extent by the effect of shape. Spherical or cylindrical objects are poor reflectors because they scatter radar energy, instead of reflecting it back the way it came. Flat surfaces, on the other hand, can be very good reflectors indeed, because if they happen to be positioned exactly at right angles to the approaching radar beam the effect is very much like a mirror, directing the radar energy straight back to the antenna. At any other angle, however, a flat surface is likely to send the echo off in the wrong direction. The most reliable all around reflectors tend to be those with uneven surfaces, because although some of the radar energy may be scattered the rough surface almost guarantees that at least some of it will be returned. Any rocky cuts and bays will be sharply shown on a radar picture. An observer must be aware and acquainted with the display in use and must always correlate a radar picture with what he sees outside through the bridge window.

7) Identifying coastal objects

As stated above the radar picture gives the outline of the coast. The high rough rocky areas are painted darker and more conspicuously then the low sandy beaches. All cuts in the coast with conspicuous headlands and bays can be easily picked up by comparing radar picture with the chart. An EBL (floating) can be used for checking bearing and distance between a known conspicuous landmark and other conspicuous ‘edges’, ‘cuts’ ‘headlands’ etc. and a comparison on chart can help identifying the other landmarks.

8) Plotting radar fixes

Any fixed (not floating) charted object/s can be used to fix vessel’s position after positive identification. A fix can be obtained by a combination of bearings and distances or else by multiple bearings and ranges. Whenever available, a total of at least 3 ranges, bearings or combination of range/bearing/s should be used. A radar position can be checked by taking an electronic or visual terrestrial fix at the same time.

9) Acquiring targets for plotting

Any target can be acquired manually or automatically. Automatic acquiring is done by fixing a guard zone at specified range and arc. Any target entering the zone will be automatically acquired by plotting. This has the disadvantage of false echoes also being acquired. Manual plotting is done by placing the cursor on the target and selecting same. Within 1 minute the vector indicating motion trend of the target is displayed and within 3 minutes target's predicted motion with all required data is displayed. Vectors can be selected in true or relative mode and length can be adjusted by feeding the 'time' interval for which the vector length is required.

10) Obtaining information of acquired target on ARPA

Once a target is being tracked, its data can be readily obtained by selecting that target. Following data is presented by the ARPA:

a) Calculated course and speed (Made good)
b) Range
c) Bearing
d) Range at closest point of approach (CPA)
e) Predicted time to CPA (TCPA).

Some ARPA sets additionally give the bow crossing range (BCR) and bow crossing time (BCT). This is the range and time the target will cross ahead of own vessel. In good visibility, the target plotted must be sighted and its bearing and correct aspect checked before taking any avoiding action under Colregs.

Apply Your Knowledge

1) Discuss the limitations of the "X" band and "S" band Radar/ARPA on your ship.

Function: Navigation

Competence: Use of ECDIS to maintain safety of Navigation

Task Reference No.: A4.1

Sub task Reference Nos.: A4.1.1, A4.1.2, A4.1.3

Topic: Use of ECDIS

Task Heading

- Demonstrate understanding of the operation of ECDIS and ENC chart symbols (S-52).
- Use the various display options (base, standard, all and customized) available on ECDIS.
- Recognize the differences between:
  - ECDIS and ECS (Electronic Charting System)
  - Raster scan and vector charts.

Objectives

- Understand and familiarize with ECDIS equipment and controls
- Familiarize with ENC chart symbols
- Use various display options
- Understand difference between ECDIS and ECS
- Understand difference between raster scan and vector charts

Index

1) Introduction – What is ECDIS
2) SOLAS requirement for carriage of ECDIS
3) Electronic Navigational Chart (ENC)
4) Electronic Chart System (ECS)
5) Official ENC
6) Raster chart
7) Vector chart
8) Display base
9) Standard display
10) Other or customized display
11) Common ECDIS controls
12) ENC chart symbols

Description

1) Introduction- What is ECDIS?

An Electronic Chart Display and Information System (ECDIS) is a computer-based navigation information system that complies with International Maritime Organization (IMO) regulations and can be used as an alternative to paper nautical charts. IMO refers to similar systems not meeting the regulations as Electronic Chart Systems (ECS). An ECDIS system displays the information from electronic navigational charts (ENC) and integrates position information from electronic position fixing system such as the Global Positioning System and other navigational sensors, such as radar and automatic identification systems (AIS). It may also display additional navigation-related information.

2) SOLAS requirements for carriage of ECDIS

SOLAS now requires some ship types built after 1.7.2012 to have ECDIS fitted and while all other old and new ships have been set a time table as given below

Application (to ships engaged on international voyages only)

Ship type	Size	New ships (construction – keel laying date)	Existing ships (not new ships)
Passenger ships	500 gt and above	July 1, 2012	Not later than the first survey* on or after July 1, 2014
Tankers	3,000 gt and above	July 1, 2012	Not later than the first survey* on or after July 1, 2015
Others	50,000 gt and above	July 1, 2013	Not later than the first survey* on or after July 1, 2016
	20,000 gt and above	July 1, 2013	Not later than the first survey* on or after July 1, 2017
	10,000 gt and above	July 1, 2013	Not later than the first survey* on or after July 1, 2018. There are no retrofitting requirements for existing ships less than 10,000 gt
	3,000 gt and above	July 1, 2014	There are no retrofitting requirements for existing ships less than 10,000 gt

* The first survey means the first annual survey, the first periodical survey or the first renewal survey, whichever is due first after the date specified. For a passenger ship, this is the first renewal survey for "Passenger ship safety survey"; for a cargo ship (non-passenger ship), this is either the "Cargo ship safety equipment survey" or the "Cargo ship safety survey" (combined survey – if the ship chooses to combine all SOLAS certificates in one). For both passenger ships and cargo ships which are under construction, if the keel is laid before, but the ship is delivered after, the date specified in the relevant regulation, the initial survey is the "first survey".

ECDIS must be able to provide all information required for safe and efficient navigation. ECDIS is also required to assist in route planning and monitoring.

3) Electronic Navigational Chart (ENC)

A ship fitted with an IMO approved ECDIS (with backup) is not required to carry paper charts for area covered by Vector charts.

ENC means the database, standardized as to content, structure and format, issued for use with ECDIS on the authority of government authorized hydrographic offices. The ENC contains all the chart information necessary for safe navigation and may contain supplementary information in addition to that contained in the paper chart (e.g. sailing directions) which may be considered necessary for safe navigation.

System Electronic Navigational Chart (SENC) means a database resulting from the transformation of the ENC by ECDIS for appropriate use, updates to the ENC by appropriate means and other data added by the mariner. It is this database that is actually accessed by ECDIS for the display generation and other navigational functions, and is the equivalent to an up-to-date paper chart. The SENC may also contain information from other sources.

4) Electronic Chart System (ECS)

ECS is a navigation information system that electronically displays vessel position and relevant nautical chart data and information from an ECS database on a display screen, but does not meet all the IMO requirements for ECDIS and is not intended to satisfy the SOLAS Chapter V requirements to carry a navigational chart.

5) Official ENC

ENC means the database, standardized as to content, structure and format, issued for use with ECDIS on the authority of government-authorized hydrographic offices.

The ENC contains all the chart information useful for safe navigation, and may contain supplementary information in addition to that contained in the paper, which may be considered necessary for safe navigation.

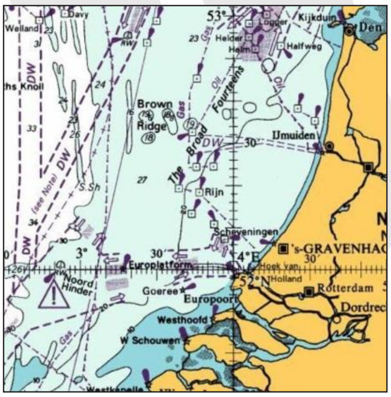
Official ENC's have the following attributes:

- ENC content is based on source data or official charts of the responsible hydrographic office;
- ENC's are compiled and coded according to international standards;
- ENC's are referred to World Geodetic System 1984 datum (WGS84);
- ENC content is the responsibility of the issuing hydrographic office;
- ENC's are issued only by the responsible hydrographic office; and
- ENC's are regularly updated with official update information distributed digitally.

Official ENC's are vector charts.

6) Raster chart

Raster charts are visual scan of paper charts. ECDIS alarms will not get triggered off by the chart data in case of raster charts.



A raster chart is basically just a visual scan of a paper chart. It is a computer-based system which uses charts issued by, or under the authority of, a national hydrographic office, together with automatic continuous electronic positioning, to provide an integrated navigational tool.

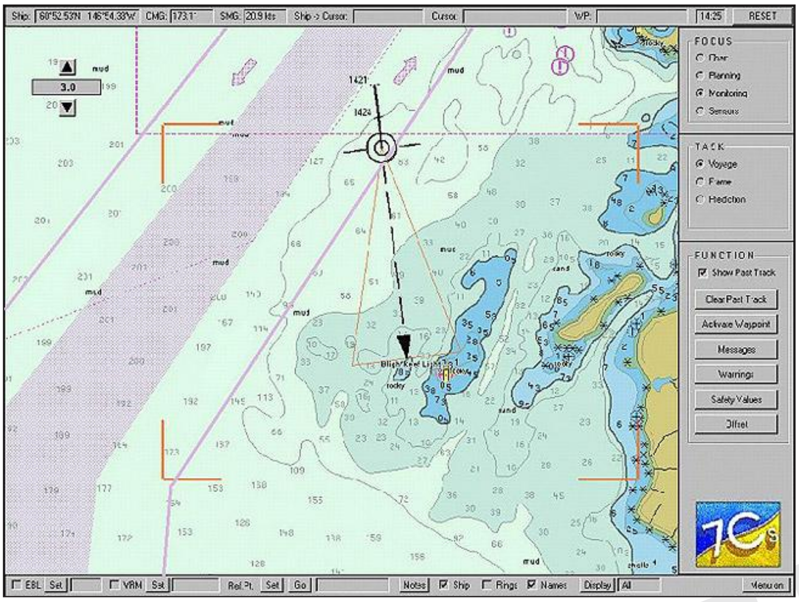
- It cannot be interrogated and hence, certain safety parameters of ECDIS cannot be used.
- The alarms will not get triggered off by the chart data.
- Excessive zooming may degrade the display.
- The chart may look cluttered.

7) Vector chart

Official ENC's are vector charts.

A vector chart is more complex. Each point on the chart is digitally mapped, allowing the information to be used in a more sophisticated way, such as clicking on a feature (for example, a lighthouse) to get all the details of that feature displayed. Charted objects can be interrogated to obtain more details. Alarms can be set to be triggered at pre-determined settings i.e. on approach to shallow waters, anchorage, TSS, etc. Information on chart can be added or removed as desired by the operator.

Minimum information as required by "Display Base" is maintained and cannot be removed.



8) Common ECDIS controls

- Display Base: For selection of chart showing minimum data. This data is not enough for navigation
- Standard Display: The display that the ECDIS shows when switched on. The information available is as defined by IMO standard
- Zoom Out/In: For Zooming In/Out the chart. Both raster and vector charts can be zoomed in/out.
- Enter: For confirming selection
- Alarm Ack: For acknowledging alarm
- Select/Deselect data: Selecting/ deselecting data required to be displayed
- Range: For selecting range visible ahead.

In addition to above, numbers of controls are available to set alarms, carryout route planning, route check and monitoring.

9) Display base

It means the level of SENC information which cannot be removed from the display, consisting of information which is required at all times in all geographic areas and all circumstances. It is not intended to be sufficient for safe navigation. It consists of:

- Coastline (high water);
- Own ship's safety contour, to be selected by the mariner;
- Indication of isolated underwater dangers of depths less than the
- Safety contour which lie within the safe waters defined by the safety
- Contour;
- Indication of isolated dangers which lie within the safe water
- Defined by the safety contour such as bridges, overhead wires, etc.,
- And including buoys and beacons whether or not these are being used
- As aids to navigation;
- Traffic routeing systems;
- Scale, range, orientation and display-mode;
- Units of depth and height.

10) Standard display

Standard display to be displayed when the chart is first displayed by ECDIS, consisting of:

- Display base

- Drying line
- Indication of fixed and floating aids to navigation
- Boundaries of fairways, channels, etc.
- Visual and radar conspicuous features
- Prohibited and restricted areas
- Chart scale boundaries
- Indication of cautionary notes

Any information besides the display base information can be removed by the operator.

11) Other or customised display

Information in addition to Standard can be selected and displayed individually on demand, for example:

- Spot soundings
- Submarine cables and pipelines
- Ferry routes
- Details of all isolated dangers
- Details of aids to navigation
- Contents of cautionary notes
- ENC edition date
- Geodetic datum
- Magnetic variation
- Graticule
- Place names

12) ENC chart symbols

All ENC charts use the symbols specified in IHO Publication S52 (Appendix 2)

Apply Your Knowledge

1. Observe the second officer listing out the ENCs required for the voyage.

Function: Navigation

Competence: Respond to Emergencies

Task Reference No.: A5.1

Sub task Reference Nos.: A5.1.1

Topic: Emergencies at Sea

Task Heading

- Understudy officer in charge during an abandon ship drill.

Objectives

- Understand purpose of having drills
- Take part in an abandon ship drill and understand the procedure for carrying out a drill.

Index

1) Introduction
2) Initial action
3) Drill programme
4) Muster
5) Action after mustering
6) Precautions
7) Debriefing

Description

1) Introduction

To ensure that we have a coordinated approach while fighting an emergency and also to make sure that the equipment designed and provided to be used for emergency purposes are maintained properly and available for immediate use we need to regularly exercise drills. Drills must be realistic. It is also important that performance of crewmembers during drills is evaluated and any shortcoming improved upon – remember, this is a SOLAS requirement, thus recording every drill as 'satisfactory' will not be correct. We need to carry out drills for various emergencies that may be envisaged on board. Ships of different types will have special ship specific drills in addition to drills for general expected emergencies

2) Drill programme

With the advent of ISM code it became mandatory for companies to establish programme for drills and exercises to prepare for emergency actions. This would obviously include all types of emergencies that a particular ship type could have and also comply with SOLAS requirements.

Company procedures must now specify the frequency for each drill required to be carried out. Fire, abandon ship and security drills must be carried out at least as often as specified in the SOLAS and ISPS codes while frequency of pollution drills must be as specified in the SOPEP/SMPEP/VRP manual.

> SOLAS requires that each crew member take part in at least one Abandon Ship and Fire drill every month.

SOLAS requires that each crew be familiar with his/her emergency duty before vessel proceeds to sea.

This will mean that if any crew is unable to attend such a drill, another drill must be held later in the month to ensure that the absentee crew can take part. If at any time there is more than 25% crew who has not taken part in an abandon ship or fire drill within the previous month a drill must be held within 24 hours of leaving port.

3) Initial action

Remember that initial actions for a drill and for an actual emergency will be same. Some further actions taken during a drill may not be required to be taken in an emergency.

It is better to discuss beforehand with key persons involved, the object and execution of a drill so that maximum benefit could be derived. During this pre-drill meeting, the check lists for various planned drills must be referred to.

This meeting must be done before the commencement of the drill.
Using substitutes for team incharges should be discussed during this meeting.

A risk assessment may need to be done before a drill and should be discussed in the pre-drill meeting.
If abandon ship drill is planned along with other drills, it must, for logical reasons be the last drill.

The immediate reaction on seeing any emergency situation must be to raise an alarm – this is essential to alert the entire crew. Once alerted regarding the emergency, the general alarm must be raised followed by announcement on the PA system. There should never be any hesitation in raising the general alarm.

4) Muster

Once the general alarm is sounded it must be followed by an announcement on the PA system stating the type of drill being exercised.

Entire crew must then proceed and muster at their respective muster stations. In case, crew is required to muster at secondary muster stations this must be stated over the PA system.

Crew at Abandon Ship Muster Stations

IMO symbol for Muster station

The crew must don their life jackets and if instructed, the immersion suits with life jackets. Enclosed lifeboats are boarded without immersion suits. Muster for an abandon ship is done near or abreast of respective lifeboat boarding stations.

The crew must carry with them all equipment as specified in the muster list. Crew assigned duty to carry SART; EPIRB etc must bring same before mustering.

5) Action after mustering

As soon as possible after the sounding of the emergency signal, communication with various parties must be tried out. All team in charge must be provided with hand held radios (or lifeboat R/T sets) and the communication channel to be used must be mentioned in the muster card.

As the crew begins to muster, team in charges must take a head count and report status to the command centre. It is however not necessary to wait for all crew to be present before detailing the crew for duties. It is only important that all hands are safe and accounted for. Command centre must be informed if any crew has failed to report for the muster and his whereabouts unknown, a search operation must then be carried out immediately.

Depending on nature of emergency, the nearest coastal state and flag state may also have to be informed. If time permits, office must be informed. It is a good idea to have blank copies of ‘reporting formats’ available on the bridge. All information of permanent nature can be inserted permanently in these forms – i.e. ship’s name, IMO number, call sign, contact details etc. can be inserted beforehand in these forms. All reporting work is carried out by the command center.

Command centre must maintain in chronological order, all events and actions – this is very important but often not done properly.

A record properly kept can be of great assistance later – remember each incident nowadays requires an investigation to be carried out and root cause analysis done to avoid such incidents happening again.

In an actual emergency, distress signals over radio and Inmarsat will also be sent.

> Remember, order for “Abandon Ship” will be given verbally by the Master only or the Chief Officer if the Master is incapacitated.

The crew on mustering and headcount must prepare the boats for lowering which will include securing the painter, removing battery charging connection (if provided), removing the boat securing arrangement (pins etc). Some boats may require the gripes also to be released. Lifeboats can be lowered with all crew in boat but if required to be hoisted, it must have only the operating crew in the boat. All persons in an enclosed boat must be strapped down.

Each abandon ship drill must include

- Summoning of crew to muster stations with the general alarm supplemented by using the PA system
- Reporting to stations and preparing for duties
- Checking crew is suitably dressed
- Checking that life jackets are correctly donned
- Lowering of at least one lifeboat
- Trying out lifeboat engine
- Operation of liferaft launching davits
- Instructions in the use of radio life saving appliances
- Emergency lighting for mustering and abandonment must be tested

A typical checklist for abandon ship drill is attached.

BRIDGE TEAM

Time	Action
	Sound General Emergency Alarm (Internal & External)
	Announce "Abandon Ship" on Public Address system.(By Master).
	Send distress message on all frequencies and by all available means. Distress message should include position, nature of emergency and weather condition (time permitting).
	STOP all Machinery.
	If possible, following items should be taken to the lifeboat. • Charts & Navigation instruments. • Sextant • Nautical tables • Ruler, pencils, dividers • Chronometer • Ships Log Book • Crew Documents • If time permits, inform AESM as per emergency reporting format.

EMERGENCY TEAM

	Action
	Muster at respective Lifeboat Station & Complete Head count.
	Mount rescue operation if anyone is missing.
	Carry following equipments to the lifeboats: • EPIRB • SART • GMDSS Walkie Talkies with lithium and other spare batteries • Aldis Lamp with battery • Ship's distress signals • Line throwing equipment • Torches and spare batteries

SUPPORT TEAM

	Action
	Close all water tight doors, hatches
	Prepare lifeboats and liferafts for launching

ENGINE TEAM

	Action
	Stop all machinery
	Close all doors, entrances, sky lights and other opening to Engine Room
	Report at respective Lifeboat

MEDICAL TEAM

	Action
	Bring extra provision and fresh water to the Lifeboats
	Bring extra blankets to the Lifeboats

6) Precautions

An abandon ship drill, involves handling mechanical equipment like davits, winches etc and also ropes etc. It also involves being close to moving parts. Proper PPE must be donned and instructions of officer incharge followed.

7) Debriefing

After the drill, all lifeboats and davits must be secured to entire satisfaction of the boat incharge. Entire crew must then be debriefed by the master/ senior officer, where any shortcoming observed must be discussed so as to not repeat same in future. Remember that prompt mustering, preparing boat for launching, boarding and lowering is of paramount importance while abandoning a ship.

Apply Your Knowledge

1. The following is the complement of your ship. Using your ship's muster list as a reference, prepare a muster list indicating various squads and duties of all personnel as indicated below. (Please note that you only have the following persons on board.)
   - Master, Chief Officer, 2nd Officer and 3rd Officer.
   - Chief engineer, 2nd Engineer and 3rd Engineer.
   - Three Able seaman (AB), 2 Ordinary Seaman (OS)
   - One Fitter, Two Oilers
   - One Cook, One Steward

   Total 17 crew members

   Discuss the list with your Shipboard Training Officer.

Function: Navigation

Competence: Respond to Emergencies

Task Reference No.: A5.2

Sub task Reference Nos. : A5.2.1, A5.2.2

Topic: Emergencies in Port

Task Heading

- Prepare a detailed contact list for port stay, listing the contact details of port control, fire department, local police, ambulance and tugs, by telephone or other methods of contact.
- Update the information in the fire wallet.

Objectives

- Understand purpose of having a contact list ready for each port
- Preparing a port contact list and displaying same
- Locating the fire wallet and familiarizing with contents of fire wallet

Index

16) Introduction
17) Contents of contact list
18) Where to be displayed
19) Fire plan wallet – location and contents

Description

1) Introduction

For responding to any emergency situation in port, we can be assisted by port authorities if they are alerted in good time. In addition some official agencies including own office need to be informed. Assistance and suggestions from office, owners, charterers and agents can be of great help in any emergency. We need to make and display port specific contact list, so that in an emergency concerned authorities could be contacted. To enable port emergency services get access to vessel's FFA/ safety plan soon after boarding, a copy of the plan with some other necessary papers is kept outside the accommodation area in a box called "Fire plan Wallet" (or tube).

2) Contents of contact list

A contact list must at least have 24 hrs contact telephone numbers of following parties. Wherever available, fax and email details should also be provided.

- Coastal state, as stated in SOPEP
- Port facility security officer
- DPA
- 24hrs emergency contact number of office
- Office emergency email ID, if available
- Superintendent incharge of ship
- P & I club
- P & I club local correspondent
- Owners
- Charterers
- Agents
- Nearest hospital
- Police station
- Fire brigade

- Port control
- Tug company, if privately managed

3) Where to be displayed

The contact list must be available with the master and displayed at the cargo control room (if provided). Additionally, it must be displayed near each Inmarsat telephone and near any other local telephone provided on board.

4) Fire plan wallet – location and contents

A set of fire plans must be stowed in a prominently marked weather tight enclosure outside the accommodation block for the assistance of shore side fire fighting personnel. Generally, one container is fitted on each side of the ship, near the gangway or at the accommodation entrance. These containers are also called fire wallets and must be conspicuously marked.

A fire wallet must contain ship's fire plan, updated crew list, updated cargo plan and the stress and stability calculations on arrival and expected departure condition.

The variable contents of the fire wallet, i.e. crew list, cargo plan and the stress/stability calculations must be updated before arrival each port.

Apply Your Knowledge

1. Prepare a contact list for any two ports of call on board your ship.

Function: Navigation

Competence: Respond to Distress signals at Sea

Task Reference No.: A6.1

Sub task Reference Nos.: A6.1.1

Topic: Distress signals

Task Heading

- Identify the distress signals used at sea.

Objectives

- Understand meaning of "distress" at sea
- List all distress signals used at sea
- Means of making distress signal

Index

Description

1) Introduction

A distress situation is one in which a vessel, aircraft, vehicle, or person is in grave and imminent danger and requires immediate assistance. Some examples of "grave and imminent danger" in which a distress call would be appropriate include fire, explosion, sinking, piracy etc. International regulations require a master of a ship at sea, which is in a position to be able to provide assistance, on receiving information from any source that persons are in distress at sea, is bound to proceed with all speed to their assistance, if possible informing them or the search and rescue (SAR) service that they are doing so.

All navigating officers must be able to distinguish distress signals and know the action to be taken on receipt of such a signal. They should also know how to transmit a distress alert/signal in the unfortunate event of themselves requiring sending a distress signal.

2) Distress signals

All navigating officers must be able to distinguish and immediately identify distress signals and know the action to be taken on receipt of such a signal. They should also know how to transmit a distress alert/signal in the unfortunate event of themselves requiring sending a distress signal.

The International regulations for prevention of collision at sea (IRPCS) in Annex IV give the list of distress signals as detailed below:

> Inform Master immediately in case you see a distress signal.

a) a gun or other explosive signal fired at intervals of about a minute;
b) a continuous sounding with any fog-signalling apparatus;
c) rockets or shells, throwing red stars fired one at a time at short intervals;
d) a signal made by any signalling method consisting of the group … _ _ _ … (SOS) in the Morse Code;
e) a signal sent by radiotelephony consisting of the spoken word " Mayday";
f) the International Code Signal of distress indicated by N.C.;
g) a signal consisting of a square flag having above or below it a ball anything resembling a ball;
h) flames on the vessel (as from a burning tar barrel, oil barrel, etc.);

i) a rocket parachute flare or a hand flare showing a red light;
j) a smoke signal giving off orange-colored smoke;
k) slowly and repeatedly raising and lowering arms outstretched to each side;
l) a distress alert by means of digital selective calling (DSC) transmitted on:
   i. VHF channel 70, or
   ii. MF/HF on the frequencies 2187.5 kHz, 8414.5 kHz, 4207.5 kHz, 6312 kHz,12577 kHz or 16804.5 kHz;
m) a ship-to-shore distress alert transmitted by the ship's Inmarsat or other mobile satellite service provider ship earth station;
n) signals transmitted by emergency position-indicating radio beacons;
o) approved signals transmitted by radio communication systems, including survival craft radar transponders.

The use or exhibition of any of the foregoing signals except for the purpose of indicating distress and need of assistance and the use of other signals which may be confused with any of the above signals is prohibited.

Attention is drawn to the relevant sections of the International Code of Signals, the IAMSAR Vol III and the following signals:

- a piece of orange-colored canvas with either a black square and circle *or* other appropriate symbol (for identification from the air);
- a dye marker.

3) Means of making distress signals

The above distress signals take into account practically all means of making a signal. A vessel in distress may not have any electrical power – thus many of these signals do not require power. Signals requiring power e.g. radio communication can be sent using emergency batteries. Radio communication is the preferred method if thee is no ship or shore station in visible horizon.

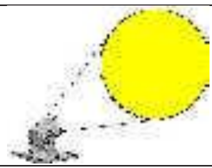
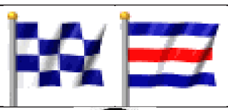
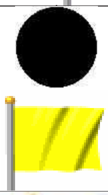
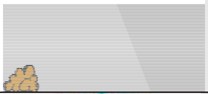
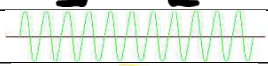
It must be remembered, that EPIRB is stand alone equipment with independent battery and can alert RCCs who can obtain vessel's position but not nature of distress.

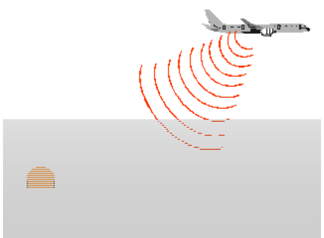
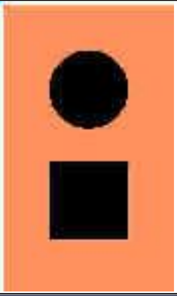
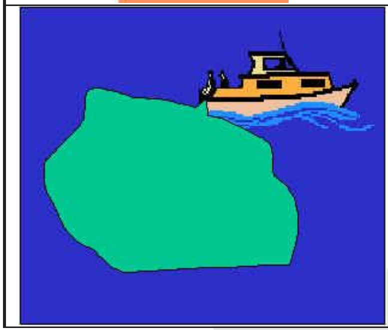
Pyrotechnics are visible over relatively large distances and all ships have stock of 12 parachute rockets. Additionally, each of the lifeboats and life rafts are also equipped.

Apply Your Knowledge

1. Identify the distress signal, mention when it should be used and up to what distance this signal can be seen or heard.

Distress signal Image	Text of Distress Signal	When to use	Distance at which it can be seen / heard
			
			

Function: Navigation

Competence: Respond to Distress signals at Sea

Task Reference No.: A6.1

Sub task Reference Nos.: A6.1.2. A6.1.3, A6.1.4, A6.1.5

Topic: Distress signals

Task Heading

- Read the contents of ALRS Volume 5 related to operation of GMDSS.
- Demonstrate understanding of the actions to be taken upon receiving distress messages and signals at sea.
- Demonstrate understanding of the procedure for transmitting a distress alert using MF/HF, DSC and EPIRB.
- Demonstrate understanding of the procedure for transmitting a distress message using MF/ HF, R/T, VHF, Inmarsat C, NBDP, Inmarsat B and Fleet-77.

Objectives

- Familiarise with concept of GMDSS and contents of ALRS Vol V.
- Action to be taken on receipt of distress message.
- Demonstrate procedure of transmitting distress alerts.
- Demonstrate procedure for sending a distress message.

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23) Introduction
24) GMDSS introduction
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30) Action to be taken on receiving DSC distress alert by MF
31) Action to be taken on receiving DSC distress alert by HF
32) Transmitting distress alert by EPIRB
33) Transmitting distress alert by VHF/MF/HF
34) Distress alert by Inmarsat

Description

1) Introduction

A distress alert or message is only to be made under express and clear orders of the Master of the vessel.

A distress situation is one in which a vessel, aircraft, vehicle, or person is in grave and imminent danger and requires immediate assistance. Some examples of "grave and imminent danger" in which a distress call would be appropriate include being in imminent danger due to fire, explosion, sinking, piracy etc. International regulations require a master of a ship at sea, which is in a position to be able to provide assistance, on receiving information from any source that persons are in distress at sea, to proceed with all speed to their assistance, if possible informing them or the search and rescue (SAR) service that they are doing so.

All navigating officers must however be able to transmit distress alerts/ messages and know what action to take in event of receiving a distress alert/ message.

2) GMDSS introduction

The GMDSS is specifically designed to automate a ship's radio distress alerting function, and, as a consequence, removes the requirement for manual (i.e., human) watch keeping on distress channels.

The system is quicker and, most importantly, more efficient and reliable than the old manual Morse code and radiotelephone alerting systems. The basic concept of the new system is that Search and Rescue (SAR) authorities ashore, as well as shipping in the immediate vicinity of the ship or persons in distress will be rapidly alerted so that they can assist in a coordinated SAR operation with the minimum of delay.

The emphasis is more on ship to shore alerting than ship to ship alerting. The system also provides for urgency and safety alerting and also for the broadcast of Maritime Safety Information (MSI - weather reports and navigation warnings).

One of the principal advantages of the GMDSS is that the system is actually an amalgam of various individual radio systems, both terrestrial and satellite thus distress alerts/ messages may be sent and received over short and/or long distances.

In other words, every ship is able to perform those communication functions which are essential for the safety of the ship itself and independent of other ships operating in the same area - irrespective of the area through which it sails.

3) GMDSS concepts

The GMDSS regulations require that every GMDSS equipped ship shall be capable of:

- transmitting ship-to-shore distress alerts by at least *two separate and independent means*, each using a *different* radio communication service;
- receiving shore-to-ship distress Alerts; transmitting and receiving ship-to-ship distress alerts;
- transmitting and receiving search and rescue co-coordinating communications;
- transmitting and receiving on-scene communications;
- transmitting and receiving locating signals;
- receiving maritime safety information;
- transmitting and receiving general radio communications relating to the management and operation of the vessel;
- transmitting and receiving bridge-to-bridge communications

The radio communications equipment to be fitted to a GMDSS ship is determined by the ship's area of operation, rather than by its size and with limitations with regards to range and services provided. The new system divides the world's oceans into 4 areas:

- **Area A1** lies within range of shore-based VHF coast stations (20 to 30 nautical miles);
- **Area A2** lies within range of shore based MF coast stations (excluding A1 areas) (approximately 100 - 150 nautical miles);
- **Area A3** lies within the coverage area of Inmarsat communications satellites (excluding A1 and A2 areas - approximately latitude 70 degrees north to latitude 70 degrees south); and
- **Area A4** comprises the remaining sea areas outside areas A1, A2 and A3 (the Polar Regions).

4) GMDSS equipment: The GMDSS utilises both satellite and terrestrial (i.e.: conventional) radio systems.

Sea Area A1 requires short range radio services - VHF is used to provide voice and automated distress alerting via Digital Selective Calling (DSC).

Sea Area A2 requires medium range services - Medium Frequencies (MF - 2 MHz) are used for voice and DSC.

Sea Areas A3 and A4 require long range alerting - High Frequencies (HF - 3 to 30 MHz) are used for voice, DSC and Narrow Band Direct Printing (NBDP - radio telex).

Equipment requirements vary according to the area the ship is trading to or through. Accordingly, it is quite possible that a small 300 ton cargo vessel may carry the same amount of communications equipment as a 300,000 ton oil tanker, if they are both operating in the same area.

5) ALRS Vol V extracts

The Admiralty list of radio signals Vol V explains the GMDSS system in detail with special emphasis on its use at time of distress. Details of various equipment required to be carried for ships trading in different areas are also explained in this volume along with other relevant extracts from ITU regulations.

Please refer ALRS Vol V for details.

6) Digital selective calling (DSC)

DSC is, basically, a paging (alert) system that is used to automate distress alerts sent over terrestrial (i.e. non-satellite) VHF, MF and HF marine radio systems. An alert is followed by a message over RT or NBDP if time and circumstances allow.

The DSC system's digital processing techniques, combined with the relatively narrow receiver bandwidths used, provide a DSC signal with resistance to noise and fading over the radio path. This result in increased range compared with radiotelephone transmissions.

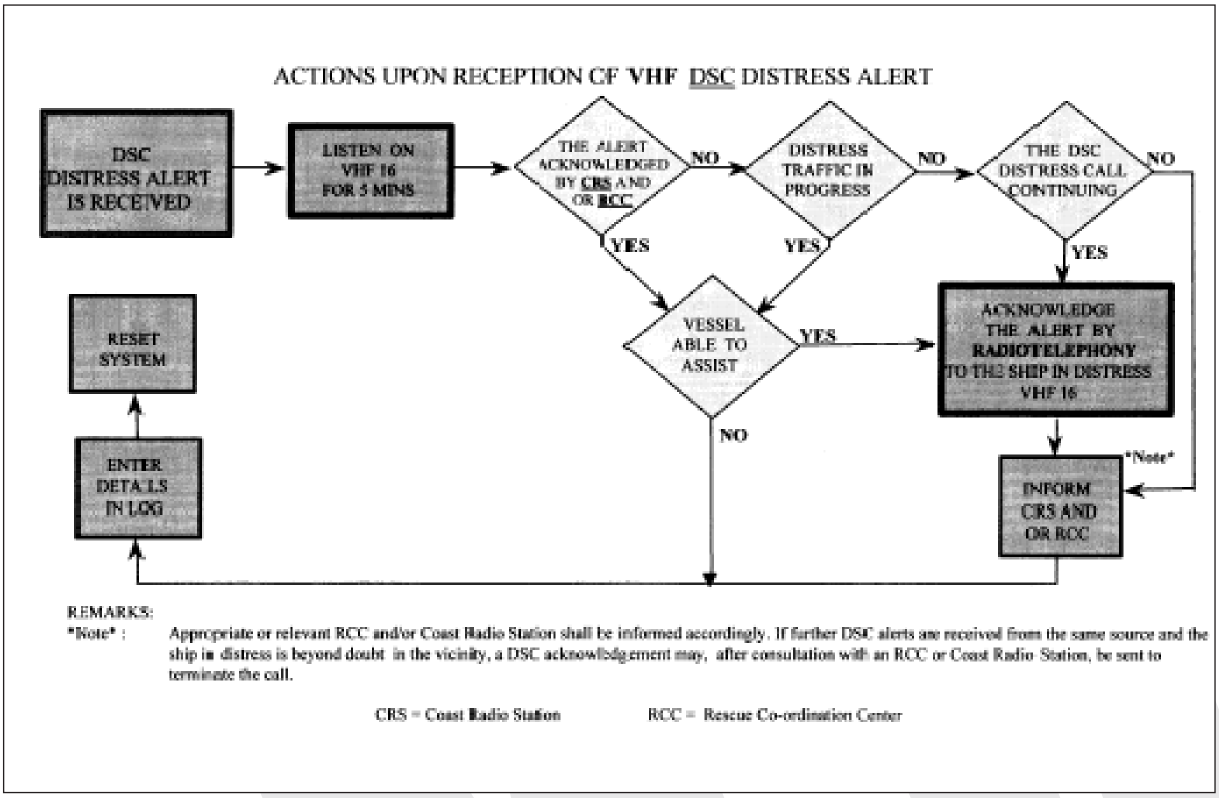
Unfortunately, DSC remains one of the GMDSS's least understood sub-systems. This lack of understanding is reflected in the very high DSC false alert rate.

DSC system allows following information to be transmitted, including:

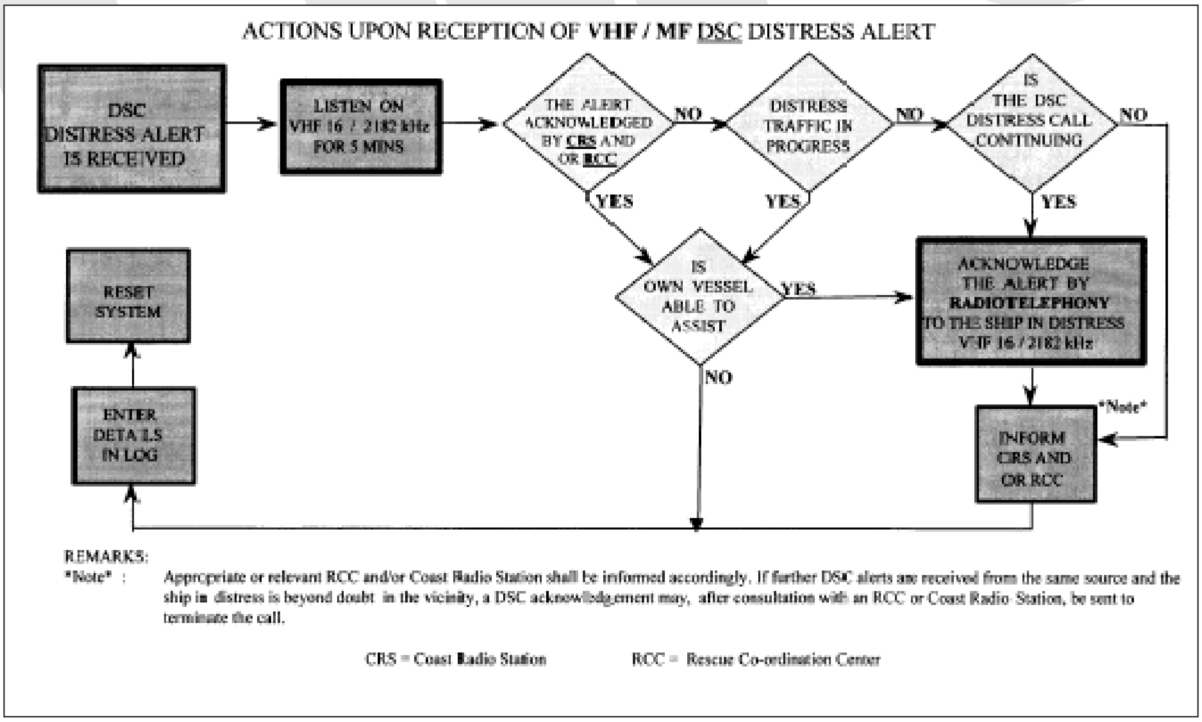
- the priority of the call - DISTRESS, URGENCY, SAFETY or ROUTINE;
- the address - i.e.: all ships or a single ship/station;
- the identification of the ship in distress;
- the position of the ship in distress; and
- the nature of the distress.

DSC Controller and Watch keeping Receiver

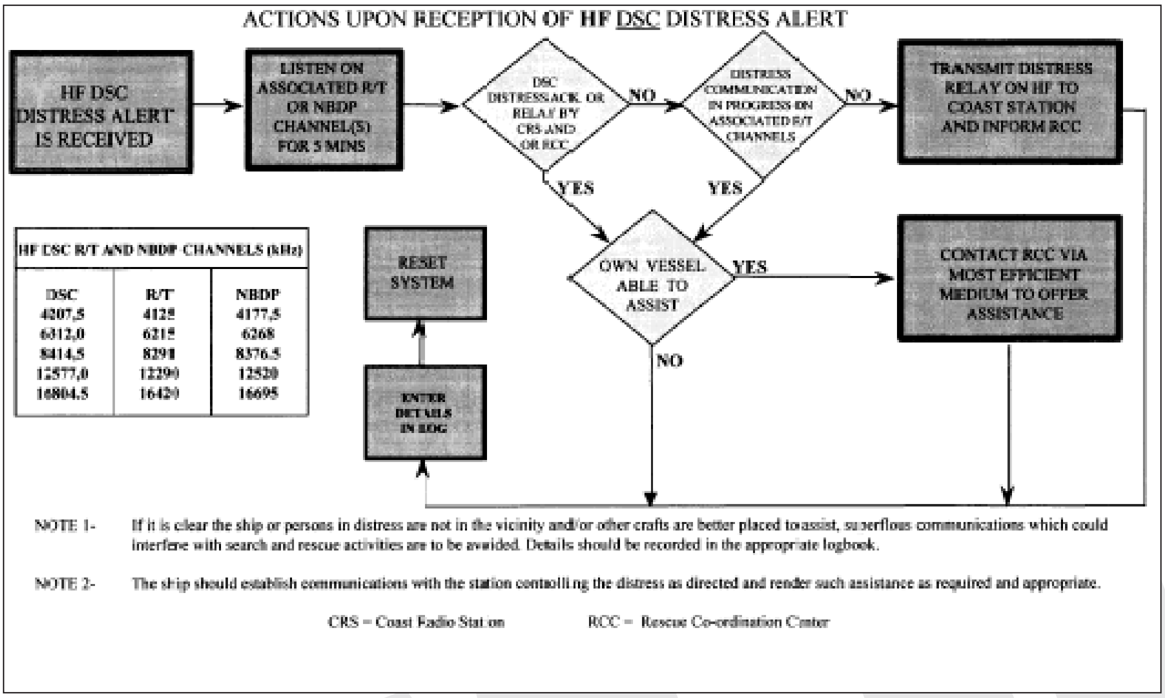
7) Action to be taken on receiving VHF distress alert by VHF



8) Action to be taken on receipt of DSC alert on MF



9) Action to be taken on receipt of DSC alert on HF



10) Transmitting distress alert by EPIRB


Emergency Position Indicating Radio Beacon

EPIRB (Emergency Position Indicating radio Beacon) is a one way system – it can send an alert automatically without any human intervention. It can also send an alert manually. Manual activation is by a switch, which, if operated keeps transmitting the alert till returned back to off or stand by position. In stand by position, if the EPIRB is floating in water, transmission of alert is done automatically. The EPIRB is installed with a Hydrostatic Release unit (HRU) which enables the EPIRB to be automatically released if it is carried down by a sinking ship.

11) Transmitting distress alert by VHF/MF/HF DSC

If time permits, an operator sending a VHF DSC distress message keys in:

- nature of distress (defaults to 'unspecified'); and
- the ship's last known position (latitude and longitude) and time (in UTC) the position was valid (normally inserted automatically from GPS).

If time is short, simply lift the cover, press and hold down the red DISTRESS button.

After the DSC message is sent, the operator then switches to channel 16 and sends a voice MAYDAY message.

Distress Message Format on - VHF Channel 16, 2182 kHz and HF

Calling
2182 kHz / Channel 16
- MAYDAY - 3 times
- This is
- Name/call sign of ship in distress - 3 times

Message
2182 kHz / Channel.16
- = MAYDAY
- = Name / call sign of ship in distress
- = Position at - - - UTC
- = Nature of distress
- = Kind of assistance required
- = Any other information which will facilitate rescue.

DSC distress messages received on VHF channel 70 are normally acknowledged by radiotelephony on channel 16. Acknowledgment of a DSC distress alert by the use of a DSC acknowledgment message is normally made by coast stations only. A ship receiving a distress alert on channel 70 should immediately listen on channel 16 for the voice MAYDAY message from the ship in distress.

DSC distress alert on MF and HF are sent on respective frequencies either manually by selecting “nature of distress” etc and mode of subsequent communication (RT or NBDP) or automatically by pressing the Red ‘distress’ button provided. If the message is sent directly without selecting nature of distress, the default is “undesignated”. After sending the alert – which can be sent on multiple HF DSC frequencies besides MF (2187.5), the sender must listen on corresponding RT frequency or change to the NBDP frequency (if this option was given for subsequent transmission.

DSC Guard Frequency	R/T Frequency	NBDP Frequency
156.525MHz	156.8MHz	N/A
2187.5 kHz	2182 kHz	2174.5 kHz
4207.5 kHz	4125 kHz	4177.5 kHz
6312.0 kHz	6215 kHz	6268 kHz
8414.5 kHz	8291 kHz	8376.5 kHz
12577.0 kHz	12290 kHz	12520 kHz
16804.5 kHz	16420 kHz	16695 kHz

12) Distress alert by Inmarsat

a. Distress alert/message by Inmarsat C


Inmarsat C unit

Distress alert by Inmarsat C is sent manually by pressing and holding the red ‘distress’ button for specified time when the sound tone changes indicating transmission of distress alert. The alert is transmitted to the RCC through selected shore station or ocean area NCS. A manually prepared distress message can also be sent with distress priority. Refer to equipment manual for equipment specific details. Thus you can send the distress alert by any of the following methods:

i. **Undesignated distress alert**: Press the two remote buttons on the front panel (for 5 seconds) giving quick access to MRCC/RCC sending out the minimum info "ID, POSITION AND TIME".

ii. **Designated distress alert:** Update the distress menu and send by pressing the two remote buttons on the front panel (for 5 seconds).

iii. **Distress priority:** Make the message in the editor, go to transmit menu and send the message by selecting distress priority.

b. Distress alert/message by Fleet 77 and Inmarsat B: Distress alert/ message by Inmarsat B can be sent by telex or voice.

Following is procedure for sending distress message by telex:

Inmarsat B: How to make a distress call using telex

A Distress Alert Generator may be fitted to an Inmarsat B MES and may be used to transmit a Distress Alert, alternatively, a distress message may be sent which is routed automatically through a Land Earth Station (LES)/Service Provider (Service Provider) to a land-based Rescue Co-ordination Centre (RCC).
The procedure for sending a distress message or alert is outlined below:
1. Press and hold down the Distress "Push-button" for at least 6 seconds
2. Wait for automatic connection to the RCC.
Then either:
A. Type your distress message using the following format
MAYDAY MAYDAY MAYDAY
THIS IS *[ship's name/call sign]* CALLING VIA INMARSAT-A FROM POSITION *[latitude and longitude, or relative to a named point of land]*.
MY INMARSAT MOBILE NUMBER IS *[IMN for this channel of your MES]* USING THE *[Ocean Region]* SATELLITE.
MY COURSE AND SPEED ARE *[course and speed]*.
You should then give:
The NATURE OF YOUR DISTRESS*, for example:*

Fire/explosion	Sinking
Flooding	Disabled and adrift
Collision	Abandoning Ship
Grounding	Attack by Pirates
Listing	

ANY ASSISTANCE REQUIRED
ANY OTHER INFORMATION *to help rescue units*
DO NOT CLEAR THE CALL UNTIL INSTRUCTED BY THE RCC TO DO SO
Then keep your MES clear of traffic so that the RCC can call you back when necessary.
or
B. Transmit the distress message stored in the Distress Message Generator (DMG) in your. (Refer to your MES manufacturers' manual for instructions).

Distress alert/message (voice) is sent through Inmarsat B and Fleet 77 by pressing the red 'distress' button provided. This automatically connects you to RCC and communication is by voice. All Inmarsat distress alerts and messages take absolute priority over all other type of messages. Refer to equipment manual for equipment specific details.

Apply Your Knowledge

1. State the procedures for responding to an MF (2187.5 kHz) DSC distress alert.
2. Discuss the procedure for sending a distress on the EPIRB on your ship.
3. Discuss the procedure for testing the MF/HF DSC on your ship.

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: A7.2.1, A7.2.2, A7.2.3

Topic: Use of English in written and oral form

Task Heading

- Use hand held transceivers (walkie talkies) and communicate in English.
- Communicate clearly in English during drills and exercises.
- Communicate clearly in English at arrival and departure stations

Objectives

- This module is an entirely practical module that is self-explanatory. Some notes are given for guidance purposes**.**

Index

1. Use of transceivers
2. Communication on walkie talkies
3. The IMO standard marine communication phrases (SMCP)
4. Ability to communicate clearly in English during drills and exercises.
5. Ability to communicate clearly in English during arrival/ departure stations

Description

1. Use of transceivers

Use of hand held portable transceivers, usually referred to as walkie talkie, as they can be carried along and used even while moving, hence portable, have become an integral part of on board communication. To be able to use the same, understanding all the functions thus becomes necessary to fulfil the criteria.

> Do read the equipment manual for hand held portable transceivers to understand all the functions.

2. Communication on walkie talkies

It must be understood that walkie talkie channels usually allow one-way communication. It is thus important that all communication is kept short and the channel kept clear for other concerned parties to communicate. If any order is not understood, there should be no hesitation in requesting repetition. All orders, once received must be repeated back and acknowledged. Some points with regards to walkie talkies to note are:

- They are mostly used on board for on board communications during any operation such as loading, discharging, mooring stations, drills and other operations.
- They are expensive pieces of equipment on board and should be handled carefully.
- Operation of a walkie-talkie is quite simple. It usually has a channel selector, a volume knob and a squelch knob.
- Only simplex communication is possible with a walkie-talkie. This means you have press the transmit switch to talk and release the switch after speaking to hear what the other person is saying. It is unlike telephones where both the parties can speak simultaneously.
- Walkie-talkies should always be carried in the leather cover provided and secured to the body by means of a belt.
- They should not be carelessly carried in boiler suit pockets and care should be taken that they are not dropped.
- They should be protected against weather especially rain.

- Walkie-talkies usually use nickel cadmium batteries and these should be allowed to completely discharge before recharging, as this prolongs the life of the batteries.

3. The IMO standard marine communication phrases (SMCP)

All navigational and safety communications on board ship must be precise, simple and unambiguous so as to avoid confusion and error. Since there has been an increased number of internationally trading vessels with crews speaking many different languages, the problems of communication may cause misunderstandings leading to not only dangers to the vessel, but also to the people on board and the environment.

There is a need to standardize the language used, hence the use of IMO Standard Marine Communication Phrases (SMCP), from now on referred to as SMCP is strongly recommended. A fundamental aspect of the IMO SMCP is that they represent an attempt to choose the simplest, clearest wording and the easiest to memorize from among the innumerable possible or existing combinations to express a given action, question, recommendation, or intention.

In short, the aim has been to make the phrases as simple as possible; they never include complex subordinated clauses, difficult morphological structures, or sophisticated vocabulary other than the terms proper to the maritime context.

4. Ability to communicate clearly in English during drills and exercises

Different languages and accents does create misunderstandings especially when sailing with multinational crew and at times of critical operations these misunderstandings have the potentiality to result in catastrophe, if interpreted wrongly and acted upon, hence the use of IMO SMCP is strongly recommended.

On board communication during drills and exercises should only be in English language and as guided by the IMO SMCP. Every cadet should familiarise themselves with the content in company's shipboard manuals as early as possible.

5. Ability to communicate clearly in English during arrival/ departure stations

Communication while on stations during arrival or departure ports should be precise, concise and quick, to avoid valuable waste of time during critical operations.

Responding to questions, using IMO SMCP in English language is strongly recommended. The communication should be closed loop as it ensures that a message that was sent is received and understood. This includes the sender sending the message, receiver receiving the message and interpreting it, acknowledging it and finally the sender following up to ensure that the intended message was received.

Communication on stations during arrival / departure ports at all times must be clear and well understood. If there is any doubt after the order has been passed from the conning station (bridge), it must be cleared instantly and further clarifications must be sought. No hesitation must be made while doing so, as it should be borne in mind that misunderstandings can create confusion, which can result in accidents. For the sake of clarity and ease of understanding the orders should be repeated loudly, to let the party imparting the orders, understand without any doubt that the precise orders to be executed has been clearly understood.

The aim of IMO SMCP is to get around the problem of language barriers at sea and avoid misunderstandings which can cause accidents; its use during these critical operations is strongly recommended. IMO does not make it compulsory to use only English on the bridge etc. - it allows use of other languages when persons directly involved in the communications speak a common language other than English. SMCP is also published in some other languages.

Apply Your Knowledge

Whenever safely feasible, monitor the conversation of officers using transceivers. Check the salient features of this conversation.

Function: Navigation

Competence: Transmit and receive information by visual signalling

Task number: A8.2

Sub-task Reference number: A8.2.1, A8.2.2, A8.2.3, A8.2.4

Topic: Signalling by Flags

Task Heading

- Identify International Code of Signals flags and principal national flags.
- Recognize the meaning of single letter flag hoists.
- Code and decode using the International Code of Signals.
- Demonstrate understanding of flag etiquette.

Objectives

- To learn the use of international code of signals.
- To understand different types of flag hoists used in the international code of signals.
- Code and decode messages using the international code of signals.
- Understand proper ways of hoisting flags on board, and their etiquette

Index

1. Uses of International Code of Signals
2. Methods of signalling
3. Single letter signals
4. Two letter signals
5. Three letter signals
6. Flag etiquette

Description

2. Uses of International Code of Signals

Communication plays a vital role on board the ship. This is much more evident on board merchant ships, sailing on different waters, seas, countries and continents, with at times having multinational crew on board. When there is a need to communicate specially between people who do not understand a common language – communication can only take place by means of signs and signals and not by language. This is where the "International Code of Signals" finds its use.

The code is intended for communications between ships, aircraft and authorities ashore during situations related essentially to the safety of navigation and persons; it is especially useful when language difficulties arise. The code is suitable for transmission by all means of communication, including radiotelephony and radiotelegraphy.

The purpose of the international code of signals is to provide ways and means of communication in situations related essentially to safety of navigation and persons, especially when language difficulties arise. In the preparation of the code, account was taken of the fact that wide application of radiotelephony and radiotelegraphy can provide simple and effective means of communication in plain language whenever language difficulties do not exist.

The signals used in the International Code of Signals (INTERCO as it is commonly known as) consist of:

- Single-letter signals allocated to signification's which are very urgent, important or of very common use.
- Two-letter signals for the general section.
- Three-letter signals beginning with "M" for the medical section.

Each signal should have a complete meaning and this principle is followed throughout the code. In some cases complements are used to express variations in the meaning of the basic signal.

Some examples of the basic signal and its complements are as follows:

IN	I require a diver.
IN 4	I require a diver to clear my anchor.

In the above examples the first signal is the basic signal and the same signal when supplemented with a number becomes its complement.

3. Methods of signalling

For the purpose of International Code of Signals any of the following methods of signaling may be used:

- Flag signaling, the flags used being those shown later in this module.
- Flashing light signalling using Morse code (Can use aldis lamp or signalling lamp on board).
- Sound signalling, using Morse code (whistle or other sound signalling apparatus).
- Voice over loud hailer
- Radiotelegraphy
- Radiotelephony
- Morse signalling by hand-flags or arms

We will now describe each of the signals in the International Code of Signals briefly:

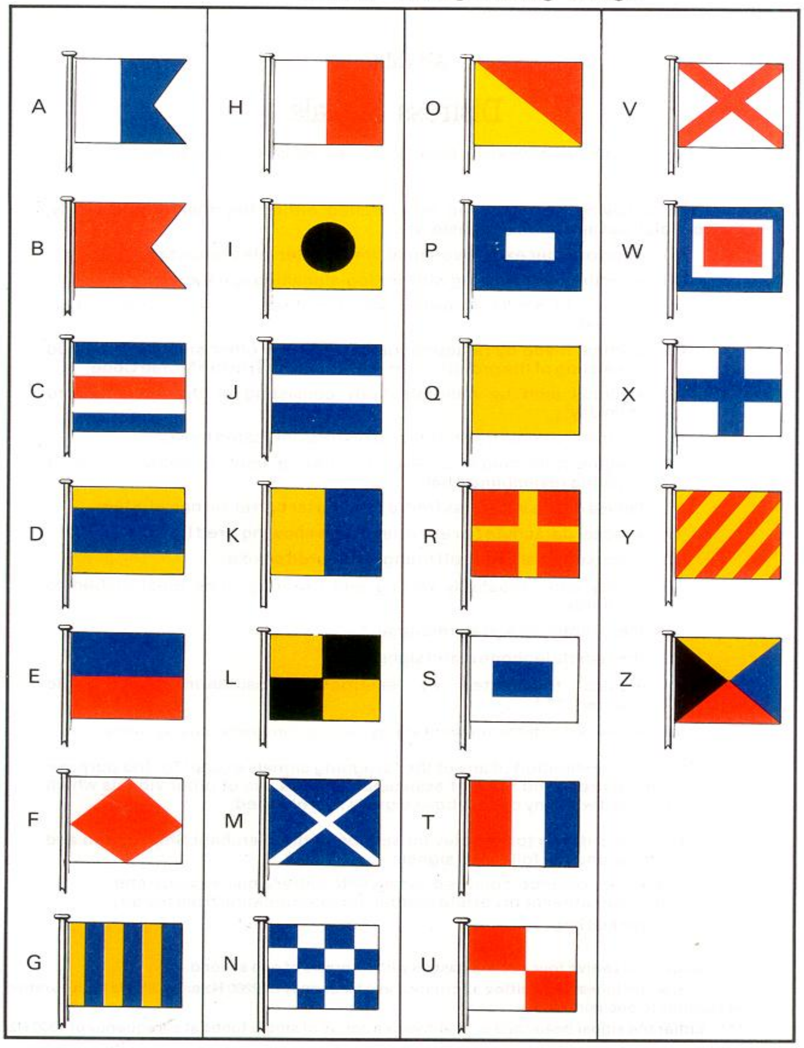
4. Single letter signals

Chapter XI of International Code of Signals contains single letter signals; this is the most used signals on board the ship.

Chapter XII contains single letter signals with complements, and Chapter XII contains single letter signals between ice-breaker and assisted vessels.

The table of signalling flags and their meaning of single-letter signals are given below:

Table of Signalling Flags



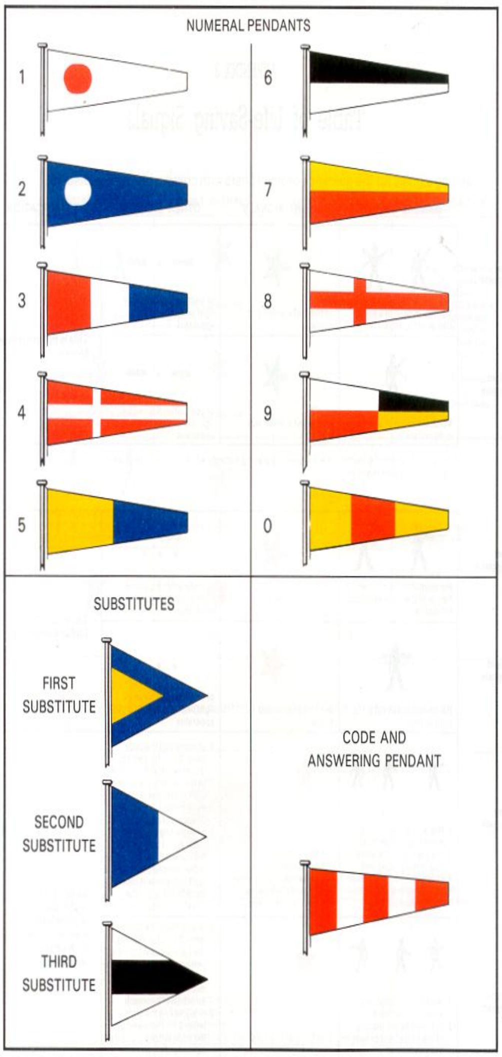


Table of Single Letter Signals (meaning)

A	I have a diver down; keep well clear at slow speed.
***B**	I am taking in, or discharging, or carrying dangerous goods.
***C**	Yes (affirmative or "The significance of the previous group should be read in the affirmative").
***D**	Keep clear of me; I am manoeuvring with difficulty.
***E**	I am altering my course to starboard.
F	I am disabled; communicate with me.
***G**	I require a pilot. When made by fishing vessels operating in close proximity on the fishing grounds it means: "I am hauling nets".
***H**	I have a pilot on board.
***I**	I am altering my course to port.
J	Keep well clear of me. I am on fire and have dangerous cargo on board, or I am leaking dangerous cargo.
K	I wish to communicate with you.
L	You should stop your vessel instantly.
M	My vessel is stopped and making no way through the water.
N	No (negative or "The significance of the previous group should be read in the negative"). This signal may be given only visually or by sound. For voice or radio transmission the signal should be "NO".
O	Man overboard.

P	In harbour. All persons should report on board as the vessel is about to proceed to sea. At sea. It may also be used as a sound signal to mean: “I require a pilot”. At sea. It may be used by fishing vessels to mean:”My nets have come fast upon an obstruction”.
Q	My vessel is “healthy” and I request free pratique.
***S**	I am operating astern propulsion.
***T**	Keep clear of me: I am engaged in pair trawling.
U	You are running into danger.
V	I require assistance.
W	I require medical assistance.
X	Stop carrying out your intentions and watch for my signals.
Y	I am dragging my anchor.
***Z**	I require a tug. When made by fishing vessels operating in close proximity on the fishing grounds it means: “I am shooting nets”.

Notes:

a. Signals of letters marked * when made by sound may only be made in compliance with the requirements of the International Regulations for Preventing Collisions at Sea, Rules 34 and 35 accepting that sound signals “G” and “Z” may continue to be used by fishing vessels fishing in close proximity to other fishing vessels.

b. Signals “K” and “S” have special meanings as landing signals for small boats with crews or persons in distress. (International Convention for the Safety of Life at Sea, 1974, chapter V, regulation 16).

Sometimes the Single-letter Signals are used with Complements. Some examples are as follows:

A	with three numerals	to indicate	AZIMUTH or BEARING
L	with four numerals	to indicate	LATITUDE (the first two Denote degrees and the rest minutes)

Refer to Chapter XII of the code for other single-letter with complements.

Also there are three substitutes provided namely, first substitute, second substitute and third substitute along with a code and answering pendant.

The use of substitutes is to enable the same signal flag – either alphabetical flag or numeral pendant – to be repeated one or more times in the same group, in case only one set of flags are carried on board.

- The first substitute always repeats the uppermost signal flag of that class of flags which immediately
  precedes the substitute.
- The second substitute always repeats the second and
- The third substitute repeats the third signal flag, always counting from the top of that class of flags which immediately precedes them.

No substitutes can ever be used more than once in the same group.

The answering pendant can be used as a decimal point but is to be disregarded when determining which substitute to be used.

Single letter Signals can also be given by Morse code either by light or by sound signalling appliances. Special signals are used for various situations like for example some of the signals used between an ice breaker and assisted ship is as follows:

Code letters or Figures	Ice-breaker	Assisted vessel(s)
G — — •	I am going ahead; follow me	I am going ahead; I am following you
N — •	Stop your Engines	I am stopping my engines.

The above examples shows what the Ice-breaker will signal and how the meaning will differ when the same signal is made by the assisted vessel.

5. Two letter signals

Two letter signal letters are used for general signalling. This general section contains signals to be used for distress, emergencies, casualty, damages, aids to navigation, maneuvers, miscellaneous communications for cargo, crew, fishery, pilot, port-harbour etc., meteorology, weather, routeing of ships, communications and international sanitary regulations.

At the end of the general section – there are three tables of complements; these should be used only as and when specified in the text of the signals.

Though there is no need for the candidates to know these signals thoroughly – it would definitely assist if the candidates could go through the International Code of Signals – general section and get an idea as to what it contains and where the information could be found.

6. Three letter signals

Three letter signals are solely used for medical section when communicating for the purpose of medical requirement. These signals always begin with the letter "M".

As far as possible medical advice should be sought and given in plain language but as stated earlier, if language difficulties are encountered the code should be used.

This section contains codes for use when

a. Requesting for Medical Assistance.
b. Giving Medical advice.

At the end of this section you will find 4 nos. Table of complements which are:

TABLE M 1	Regions of the body
TABLE M 2.1	List of common diseases
TABLE M 2.2	List of common diseases in Latin
TABLE M 3	List of medicaments

Some examples from the Medical Section are:

MEW	Patient has a swelling ….. (Table M 1)
MEW 80	Patient has a swelling in the throat
MTD	You should give ……. (Table M 3)
MTD 15	You should give Tetracycline capsule (250 mg)

7. Flag etiquette

The need to hoist flags on board ships:

- To identify the country in which the vessel is registered.
  As a mark of respect and courtesy to the country the vessel is in.
- A house flag to identify the company the vessel belongs to.
- Single letter hoist, double letter hoist as required by International and local regulation to signify something.

Positioning of the flag

- The ensign of the country to which the vessel is registered is usually flown on the ensign staff at the stern of the vessel. This is usual when the vessel is in port or at anchor. When the vessel is making way specially in rivers or lakes with pilot on board, the ensign may be hoisted at the aft halyard of the main mast. (Please note that the main mast is usually above the navigation bridge and has a yard arm extending to port and starboard. It also has a halyard rigged at the stern of the mast where the ensign flag may be hoisted.)
- The courtesy flag will be national flag of the country the vessel is in. This is mostly hoisted at the extreme starboard halyard of the vessel on the main mast.

  Note: **-** In some countries, courtesy flag is to be flown on the foremast and exhibited throughout port stay example Saudi Arabia, this has to be strictly adhered to, as there have been incidences where the ships have been fined for non-compliance of this.

  Local regulations have to be checked, mostly through ship's agents, seeking specific clarifications regarding any special requirements, that has to be adhered, in respect to flag etiquettes,
- The house flag (flag of the company) is normally hoisted on the jack staff on the bow. If it is not possible to hoist the same, the house flag can be hoisted on the extreme port halyard of the vessel on the main mast.
- Other flags like the signal flags etc. may be hoisted in any other halyards except those mentioned above.

Dipping of Ensign

The dipping of the ensign is a salute and is carried out as follows:-

Slowly lower the ensign from the 'close up' to the 'dip' keeping the halyards taut and when the salute has been acknowledged slowly hoist to the 'close up'.

For the purpose of the above we will define below what is 'close up' and 'dip'.

'Close up' – A flag or a signal is said to be 'close up' when hoisted to the full extent of the halyard.
'At the dip' – This is the position of a signal when hoisted about half the extent of the halyard.

The Ensign is dipped as a mark of respect when passing any naval ships.

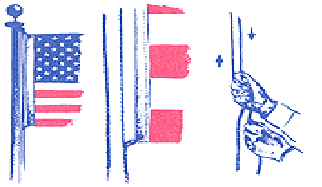
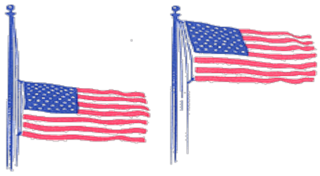
Procedure for hoisting a flag 'half mast' and lowering a flag flying 'half mast'

Flying any flag at half-mast is a symbol of mourning and grief.

According to W. G. Perrin's *British Flags,* the custom of flying a flag at half-mast as a sign of mourning was already established by at least 1612, when it is recorded that the British ship *Heart's Ease* lowered her ensign to "hang over the poop" after her captain was killed while exploring for the Northwest Passage in what is now Canada. The practice was embodied in Royal Navy regulations by the last half of the 17th century. It seems most probable that half-masting comes from an even older practice of giving a ship a slovenly appearance as a sign of bereavement.

On a simple pole, half-mast has traditionally been considered to be one-quarter of the pole length below the top, although generally is considered now as halfway. On the pole with crosstrees, a flag at half-mast has its lower edge level with the crosstrees.

An ensign displayed on a pole half-mast means halfway from the ground to the peak.

	The flag should be raised briskly and lowered slowly and ceremoniously. Ordinarily it should be displayed only between sunrise and sunset. It should be illuminated if displayed at night.
	To position the flag at half-staff, first hoist the flag to the peak of the staff for an instant and then, lower it to the half-staff position -- roughly halfway between the top and bottom of the staff. Before lowering it for the day, raise the flag again to the peak of the pole.

Dressing ship

On ceremonial occasions like national holidays the ship is required to be dressed. Though this practice is rarely seen these days a general idea of how it is done may be of some information to the candidate.

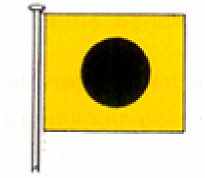
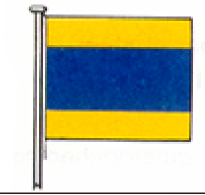
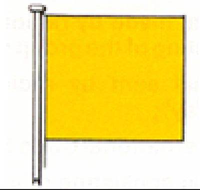
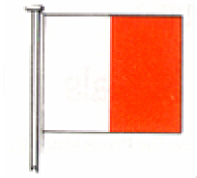
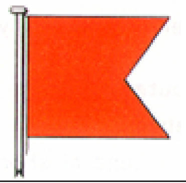
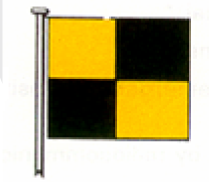
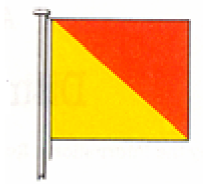
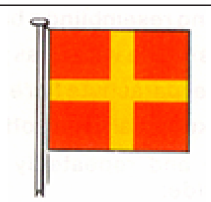
The ensign and the courtesy flags remain in the same place. The International Code Signal Flags are used. The order of the flags and the way the vessel is dressed is left entirely to the master and the responsible officer.

This type of dressing may be seen these days on passenger ships.

Apply Your Knowledge

1) Code the following message from the ship using the International Code of Signals.
Request for Medical Assistance
I have a male aged (27) years. Patient has been ill for (6) hours. Patient has had no serious illness. Pulse rate per minute is (90). Pulse is weak. Patient is sweating. Patient is in pain in Lumber (Kidney) region. The part affected is left Lumber (Kidney) region. Pain is increased by hand pressure. Bowels are regular.

2) Identify the flag; write the single letter signal associated with it in ‘letter’ and in ‘morse symbol’, and write the meaning of that code.

Flag Image	Single Letter Code	Morse code	Meaning
			
			
			
			
			
			
			
			
			

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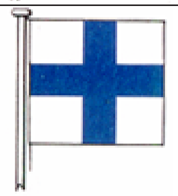			
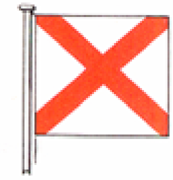			
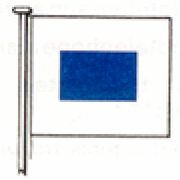			
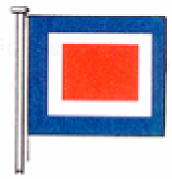			
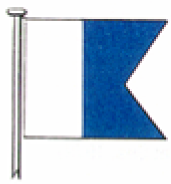			
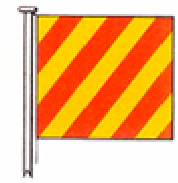			
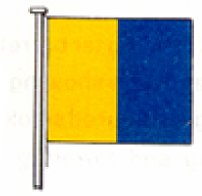			
			

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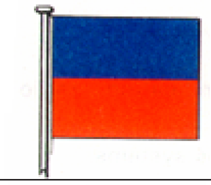			
			
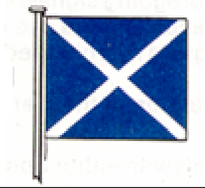			
			
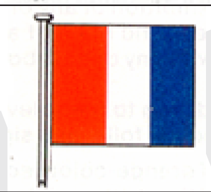			
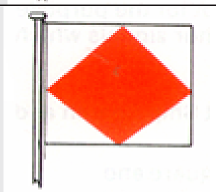			
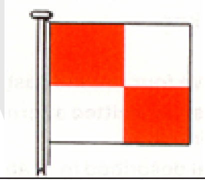			
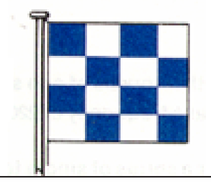			
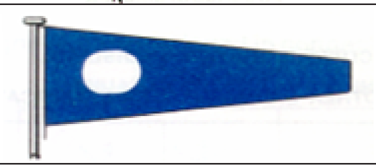			

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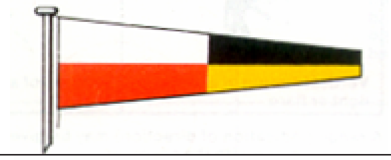			
			
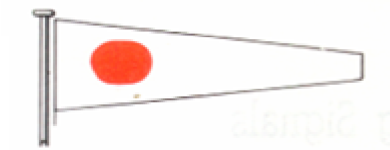			
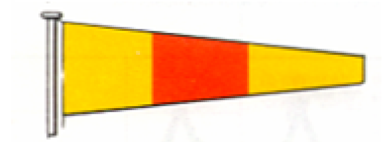			
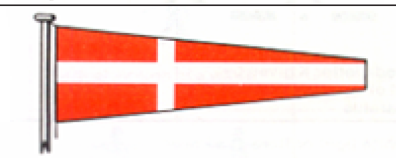			
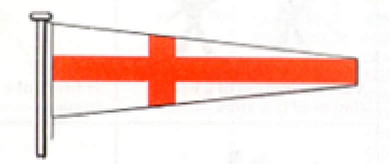			
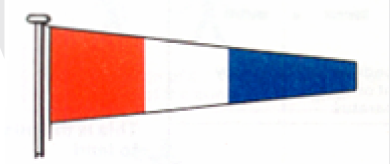			
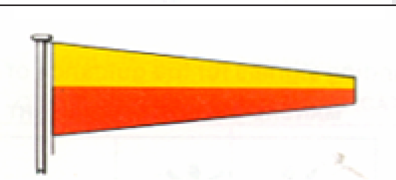			
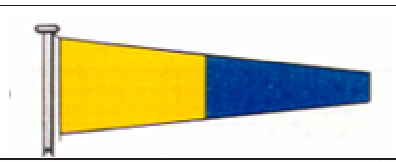			
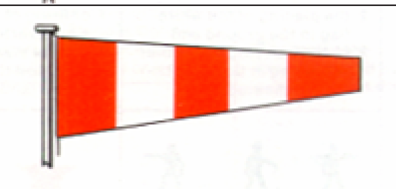			

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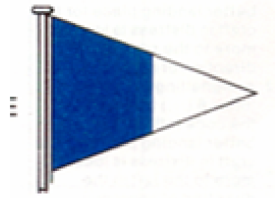
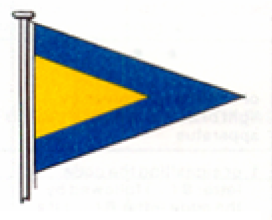
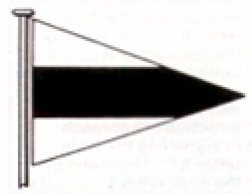
			
			
			

Function: Navigation

Competence: Maneuver the ship

Task Reference No: A9.1

Sub task Reference Nos.: A9.1.1, A9.1.2, A9.1.3, A9.1.4

Topic: Maneuvering information

Task Heading

- Locate the maneuvering information on board.
- Obtain the stopping distances and turning circle parameters from the manoeuvring information.
- Determine vessel's advance from her original course to when she has altered course by 90° from the manoeuvring information, when the wheel is put hard over at full ahead in a loaded condition, and state the turning diameter.
- Demonstrate understanding of the recommended procedure for emergency stop and slow down of engines.

Objectives

- Familiarize with the ship's maneuvering characteristics and understand the meaning of pivot point, turning circles, stopping distance and other ship handling terms.

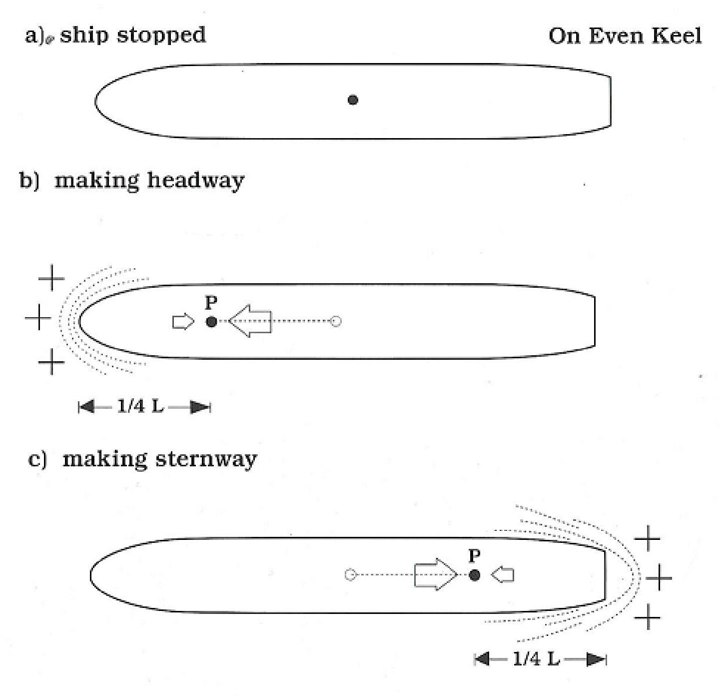
Index

1) Introduction, maneuvering characteristics, pivot point
2) Turning circles
3) Stopping distance
4) Effect of shallow waters on ship's maneuvering characteristics
5) Procedures for emergency slowdown/ shutdown

Description

1) Introduction, maneuvering characteristics, pivot point

Before we start to learn about a ship's maneuvering characteristics, it is very important to understand the concept of "**Pivot Point**". Pivot point is a point on the centerline about which the ship turns when the rudder is put over. The pivot point of the vessel describes the ship's turning circle. When a ship is in completely stopped condition, the pivot point is located at its centre of gravity. An increase in speed will shift the pivot point in the direction of the ship's movement until the momentum of the ship balances with the longitudinal resistance created by water. A ship's pivot point is nearly located at about one-fourth of the ship's length from her bow when moving ahead at a constant speed, and at or near her stern when moving astern. The location of the pivot point varies with ship's speed.

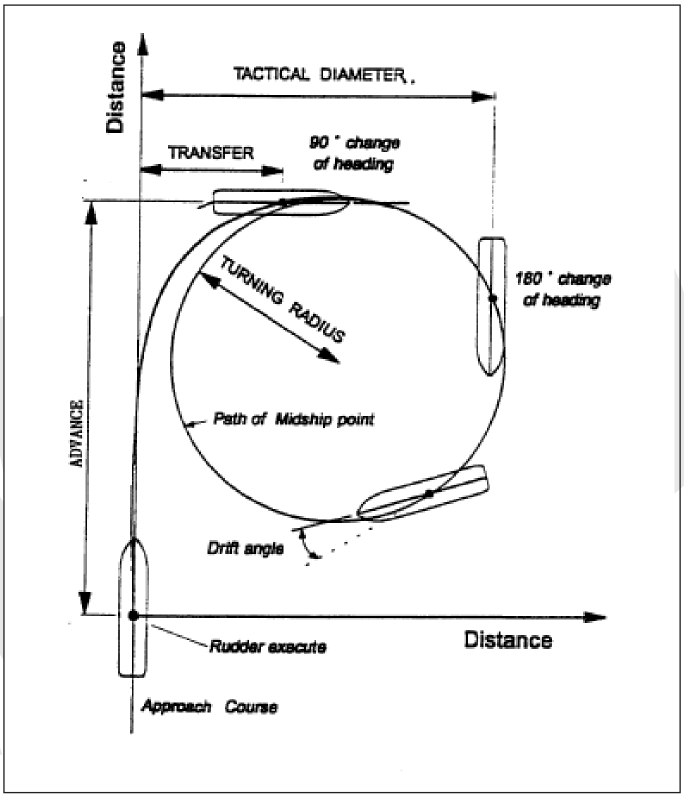


The Shiphandler's guide by The Nautical Institute, Edn 2007

Knowledge of the maneuvering characteristics of one's ship (advance, transfer, tactical diameter, stopping distance, etc.) is very much essential for a navigating officer on watch, not only for safe ship handling but even for anti collision and emergency maneuvers, whether in restricted waters or in open seas. Maneuvering information is provided on board each vessel and posted in the wheel house. Generally, the values given are the actual values obtained during the sea trials of the vessel, in light airs and calm sea conditions. The turning circles & stopping distance values are generally provided at two different speeds and in loaded and in ballast conditions.

2) Turning circles

When a vessel alters her course under helm through 360 degree she moves nearly on a circular path. A ship's turning circle is the path followed by the ship's pivot point when making a 360 degree turn. Throughout the turn her bow will be slightly inside the circle and her stern a little outside it.



The circle does not link up with the original course due to some **side-slip** when helm is first used. During the turn the vessel suffers some deceleration. For a full form loaded VLCC, after turning through 90 degrees, the **loss in speed** is about 50%, and after a further 90 degrees the speed settles at about one-third of the original speed. Thereafter the speed remains roughly constant.

With a right – handed propeller the circle to port will be slightly smaller in radius than the circle to starboard, due to the effect of transverse thrust. The diameter of the turning circle varies with rudder angle and speed. With constant rudder angle, an increase in speed results in an increased turning circle. Very low speed (that approaching bare steerageway) also increases the turning circle because of reduced rudder effect.

Advance
Of a ship for a given alteration of course is the distance that the vessel moves in the direction of her original course, measured from the point where the rudder is put over.

Transfer
The transfer is the distance traveled by the pivot point, measured from the original track to the point where the vessel has altered her course by 90 degrees.

Tactical diameter
Tactical diameter is the distance gained to left or right of the original course after a turn of 180° is completed. Basically, tactical diameter is the transfer for 180 degrees.

Final diameter
Final diameter is the distance perpendicular to the original course measured from the 180° point through 360°. If the ship continued to turn at the same speed and rudder indefinitely, it would turn on this circle. The final diameter is almost always less than the tactical diameter.

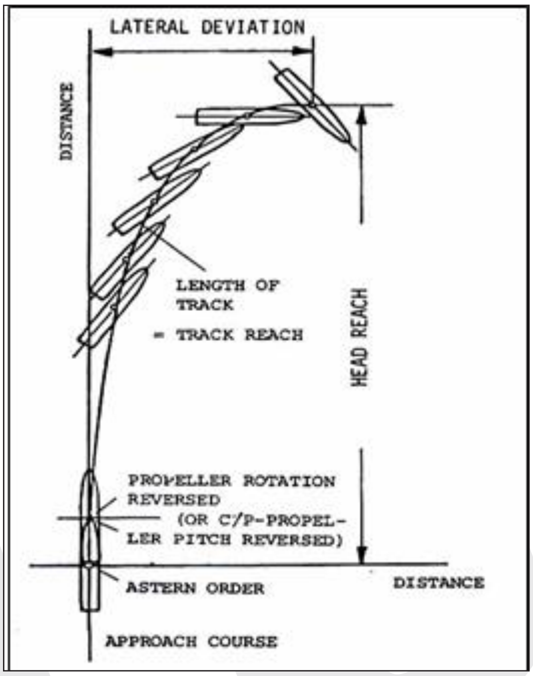
Drift angle
The drift angle during a turn is the angle between the ship's fore-and-aft line and the tangent to the turning circle. During a turning circle every point of ship's hull has its own drift angle. **Drift angle at the pivot point is Zero**. Maximum drift angle is at the after end of the ship's hull.

3) Stopping distance

The following methods are used to bring the ship to a stop in case of an emergency:

a) Inertia stop
b) Crash stop
c) Rudder cycling

Inertia stop
Inertia stop is when the **fuel is cut off** to the engine and the vessel gradually comes to rest as the momentum is lost steadily due to the friction of the hull with the water. It is usually activated by depressing the **"Emergency Stop"** button on the wheelhouse console.



Crash stop
This is the quickest way to bring the vessel to a dead stop in the water. It is activated by putting the engines **directly to full astern (not by putting the engines to stop and then to full astern)**. The data for crash stop, namely the 'head-reach', 'lateral deviation' and 'change of heading' is also obtained during the 'sea-trials' at the time of the launch of the vessel.

Rudder cycling
A crash stop maneuver puts excessive loads and thermal imbalances on the engine. There is a much likelihood of some damage caused to the engine. Hence a crash-stop is only given in an emergency in order to save the vessel from grounding or collision. But other than crash stop, following methods are widely advocated which can produce an equally effective result without unduly straining the engine.

- High frequency rudder cycling
- Low frequency rudder cycling

4) Effect of shallow waters on ship's maneuvering characteristics

Ships become reluctant to turn and do so at a much reduced drift angle when operating in **shallow waters**. The turning circle becomes **larger** as the under keel clearance reduces. Full form tankers tend to be more reluctant to respond to a given rudder angle than fine lined ships. A **crash stop** executed in shallow water condition will result in a **larger stopping distance** and an increased lateral deviation.

A ship manoeuvring through a large turn in shallow waters may also experience an increase in draft due to list. Due to UKC decreasing on one side, there will be any increase flow of water resulting in further sinkage at the low end.

5) Procedures for emergency slowdown/ shutdown

It is **extremely important** for the navigation watch keeping officer to know how to use controls of main engines in routine and all the emergency functions provided on the bridge maneuvering console for use in case of an emergency. Most of the basic controls and functions provided on the bridge maneuvering consoles are standard on all ships. However, you need to familiarize with the ship specific procedures for the operation of these controls. Generally, a procedure for the use of bridge control maneuvering console is posted next to the main engines control on bridge. Following is an extract from a typical procedure to operate these controls:

PROGRAMME BY- PASS

In an emergency, if an immediate NAVIGATION FULL SPEED is required, the **PROGRAME BY PASS** switch is to be put to **CANCEL**. In this case the load program light will go off and RPM will jump to the set value. Similarly, in case the RPM is to be dropped immediately from NAVIGATION FULL SPEED to say, SLOW AHEAD, the PROGRAMME BY PASS switch needs to be put to CANCEL. In this case also, the load down program light will go off and RPM will jump to the desired set value, SLOW AHEAD RPM.

EMERGENCY OVERRIDE

This can be used to override the following in case of an emergency (E.g.: To avoid collision, grounding etc.)

1) M / E slowdown.
2) M / E shut down due to jacket cooling water low pressure and piston cooling water low pressure. The emergency override can be reset by using the override reset button.

> As an OOW, you must know the advance and transfer of your vessel. Remember, for a vessel of, say 200m, the advance will be less than 200x4.5= 900m, which is even less than 5 cables!
> Ideally you must not, but even if you land up in a situation due to some unavoidable circumstances, where the target is just 1 mile ahead of you and coming down, giving immediate hard over can still avoid a contact (Crash stop may not help in avoiding contact in such a situation).
> And keep in mind how much of sea room is required? May be little more than your Tactical Diameter, which is less than 5 ship lengths = 200x5= 1000m, less than 6 cables!
> Remember, this maneuver is with wheel “HARD OVER” and not at 10 or 20 degrees. There is no cargo ship which is not designed to give hard over wheel at full sea speed.
> As a Duty Officer, you must NEVER hesitate to use WHEEL HARD OVER or MAIN ENGINES even before the Master comes up.

EMERGENCY STOP

In an emergency, by pressing this button, main engine can be tripped immediately as it cuts off the fuel oil supply to main engine. But after activating this trip, engine cannot be restarted from bridge. The reset for this trip is in the ECR and can be done only after taking control to ECR.

Apply Your Knowledge

1. Record the advance and transfer of your vessel in ballast and loaded conditions and analyse the differences. State the turning diameter in both cases.
2. Discuss the procedure in case you have to reduce the vessel’s speed immediately from Navigation Full Ahead Sea Speed to Slow Ahead due to Close quarter situation.
3. Discuss the effect of deadweight, draft, trim, speed and UKC on turning circles and stopping distances.

Function: Navigation

Competence: Manoeuvre the ship

Task number: A9.2

Sub-task Reference number: A9.2.1, A9.2.2, A9.2.3, A9.2.4, A9.2.5

Topic: Anchoring and Mooring procedures

Task Heading

- Assist in preparation for mooring stations.
- Accompany an officer on deck for mooring and unmooring operations including securing and letting go tugs.
- Throw heaving line ashore.
- Demonstrate understanding of various types of mooring ropes.
- Demonstrate understanding of the markings on anchor cables.

Objectives

- To understand the importance of moorings and principles of mooring layout and preparation required for mooring stations.
- Understand the procedure and importance of safe operations including line handling, mooring – unmooring operations, working with tugs, ensuring safe working environment at all given times.
- Understand the proper procedure of handling heaving line.
- Understand various types of mooring ropes, knowing their advantages and disadvantages.
- Understand the markings on anchor cables.

Index

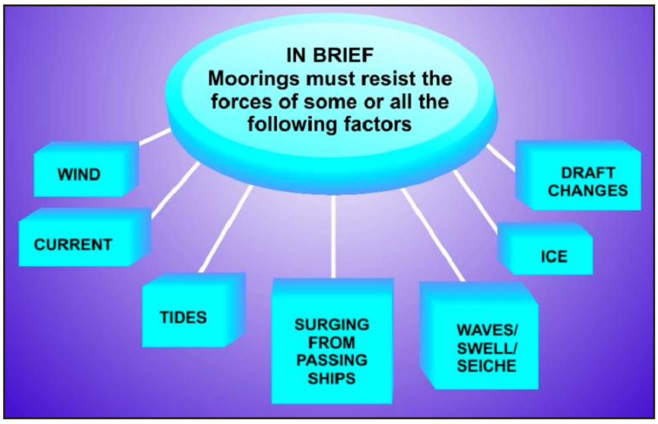
1. Importance and principles of moorings
2. General layout of the moorings and principles of mooring arrangements
3. Points to be remembered when assisting an officer during mooring operations
4. Guidelines for efficient mooring operations
5. Safety of personnel during mooring and anchoring operations
6. Snap back zones
7. Working with tugs
8. Heaving line
9. Types of mooring ropes
10. Anchor cable and markings

Description

1) Importance and principles of moorings

Need for moorings:

- To maintain ship's position against forces of wind, current, swell and suction from passing ships.
- To assist ships to come alongside and leave the berth, or In case of ship to ship transfer (STS) operations, to facilitate daughter vessel to come alongside, work cargo and cast off from the mother vessel.
- To prevent the ship from drifting away from the designated berth



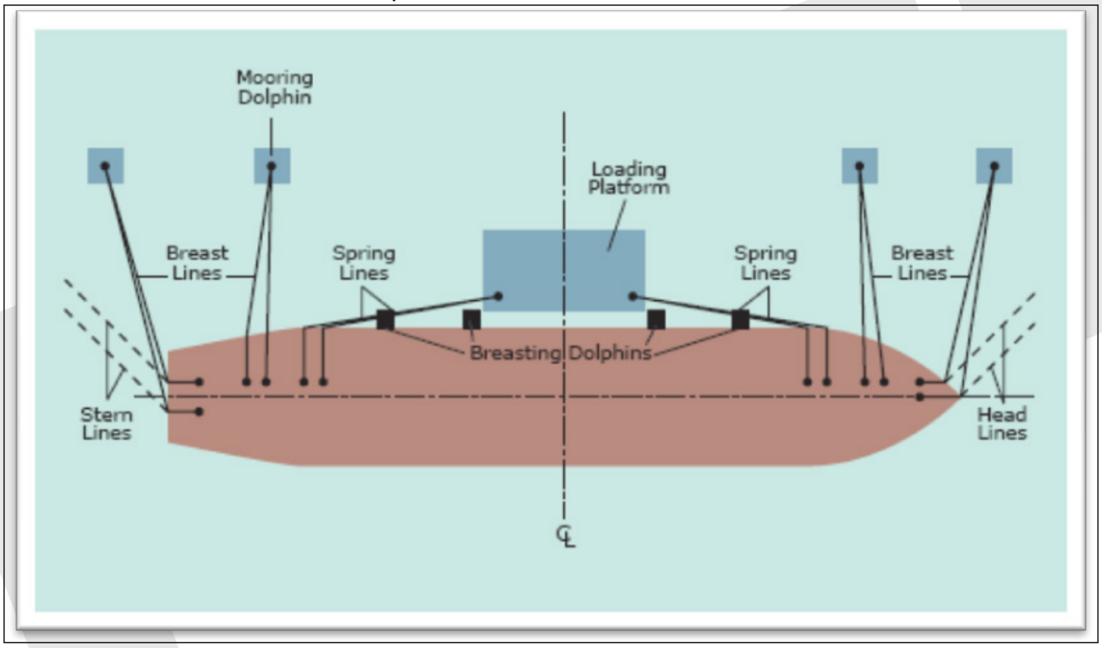
and to maintain its position alongside.

- To assist ship to shift with or without the use of engines during discharging and loading operations as required for cargo / shore interests.
- To hold the ship as accurately as possible to the loading/discharging terminals in relation with any fixed cargo-handling systems. This is very important on tankers and Ro-Ro and even on some bulk carriers which have to load from a fixed conveyor system which cannot be moved.

Due to changes in ships freeboard during loading/discharging of cargo, rise/fall in tides, change in ballast, varying wind and swell conditions etc. – moorings needs to be constantly attended to when the ship is alongside a berth. Moorings must resist the forces of some or all the factors mentioned in the diagram below:

2) General layout of the moorings and principles of mooring arrangements

Headlines: There may be two, three or even four such ropes or wires given from the bow of the vessel. These ropes or wires generally lead about 45º from the ship's bow in the forward direction. These ropes contribute to arrest the ship's movement in the fore and aft direction and to a certain extent in the athwart ship direction.



Breast ropes: May be one or two rope or wire leading as close to 90º to the ships fore and aft line. These are laid out both in the fore and after part of the ship and known as forward and aft breast ropes respectively. These ropes along with the head ropes contribute to arrest the ship's motion in the athwart ship direction when lying alongside a berth. It assists in bringing and keeping the vessel alongside, flush against the dock wall fenders. These ropes preferably should be of non-elastic material.

Spring lines: Similar to the breast ropes these ropes are also laid out both forward and aft. These lines provide the largest proportion of fore and aft restraint. The forward back springs lead aft as close to the fore and aft line of the ship as possible and the after back springs lead forward. Very often back springs are wire ropes with synthetic rope tails.

Stern lines: Are similar to the headlines – only that they lead about 45º on the quarter from the stern. These lines lead astern. Two, Three or four such ropes / wires are used as stern lines. These ropes along with the headlines arrest the fore and aft movement of the ship. They also contribute to a small extent in arresting the athwart ship movement.

3) Points to be remembered when assisting an officer during mooring operations as regards to mooring area

- ❖ Ensure that the mooring area is clear of all obstructions, free of oil, ice, grease and preferably painted with non-slip paint.
- ❖ Mooring area to be well illuminated and at least two powerful flash light should be available at night.
- ❖ In case of steam run mooring winches like on tankers – all steam pipes should be lagged to avoid accidental contact. Before using these steam winches the system should be properly drained of all condensed water. Drain cocks are to be kept open and when only steam is seen coming out of them, they should be then shut.
- ❖ Hydraulic joints checked for leaks.
- ❖ All winches should be functioning smoothly, brakes should be holding, clutching/ declutching of rope drum should be effortless. The winches should be tested before every use – well in time so that in case of a problem they could be rectified.
- ❖ NOTE: On tankers it is a requirement to carry out onboard brake holding tests annually and record the results. If a brake is found to be slipping under a calculated load, then that brake lining should be renewed.
- ❖ Winch controls should have an auto spring back to stop position when released.
- ❖ Warping drums on the winches should be smooth, free of rust, paint and oil. Prior berthing all grease points should be lubricated and open gears coated "open gear" (OG) grease.
- ❖ All operations to be carried out only under the direct orders of the supervising officer or person authorised by the master. Only one person should be signalling. Numerous accidents have occurred when the person operating the winch has been taking directions from two or more persons.

> Fair leads and rollers should be well lubricated and should be moving freely.

- ❖ Continuous and proper communication between the bridge and the mooring station. When using Walkie-talkies for communication as in modern days – ensure that the working channel is clear and there is no interference from other vessels. In case another vessel is using the same frequency – it is always better to use ships name while communicating for e.g.: "CANMAR COURAGE BRIDGE" TO "CANMAR COURAGE FORWARD" OR "CANMAR COURAGE AFT". Always use IMO Shipboard Maritime Communication Phrases.
- ❖ Ensure that the telephones/ talk back system are tested and working much prior to arrival or departure stations. Confirm working with bridge and keep it stand by at all times.
- ❖ Ensure adequate lighting arrangements have been made in case the operation is going to be in hours of darkness.
- ❖ Ensure that any extra fenders required for the operation is kept ready for use.
- ❖ *Ensure PPE required for the operation is worn by every crew member attending the operations. When struck on the head by a parting mooring line, the wearing of a hard hat will be the life or death deciding factor. A hard hat should be worn at all times when involved in mooring operations, as well as appropriate safety footwear and boiler suit (or other protective full-length clothing). It has been the general opinion on some vessels that the wearing of gloves when handling mooring ropes is an unsafe practice. This is due to concern that loose gloves may become trapped under a line on a windlass drum and hauls the crewmember over it. Gloves should be worn but crew need to be aware of the dangers associated with ill-fitting gloves when handling ropes.*
- ❖ Ensure that the walkie-talkie is fully charged and as a good practice carry a fully charged spare battery to the mooring station (especially in sub-zero temperatures). It can be disastrous if the walkie talkie set battery blacks out at a crucial moment during the operation.

> Test communications- Walkie- Talkies and Talk – back system well in advance.

- ❖ When orders are received from the bridge – repeat the same (this is good seamanship) – to convey that the orders are fully understood. In case the orders are not understood – request bridge to repeat the orders. Do not presume and act without fully understanding the order. Ensure closed loop communications at all times.

- ❖ Check with the bridge before sending out any lines, before making fast / casting off tugs and before making fast the lines.
- ❖ The officer at the stern (aft) mooring station should warn the bridge if there is any possibility of any aft mooring ropes coming in the way of the propeller especially when the ship is in ballast condition, so that the engines are not run, until the line is clear of the water.
- ❖ When throwing heaving lines ensure that the shore personnel are clear and are not in way of the heaving line.
- ❖ Keep the bridge informed of closing distances with the berth, a moored ship nearby, any floating objects, small crafts, buoys or any other obstruction which might not be easily visible from the bridge.
- ❖ Warn bridge if the passed mooring lines get excessively taut in the process of berthing. The idea is to bring the ship alongside safely and not part a mooring line which can cause personal injury as well as damage to the ship.

Making fast on bollards

- ❖ Mooring ropes should be made fast as required by the bridge – giving due consideration to the requirement of both ship and the port during the port stay.
- ❖ In case the vessel calls at the same berth or terminal frequently or even otherwise – it would be a good practise to draw a mooring arrangement plan and file it for records – mentioning all the relevant features of that particular port / berth.
- ❖ On making fast the vessel and before standing down from stations, check that all ropes are having equal tension and that all the leads are clear of any obstructions and chafes.
- ❖ Never make fast a mooring rope on the warping drums. Mooring rope should either be braked on the rope barrel or belayed on the bits.
- ❖ Rat guards must be placed over each line outboard just as the line leaves the shipside. Rat guards must be attached with a lanyard which is made fast to a strongpoint on the ship.

4) Guidelines for efficient mooring operations

- Mooring lines should be so arranged that they are as symmetrical as possible about the midship point of the ship. That is if the ship is moored with 3 headlines, 2 breast ropes and 2 springs forward then as far as possible the same configuration should be maintained aft. There are occasions or customary practices in certain ports when extra lines may have to be paid out in a particular direction. These are to counter-act the external forces that may be predominant from that particular direction.

- Breast lines should be oriented as perpendicular as possible to the longitudinal centre line of the ship and as far aft and forward as possible.

- Spring lines should be oriented as parallel as possible to the longitudinal centre line of the ship. As far as possible these springs should lead as far forward/aft.

- The vertical angle of the mooring lines should be kept to a minimum. The “flatter” the mooring angle, the more efficient the line will be in resisting horizontally applied loads on the ship.

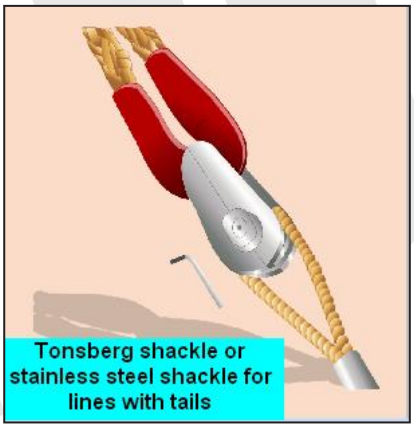
- Mooring lines should be as far as possible be of the same size and material. If this is not possible at least mooring ropes in each service like the headlines, breast ropes, springs should of the same type and material. For e.g.: If one headline is polypropylene then all the other headlines should be of the same material. Similarly if the back springs are of wires then all springs as far as possible should be of wire rope.

- Mooring lines should be so arranged such that all the lines (except breast ropes) from the same service, for e.g. head lines or stern lines or back springs – are about the same length from the ship's winch to the shore bollards. This will ensure that even load is taken up by each rope.

- If synthetic rope tails are used on mooring wires – then the same size and type should be used on all lines run out in the same service. These synthetic rope tails should be connected to the wires with special shackles called "Tonsberg" or "Mandal's" shackle. These special shackles prevent the synthetic rope from directly coming in contact with the wire rope, hence avoiding its wearing due to chafing.

- If the mooring arrangement consists of both wires and synthetic fibre ropes – care should be taken that both the wire and synthetic fibre ropes should not be made fast in the same bollard ashore.

- Note: Normally rope tails are used on all wire ropes. These ropes are made of synthetic fibres and are approximately 11 – 12 meters in length. This aids in easy handling of wire ropes ashore and in addition provides necessary flexibility to the mooring lines. It must be borne in mind that wire ropes are less elastic than synthetic fibre ropes. Hence the synthetic rope tail is attached to achieve this elasticity which is necessary when a vessel is surging alongside a berth.



- You must be aware of :
  - SWL, breaking stress, size, length and number of all mooring lines available on board.
  - Start-up and operation of all equipments including winches, windlass and their controls.
  - Limitations of any self tensioning winches and devices.
  - Types of rope/ chain stoppers to be used and correct method of applying the same.

- Factors to be considered before deciding the number of mooring ropes and mooring pattern:
  - Is the berth exposed to bad weather?
  - Is there any unusual strong tide or current which might require additional lines to be passed?
  - Has the ship regularly to shift within the berth to complete its cargo operations – If so have lines having long leads.
  - The placement of bollards ashore, with respect to the positioning of the ship.
  - Availability of mooring ropes for each service on board.
  - Volume of passing traffic.

It is often difficult to achieve an ideal mooring layout, but ship's equipment can be employed to the best advantage if the following general principles are borne in mind:

- Breast-lines provide the bulk of athwartships restraint;
- Back-springs provide the largest proportion of the longitudinal restraint; and,
- Very short lengths of line should be avoided where possible; as such lines will take a greater proportion of the total load when movement of the ship occurs.

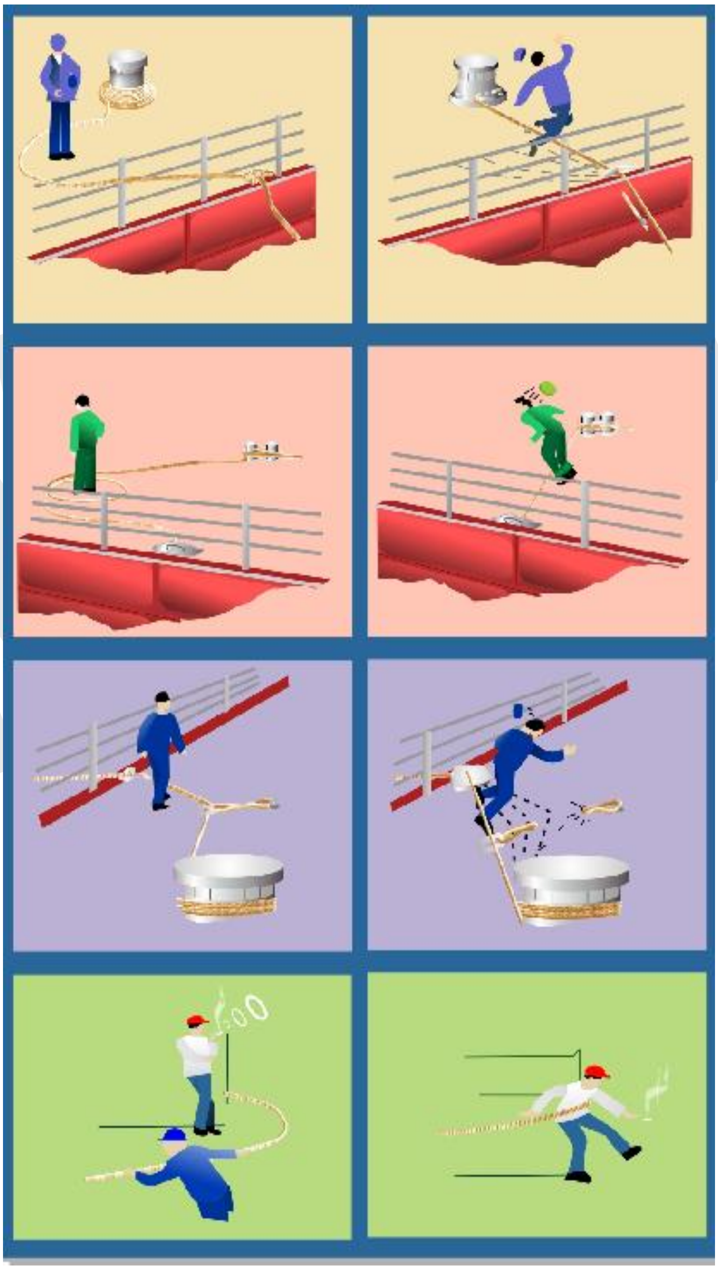
Where moorings are to be heaved on a drum end, one person should be stationed at the drum end. For heavy moorings and large vessel operations, they should be backed up by a second person backing and coiling down the slack. The line must be tended at all times. In most circumstances up to three turns on the drum end are sufficient to undertake a successful operation, and an excessive number of turns should be avoided. A wire on a drum end should never be used as a check wire. A wire should never be led across a fibre rope on a bollard; wires and ropes should be kept in separate fairleads or bollards.

When stoppering off moorings:

- Natural fibre rope should be stoppered with a natural fibre stopper.
- Man-made fibre rope should be stoppered with a man-made fibre stopper (but not polyamide).
- The 'west country' method (double and reverse stoppering) is preferable for fibre ropes.
- Wire moorings should be stoppered with chain, using two half hitches in the form of a cow hitch, suitably spaced with the tail backed up against the lay of wire, to ensure that the chain neither jams nor opens up the lay of the wire.

5) Safety of personnel during mooring and anchoring operations

Industry statistics have shown that a large percentage of accidents occur during mooring/anchoring operations. Some points to note are:



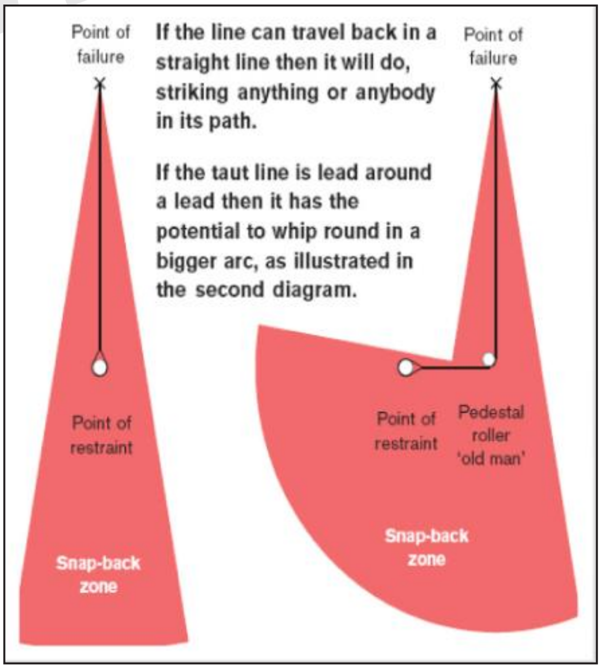
- ❖ Unless already fitted with treads, the surfaces of mooring decks should be treated with anti-slip paint. Working area at mooring stations should be kept clear of snow / ice.
- ❖ Leaking joints in hydraulic lines should be rectified immediately. Save-alls should be plugged prior arrival port until departure port.
- ❖ Fairleads and rollers should be regularly lubricated and examined for wear.
- ❖ Winches must operate and stop smoothly and be isolated after use.
- ❖ It is important that sufficient men are detailed to attend the mooring operation, and that the activities are properly supervised by a deck officer.
- ❖ The officer should take charge of communications between the mooring deck and the bridge and keep a sharp lookout for potential hazards.
- ❖ Alerting personnel to stay clear of lines in a bight or under tension should be considered an integral part of the mooring officer's duty. Personnel not involved in the mooring operations should not be allowed in the area.
- ❖ The mooring party should wear Safety helmets (with chin-straps secured), appropriate footwear and clothing, which will not become entangled during mooring operations. It is recommended that safety glasses should be used to prevent eye injuries from flying particles whilst anchoring.
- ❖ Mooring wires should not be handled without leather or similar gloves that can prevent injuries caused by snags.

- ❖ Loose fitting gloves should not be used since they are liable to become trapped between wires and other equipment.
- ❖ Mooring decks should be sufficiently illuminated after taking permission from the bridge.
- ❖ Crew must be instructed to tread carefully when decks are wet and remain alert throughout mooring operations.
- ❖ Ropes or wires should never be passed directly from a storage reel. They should be flaked on deck and run out in safe manner. Do not attempt to stop a line running out with your feet.
- ❖ Responsible officer must always keep a good watch on the mooring lines and maintain good communication between shore mooring crew, own mooring team and bridge.
- ❖ Best ropes / wires should be sent as first lines. If more than one rope is sent initially, they should be sent in such a way that they could be independently attended.
- ❖ Mixed mooring should not be carried out especially on tankers and gas carriers.
- ❖ Breast lines should be oriented as perpendicular as possible to the longitudinal centreline of the ship.
- ❖ When the vessel is warped along the quay, no mooring ropes or wires should not be used to check the ship movement while they are on the winch drum. The rope or wires shall be put around the bitts as a figure of eight for using it as a check rope.
- ❖ Wire ropes have a tendency to spring off while taking turns. While taking figure of eight around bitts one person should hold each turn down as another man puts it around. The last top turns of the wires should be lashed down to prevent springing off.
- ❖ Ropes must not be left on warping drum, as the winches are not designed to take loads on the winch drum.
- ❖ Never stand near or in line with a rope under strain.
- ❖ Remember synthetic ropes do not give any audible warning and snap suddenly.
- ❖ Always try and remain in full control of a line.
- ❖ Ensure only experienced seaman operate winch controls.
- ❖ Ensure winch operators can see the officer in-charge.
- ❖ Never leave winches running unattended.
- ❖ Never surge the rope especially when it has weight.
- ❖ Stop the winch and walk the rope back if necessary. The surging may cause heat and the synthetic rope may fuse.
- ❖ Don't stand too close to the drum end when heaving or slacking.
- ❖ Ensure that each drum handler is assisted by a second man to pay out the line or pick up the slack.
- ❖ Avoid leading ropes and wires around sharp bends.
- ❖ Always keep ropes neatly coiled and clear of working spaces when not in use.
- ❖ It must be remembered that stoppers serve only to hold the line momentarily while it is secured and sudden shocks or increased load may cause the stopper to part.
- ❖ Personnel should not in any circumstances stand in a bight of rope or wire.
- ❖ Operation of winches should preferably be undertaken by competent personnel to ensure that excessive loads do not arise on mooring, towing and hauling lines.

> Ropes must never be left on warping drums after making fast.

6) Snap back zones

Snap back is the most serious danger associated with mooring lines. It is the sudden release of the static energy stored in the stretched line when it breaks. The ends of the line snap back, striking anything in their path with tremendous force.



Snap back is common to all lines. Even long wires under tension can stretch enough to snap back with considerable energy. Synthetic ropes are more elastic therefore pose greater danger.

Line handlers must stand well clear of the potential path of snap back, which extends to the sides of and far beyond the tensioned line.

Any point in a 10-degree cone around the line, from any point at which the line breaks is in danger.

A broken line will snap back beyond the point at which it is secured, possibly to a distance almost as far as its own length. If the line passes around a fairlead, then its snap-back path may not follow the original path of the line. The end of the line will fly around and beyond the fairlead.

When mooring, towing and hauling lines are under strain all personnel in the vicinity should remain in positions of safety, i.e. avoiding all 'Snap-Back' Zones.

A bird's eye view of the mooring deck arrangement is recommended (an aerial view from a high point of the vessel can be utilised) to more readily identify danger areas. Immediate action should be taken to reduce the load should any part of the system appear to be under excessive strain. Care is needed so that ropes or wires will not jam when they come under strain, so that if necessary they can quickly be slackened off. Where a mooring line is led around a pedestal roller fairlead, the "Snap-Back" Zone will change and increase in area.

7) Working with tugs

- Good communication between the tug and vessel being aided are important to ensure that the status of tow- lines is understood by both parties at all times and thus avoid unexpected loads being applied.
- Ensure the bitts upon which the towing eye is to be placed are clear of rope or wire.
- When conducting towing operations it is important that those involved consider the safety of persons on both vessels.
- All equipment used in towing operations including messengers should be regularly inspected and replaced as necessary.
- Similar considerations need to be applied when working with any mooring operation where equipment out of direct control of the vessel is used.
- The condition of a tug line will be unknown and the personnel at the mooring stations will not normally be aware of when the tug is actually heaving or what load is being applied to the line. It is therefore important that once the tug line is made fast all personnel stay well clear at all times. If two mooring lines are required to be made fast, both lines must be of the same material.
- Tugs should only be cast off after receiving instructions from the bridge, and never on the orders of the tug crew
- The crew should be on stand-by well in time to give the tugs sufficient time to secure: this is very important as it should not happen that the crew arrives very late at their mooring stations and the vessel is at that moment already entering the approach channel to the lock.

> Cast off the tugs only after receiving orders from the bridge.

- Following recent incidents it can be stressed that rope messenger line should never be disconnected from the steel tow wire!
  - At the bow, generally it is recommended that the wire should be released in one motion, however clarification needs to be sought prior doing so from the bridge.
  - At the stern, generally the wire should be slacked gently by means of the messenger line, so that the wire can be wound by the tug's winch, and will not end up in the water. In this way, the line cannot get caught by the tug's propellers.

8) Heaving line

A heaving line is a light line used to get a hawser ashore when mooring a ship to the dock or in passing a heavy line for any purpose. One end of the heaving line **is fitted with a monkey fist to assist in getting distance** when heaving. After making the heave, the other end of the heaving line is bent to the hawser with a bowline.

The heaving line is coiled carefully with about two-thirds of the coil held in the right (casting) hand and the rest in the left hand. In heaving, the right arm should be held straight, and the line in the left hand allowed running out freely. Frequently the problem in not getting a long heave is that the coil in the left hand is not arranged clearly for running. Pre-wetting the line is done to improve distance and handling. To become proficient in heaving, you must practice frequently.

The heaving line should not be weighted by items such as shackles, bolts or nuts, or any other such objects; not attached directly to the heaving line and not inserted in the monkey's fist.

The best options for weighing a heaving line are:

- A simple monkey's fist at the end of the line, (no objects inside the monkey's fist.) As most of the heaving lines are made of floating material, this fist will float as well.
- The heaving line should not be weighted by items such as shackles, bolts or nuts, or any others such objects; not attached directly to the heaving line and not inserted in the monkey's fist.

> Do not insert shackles, bolts or nuts in the monkey fist.

Below is a point by point procedure for making the heaving line ready for throwing.

- To coil a heaving line, hold the standing end of the line in the opposite hand to your heaving hand
- Hold the line so that the coils of each bight turn towards the target (away from you).
- The bights should be three (3) or four (4) feet in circumference.
- You then separate this coil in half, keeping the half with the monkey's fist in your heaving hand.
- Allow approximately five (1.5) metres to hang between the two coils.
- Turn your body so that you are sideways to the jetty.
- Extend your heaving arm while holding the other half of the coil facing the target, with your palm open.
- Bring your heaving arm behind you and in a smooth motion heave the monkey's fist, (coil and all) toward the target, sidearm fashion.
- Allow as much line to go out as necessary
- Be sure to retain the inboard end in your hand, or you may secure it to the railings.

9) Types of mooring ropes

Mooring ropes are normally made of polypropylene, nylon, polyester, or a polyester/polypropylene mixture.

High Modulous Synthetic Fibre Rope – generally refers to rope made from high-modulous fibres such as Aramid and High-modulous polyethylene (HMPE). These fibres are much stronger than conventional synthetic fibres such as nylon, polyester and polypropylene. On tankers and gas carriers, moorings ropes should not be with high elasticity as they allow excessive movement from strong winds/current/passing ships.

When delivered, a manufacturer's certificate should accompany all mooring ropes indicating, amongst other things, the minimum-breaking load.

Aramid fibre

Typically has high strength and low stretch. The ropes do not float; however they have good cut resistance but only fair Ultraviolet (UV) and abrasion resistance.

The aramid is a kind of manmade fibre with high performance. It is polymerized, spun and drawn by special technology thus to make its solid chain rings and chains to be compounded in a whole therefore it has very stable high strength and heat resisting feature.

Advantages of Aramid ropes

- High tension/low elongation
- High breakage strength
- Temperature difference resisting
- Insulation
- Corrosion resisting
- Suitable range
- Hanging rope, suspension rope, parachute rope etc.
- Large-scale and special ships and vessels, military industrial ropes
- Suitable for operation under low and high temperature (-40℃～350℃)
- Electric cable and power engineering work
- No damage in ocean or special with inorganic solution from PH3 to PH9
- When delivered, a certificate from the manufacturer that will indicate the minimum-breaking load should accompany all mooring ropes.

HMSF ropes

Have high strength per weight ratio, low stretch characteristics and good UV resistance. They do have very good fatigue (cuts, tension, abrasion and bending) resistance but have limited temperature resistance).

HMSF ropes for the same reason as wire usually require the use of synthetic fibre rope tails to introduce some elasticity.

Nylon

Has exceptional resistance to sustained loading. It is highly resistant to chemical attack from alkalis, oils and organic solvents, but will be damaged by acids. However, its high elasticity makes it unsuitable for tanker moorings, where the ship's movement has to be restricted to avoid damaging loading arms. Use of nylon ropes onboard tankers/gas carriers is prohibited. When wet, nylon has only 80% of its dry strength. It is the dry MBL which is quoted and due allowance should be made when comparing with other fibres, or when ordering nylon lines.

Polyester
This is the heaviest of the man-made fibres. It is not as strong as nylon but it possesses the lowest extension under load of all man-made rope fibres.

Polypropylene

This has approximately the same elasticity as polyester but is significantly weaker than either polyester or nylon. Polypropylene has a low melting point and tends to fuse under high friction.

Polypropylene is lighter than water and can be used for floating messenger lines. It is the most commonly used type of rope.

10) Anchor cable and markings

- The cable is made of forged mild steel, cast steel or special quality forged steel.
- The diameter of the bar from which the common link is made denotes the size of the cable. The uniformly sized links forming each length of cable are called common links.
- The links are fitted with studs to prevent kinking and longitudinal stretching. The studs also increase the strength of the links.
- Chain cables are made in lengths of 15 fathoms or 90 feet or 27. 5 m called shackles.
- They are joined by a joining shackle that may be lugged or lugless.
- If a lugged joining shackle is used then an unstudded open link known as the 'end' link and an enlarged studded link called an 'intermediate' link will be needed to make the connection with the regular common link.
- On many ships, 'half-shackle' i.e. a length of 7.5 fathoms with a joining shackle is fitted next to the anchor to facilitate hanging off the anchor.

Chain cable and stud link – general information

Volume of anchor chain – Anchor cable when stowed in a chain locker can be estimated at approximately 0.5 cubic metres per metric ton of chain.

Anchor chain renewal – Lloyd's require any length of anchor cable to be renewed if the mean diameter at its most worn part is reduced by 11% below its original diameter.

Size of cable measurement – Cable is measured by use of external callipers. The size is found by measuring the diameter of the bar from which the link is made.

Chain grades – A method of indicating the quality of steel from which the cable is manufactured. The grades have been internationally accepted, recognized by the classification societies and listed under their regulations:

U1 Mild steel chain
U2 Special quality steel chain
U3 Extra special quality chain. (Ref. Table 3A, Lloyd's Rules)

Grade three cable – Is the lightest of the three grades of cable and ships so equipped would expect to use an increased scope when anchoring.

Wrought iron cable – Is the most expensive to produce and is weaker than the other three qualities of forged mild steel, cast steel or special-quality forged steel. It is rarely seen on present day merchant vessels. Its replacement is generally by a non-ferrous cable manufactured from aluminium bronze material.

Shackle length – Anchor cable is universally manufactured and used in shackle lengths of 15 fathoms (90 feet) or 27.5 metres.

Strength – Stud link chain is 1.6 to 1.8 times the strength of the iron from which it is made. It is also 50% greater than open link cable.

CABLE MARKINGS

To assist while letting go or heaving anchor, the shackles in a cable are numbered and marked accordingly.
The shackle and joining shackles are numbered consecutively from the anchor towards the chain locker. The first joining shackle is the one which connects the first and second shackles; the second joining shackle is the one which connects the second and third shackles and so forth.

The joining shackle is painted white and a link on each side of the joining shackle is painted white to indicate the shackle number. For example, fourth shackle will be marked by painting white the joining shackle and the fourth link on either side of the fourth joining shackle.

In addition seizing wire turns or a metallic band is put on the stud of the painted link.

A variation of the above is to paint the joining shackle red and paint a number of common links on either side of the joining shackle equivalent to the shackle number. For example four common links on either side of the joining shackle to be painted white to indicate the fourth shackle. Seizing wire or a metallic band marks the stud of the last painted link.

When the cable is running out rapidly, the flashes of white will be visible to help in counting the shackles.
These markings should be regularly maintained. If lugged joining shackles are used, the open link on each side of the shackle is not considered when making the markings. Half-shackle if fitted is ignored when the cable is marked for lengths.

The anchor and its cable should be inspected every dry dock and needful repairs like welding of missing studs etc. carried out. Normally the anchor and the cable is ranged in the dry dock and a coat of paint is given. The cable is periodically changed end to end to ensure even wear and tear. The cable markings need to be redone at such times.

Apply Your Knowledge

1. What are the hazards when on mooring stations and how would you safeguard yourself against getting injured? Answer briefly in bullet points.

Semester 3
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 Reference No.: B1.1

Sub task Reference Nos.: B1.1.1, B1.1.3, B1.1.4, B1.1.5

Topic: Cargo Hold Preparation

Task Heading

- Assist the crew in preparation of cargo holds for loading cargo.
- Clean bilges, wells and strum boxes and apply burlap on bilge well covers.
- Confirm hold scuppers are clear.
- Test bilge suctions.

Objectives

- Understand why hold cleaning is necessary
- Handling residues
- Different methods of cleaning
- Cleaning bilges
- Applying burlap
- Lime washing procedure
- Cleaning scuppers and confirming same are clear
- Trying out bilge pumping arrangement

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Description

> Maximum bulk cargo damage claims are for damage due to contamination with previous cargo, rust, paint etc

1) **Introduction:** Before loading any cargo in to a cargo hold, we must ensure that it must be ready to receive the cargo. This will mean that it is clean, dry, well ventilated and, if required, any special treatment is carried out. Cargo loaded in to a hold, which is not well prepared for receiving the specific cargo, could result in cargo damage, leading to heavy claims. Imagine, a cargo of sugar loaded in to a hold from which coal has been discharged but due to time constraint or otherwise the hold is not properly washed down.

> If in any doubt regarding standard of cleaning required, the charterers/ owners must be contacted.

2) **Planning:** Planning for hold cleaning must be done as soon as it is known what the next cargo will be. Special equipment or material

may be required depending on last cargo, general hold condition and next cargo. Charterers and owners may have to be contacted to know the nature and extent of cleaning required for special cargoes and also if there is a time constraint. For many cargoes, holds are inspected prior loading by special surveyors – and they may be having special and exacting standards. Agents of load port may be able to assist in informing exact requirements.

3) **Care while discharging:** While discharging cargoes like grain etc, care has to be taken as the cargo level goes down to ensure that all remnants over beams, longitudes and other horizontal surfaces are swept off. It must be kept in mind that more the care taken during discharging to ensure that minimum remnants are left on board the easier it would be for the ship's crew to tackle the cleaning after discharging. If required and if local rules allow, crew could be used to take out all cargo, which may have found its way in to the bilges and corners etc before final discharging is competed. If the stevedores are required to sweep the holds, supervision must be exercised to ensure thorough sweeping.

> Cleaning can be made easier if cargo lying over high horizontal surfaces like beams, stringers etc is swept or knocked down during the discharge operation.

> Always comply with Marpol and other local regulations if any cargo residue or washings are to be discharged overside.

Marpol and other regulations govern the disposal of cargo residues and determine if they could be disposed at sea or landed ashore.

> **Remember:** **In some ports the dockside unions do not permit ship's crew to clean the holds whilst in port. In case cleaning of hold is planned when the ship is alongside a port - it has to be checked if cleaning is permitted.**

Cargo material 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 International Maritime Dangerous Goods code and the bilge water is discharged from a loaded hold through the vessel's fixed piping bilge drainage system.

4) **Precautions while entering holds at sea:** A thorough risk assessment must be done if the crew is required to enter the holds for cleaning or otherwise during the voyage. Hold must be well-ventilated and appropriate tests of atmosphere carried out before allowing entry. If hatch covers are to be opened, special precautions will have to be taken and after opening the covers will have to be secured to prevent accidental closing. Adequate lighting is essential for crew to work safely in the hold. If any company specific checklist is provided for this purpose, it must be followed.

> Remember, many lives have been lost due to lack of oxygen in the holds or due to falling from heights. Follow all safety precautions and company/ industry laid out procedures.

5) **Methods of hold cleaning:** The cleaning method employed will depend upon the cargo to be loaded and last cargo carried. No cleaning may be required if iron ore is to be

> The cleaning method employed must be the one, which is most effective and efficient. Often, fine dust can be removed by simple blowing instead of using heavy material for washing/hosing.

loaded after discharging same but at times charterers may require some cleaning to be done even in such a case. Different cleaning methods are – sweeping, blowing with compressed air, water washing, chemical cleaning etc. Water washing is very common and could be done by using ordinary hoses with ship fire pumps, or a combination of ship's water supply with compressed air/ venturi system to boost up the water pressure i.e. combiguns, maxi guns etc. These guns are useful in delivering water to high heights, or high pressure cleaning machines – these machines can deliver water at pressure up to few hundred bars. These are very useful in removing any cargo or rust etc rigidly attached.

Chemicals may be required to get rid of some residues. It must be ensured that Material Data Safety Sheets are studied and proper precautions taken before handling these chemicals. Proper PPE must be worn.

The following equipment is generally required for sweeping the holds:

- Use a rope net sling with a lining of canvas or tarpaulin to remove sweepings from the hold.
- Some rope slings.
- Brooms and shovels.
- Cluster lights
- If a net sling is not available then some empty 200 liter drums with slings.

When preparing holds for loading of various types of cargoes, following factors should be given due consideration:-

- Holds should be thoroughly swept and cleaned to remove any residues of the previous cargo. For this to be done efficiently, it is very important that during the previous cargo discharge.
- Loose rust scale or loose paint will have to be removed using scrappers.
- Broken dunnage used for the previous cargo should be removed. Dunnage that could be re-used should be separated and stowed. **Some of the dunnage may have nails that might cause injury to personnel handling the dunnage or walking on top of them.**
- Remember that disposal of sweepings is to be done strictly in accordance to MARPOL Annex 5.
- Depending on the previous and the next cargo to be carried, the holds may need to be washed. If carrying the same cargo as the previous cargo and if the charterer does not require washing, then the hold is prepared only by sweeping. If washing is required, the intensity of washing will depend on the type of cargo being carried for example a grain cargo or a cargo of mineral sand like alumina or talc will require extensive washing.

Some cargoes can be contaminated by stains for example talc or alumina if carried in bulk. It is very important that the hold is clean enough so that the cargo in contact with the sides of the holds are not stained (this requires a very high degree of cleanliness specially on a ship which is more than 10 years old and the coating of the hold not intact). This, in marine commercial terms, is known as 'required to be GRAIN CLEAN'**.**

6) Hold washing: Generally sea water is used. Often, a fresh water rinse may be required after sea water hosing to remove the salt.
A systematic washing sequence would be as follows:

- First wash the hatch covers including the insides of the covers.
- The hatch coamings to be washed next from main deck.
- The underside of the main deck, the deck heads and top vertical portion of the holds to be washed next.
- The hold vertical sides and bottom.
- The tank top and finally the bilges.

If this sequence is followed it would result in very little cargo residue left and will achieve optimum cleaning. It must be noted that cleaning should be carried out as economically as possible within the least amount of time. Usually there are time constraints due to short voyages between discharge and load ports and for example rough weather conditions.

> The system we require to use for washing down will depend upon the previous cargo and degree of cleaning required for the next cargo.

The various methods of hold washing are:

a) **Using hand held hoses:** After discharging some cargoes, which do not stick around with the steel surface of the ship, we can use hand held hoses for hosing down the holds. Water is supplied from the general service pump/s at 5-6 bar pressure and rubber/ canvas hoses may be used with jet nozzles. This method of washing is effective when only the deck (or tank top) requires to be cleaned, as the water jet will not travel high enough to be effective.

b) **High pressure portable systems:** After discharge of some cargoes, higher water pressure than that provided by the ship's general service pump is required to remove all the remnants. Some cargoes require that the holds are very clean - "hospital clean" before being loaded.

Systems that use compressed air to boost up the pressure can be used and are available under various trade names. The combigun uses compressed air supplied from the ship's air supply line and is provided with a tripod to take care of the recoil. The system is used from deck level and has a sea water hose connected and the pressure is boosted by the air venturi system. The maxigun can also be used from tank top level but more than one hose can be connected to it. It is more effective than the combigun, though the operating principle is same.

Stand alone high pressure systems capable of delivering upto 500 bar pressure are also available and very effective for removing cargo and other remnants stuck on deck and sides. These are self contained units with hoses etc attached and electrically or diesel engine driven. The electrical ones are more commonly used.

(A hold being washed)

(A Combigun)

(A Maxigun) *(A high pressure washing machine)*

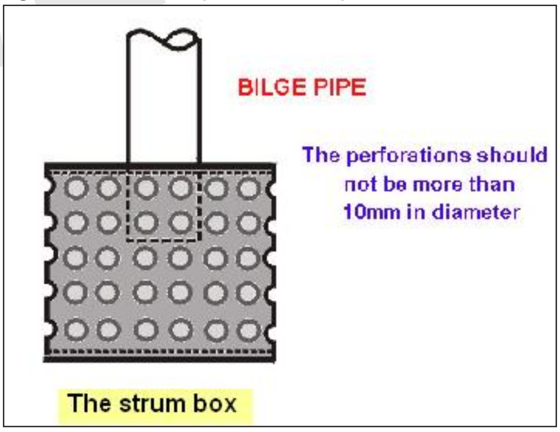
c) **Fixed washing systems:** Some ships on dedicated trades requiring frequent changeover from dirty to clean cargo are fitted with fixed tank cleaning machines. Machines may be single or with multi nozzles. These are commonly fitted on ore-bulk-oil carriers and some of the single nozzle machines can also be programmed so that the washing could be concentrated over particular area.

7) Water pumping out procedure: Any water which finds its way in to a hold must be removed. Water in the hold can enter due to openings not being weather tight, condensation in the hold or intentionally during washing of holds.

The hold bottom (deck) is so shaped that all water finds its way to the ends of the hold (after end) into bilges. Bilges are "well" like structure in the after ends of the hold where all water formed or entering the hold finds its way due to the natural slope provided. Obviously, as the bilges are in the after end, any trim by stern will assist in the water flow. Most ships have two bilge wells while some may have only one. The older ships had bilges on each side extending throughout the length of the hold.

> The strum box must be in place at all times except when removed for cleaning

Each bilge is provided with a pumping arrangement and a perforated plate to cover the bilges. The pumping arrangement consists of a pump with pipelines leading to each bilge and isolated by valves which are controlled from outside the hold space. In addition, one or more non return valves are provided to ensure that due to any mal-operation while setting the lines or otherwise, water does not flow into the hold. Instead of the pump, some ships are fitted with eductors which work on the venturi principle. Eductors use sea water as the driving liquid. Some ships also have a dedicated hold wash tank. The water is transferred from the bilges using a submersible pump into this dedicated tank.



The suction pipe in each bilge has a filter at the end to avoid solid substances being carried away in to the pipe towards the pump. The filter is called a "strum box" and can be easily removed for cleaning. An open pipe without a "strum box" would result in clogging of the line and could also damage the pump. It must be in place during hold washing and before loading.

Modern ships have what is called the "Bilge well" or the "Drain well" situated at the aft corners of each hold both on the port and starboard sides. They are covered by perforated steel plates (strainer plates) which allow only liquid to flow through them into the bilge wells. The cubic capacity of the bilge well differs from ship to ship and type of cargo it is designed to carry - but is generally between 1-3 m^3.

The bilge well will have at least two compartments separated by a partition plate. The bilge suction pipe is situated in the inner compartment. The partition plate allows only the liquid to flow over it in to the inner compartment. Debris, cargo residue and foreign particles being heavier settle down in the outer compartment thus assisting in the filtering of the liquid.

The bilge suction pipe ends in a strum box situated in the inner compartment. The perforations in the strum box further help in filtering the liquid being sucked up and pumped out through the bilge pump.

Bilges are cramped spaces, which hamper normal working; hence care must be taken when cleaning bilges to prevent injuries.

8) **Cleaning bilges**: On completion of hold washing the bilges will obviously have to be cleaned. Whatever remains in the bilges must be dug out if required.

> Hold cleaning is not complete without the Bilges being cleaned.

Bilges are required to be cleaned because any residue left could interfere with the drainage and pumping out of the water, and especially if perishables were carried as last cargo the residue may decay and decompose. Food stuff such as grain etc. requires that the bilges are meticulously clean with every trace of matter removed.

9) **Trying out bilge pumping arrangement:** If there have not been problems with the bilge pumping arrangement during water washing, it would mean that the pumping arrangement is OK. If however, washing was not done, the bilge suctions must be tried out prior loading cargo. Any water remaining in the bilges after trying out must be mopped up.

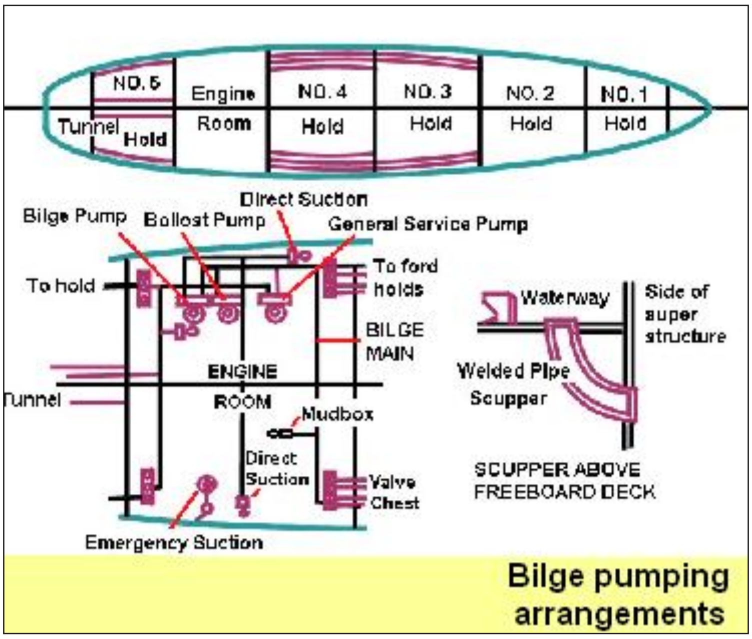
> Pumping arrangement of each bilge must be tried out prior loading any cargo.

Generally there are two types of piping arrangement for bilges on board the ship:

a) Each individual bilge well is connected to the engine room by a direct line ending in a valve chest one for the port side and other for the starboard side. This is generally the arrangement found on modern ships that do not have a duct keel. The bilge suction at the bilge well has a non-return flap or disc valve and so has the valve-chest, which has a screw-lift non-return valve. All the bilge suction valves are operated from the engine room.

OR

b) A common bilge main line one for port side and one for the starboard side with branch lines connecting each bilge well. This type of system is common on ships with a duct keel. Here the bilge suction valves are located in the stool space



Bilge pumping arrangements

between the two holds and can either be operated from deck via a long spindle or they are hydraulically operated butterfly valve controlled from a centralized ballast control room. The bilge suction also has a non-return valve to prevent water ingress into the bilge well. The advantage of this system is that the cost saving is enormous as only one main line on each side runs all the way to the engine room. Unlike the above system where each bilge well is directly connected to a valve chest in the engine room. The major disadvantage of this system is that if one of the valve jams in open position - none of the bilges of that side can be pumped out as air will be drawn from the valve which is jammed open.

Precautions to take prior to pumping out hold bilges after hold cleaning

- Ensure bilges are not blocked or choked prior to pumping out bilges.
- Remove all sweepings from the holds prior to washing holds.
- Use portable bilge baskets (can be made on board using perforated steel plates) in the bilge wells prior to washing holds. This bilge basket can also be used as a top hat.
- Monitor hold washing - there should be no build up of water inside the hold.
- If build up of water occurs - stop washing holds immediately.
- Clean the strum box, bilge well bottom and the bilge basket at frequent intervals to remove any cargo residues or sediments.

Testing of hold bilge suctions

- Normally all holds have port and starboard bilges.
- Try out one bilge suction at a time and see if the water in the bilge hold can be pumped out.
- Bilges can be filled from its sounding pipe (this also ensures that the sounding pipe is clear) or with a hose.
- All bilge suction lines end up in the engine room valve chest and all these valves are screw lift non-return valves.
- There are two non-return valves in each bilge line - one is a non-return flap valve near the bilge suction and one is a non-return screw valve in the engine room.
- For water to enter into the bilge through the bilge line, both of them must malfunction.
- Frequently both the valves are to be checked and inspected for proper functioning.
- The non-return flap valve in the bilge well should be opened at the flange and the flap should be seen to be free (this should be included in the ship's maintenance schedule).
- To test the non-return valves: flood the bilge line from the engine room and see if the water enters the bilge well in the holds.
- The non-return valve fitted on the bilge line near the suction must be tested prior to every loading. This is to ensure that the water cannot enter the hold through the bilge line. The easiest way to check this is to stop the bilge pump or the eductor and allow water to flood back into the bilge line. If the water flows into the hold bilges, the non-return valve is not functional and must be opened up and cleaned. The non-return valve could be situated either in the bilge well itself or in the stool space between two holds or in the duct keel.

10) **Applying burlap (on bilges):** Bilge wells are provided with perforated plates, which sit flush with the tank top. The size of the perforations does not allow large particles to enter the bilges but small particles can fall into the bilges. It is quite a common practice to line the bilge cover plate with burlap (sacking cloth). This is achieved by wrapping the burlap cloth around the perforated plate, placing the plate in its normal position and then sealing the edges with cement or

> Burlap allows water to pass through but does not allow small pieces of cargo etc to pass through.

some adhesive tape. After fitting of burlap, the cover must sit flush on tank top to avoid it getting dislodged during cargo handling. If it does get dislodged, cargo will enter the bilge well and block the suction.

11) **Lime washing:** Before loading some cargoes, the shippers require that the sides and tank top are lime washed. Salt and sulphur are two such cargoes. These cargoes are susceptible to getting damaged if it comes in contact with rust.

> Lime wash is made by mixing one part by weight of slaked lime (hydrated calcium hydroxide) with three parts of fresh water.

Lime wash is applied using a portable pump or manually. Aim must be to cover the tank top and the bulkhead till the height the cargo is expected to be loaded, with a good, thick and even coat of lime wash. A coat of lime wash dries within few hours.

12) **Cleaning scupper pipes:** If vessel is fitted with scupper pipes from other spaces leading to the bilges same must be confirmed to be clear. This is best achieved by flushing the pipes with water from the top most drain opening. If the pipe has more than one opening, the other openings will be required to be plugged. To ensure that all branches are clear, water must be flushed through each opening with others plugged. This flushing must be done prior to hold cleaning/ washing.

> If the pipe is choked, it must be cleared before loading.

A choked pipe could be cleaned either by using high pressure water or compressed air. Pressure must never be raised to more than the working pressure of these pipes. Pipes which are difficult to be cleaned may have to be removed from flanges and then cleared. Pipes are often clogged in the bends and are thus difficult to be cleaned.

13) **Pre-loading checks:** After preparing the hold for loading, pre-loading checks are required to ensure that nothing is missed out. A typical pre-loading check may be referred to in the shipboard SMS manuals.

Apply Your Knowledge

1. Using bullet points, list the procedure followed on board your ship for cleaning hold and hold bilges. State the checks and inspections to carry out after cleaning the hold to ensure that the hold is ready for loading the next cargo and state the type of cargo.

Function: Cargo Handling and Stowage

Competence: Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

Task Reference No.: B1.1

Sub task Reference Nos.: B1.1.2

Topic: Cargo Hold Preparation

Task Heading

- Accurately calculate the capacity of spaces available for loading cargo.

Objectives

- Take physical measurements and use information provided on ship to determine vacant cargo space available
- Understand information available in a “Capacity Plan”

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14) Introduction
15) Stowage factor
16) Broken stowage
17) Load density
18) Deadweight
19) Calculation of cargo space
20) Capacity plan
21) Bale capacity
22) Grain capacity

Description

14) Introduction: For a vessel to load cargo it is very important that space available is known to the officer in charge of loading, generally the chief officer. After calculating the available space the officer determines if the booked cargo can be volumetrically accommodated in the cargo spaces. Heavy cargoes are loaded depending on the deadweight capacity available.

15) Stowage factor: Stowage factor refers to the ratio of weight to stowage space required under normal conditions. It is the volume occupied by unit weight of cargo usually expressed as cubic metres/tonne or cubic feet/long ton. The number indicates how many cubic meters one metric ton of a particular type of cargo occupies in a hold, taking account of unavoidable stowage losses in the means of transport.

From above definition it is clear that heavy cargoes will have lesser stowage factor than lighter cargoes. The stowage factor of a cargo may vary, since it depends on the packaging and the nature of the cargo. Where bale goods are concerned, an important parameter is whether they are transported compressed or uncompressed.

Stowage factor of all cargoes loaded is required by the ship’s officer to calculate how much space would be required and if same is available, consider other factors like port rotation, cargo compatibility etc.

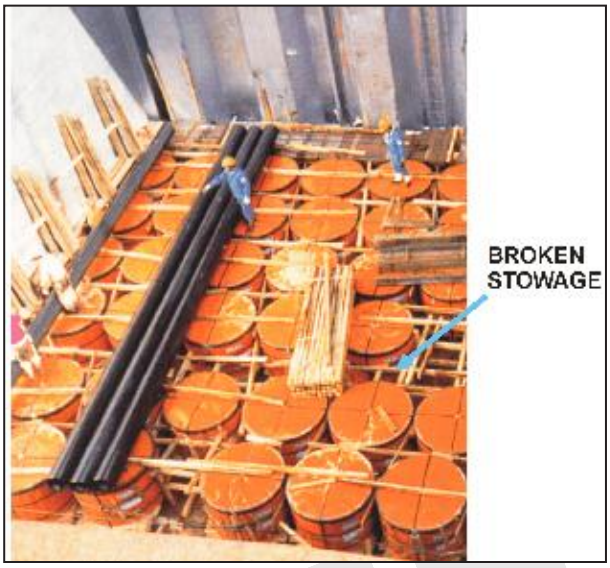
The shipper always lets the ship know well in advance the SF of the cargo to be loaded. He endorses this in the form of a "shipper's declaration", which is given to the Master on berthing.

It will be noticed that stowage factor is the reciprocal of density. Cargoes with high density have a low stowage factor.

> Broken stowage reduces the capacity of the ship to carry cargo.

Notation for stowage factor is SF.

16) **Broken stowage**: This is applicable for general cargo which is in packaged form. It is the space in between the packages which remains unfilled or unoccupied. This factor varies with the type of cargo and the shape of the hold. It is greatest when the packages are large and irregular shapes. It is expressed as a percentage of the volume of the cargo and not of the space stored in. The spaces which contribute to broken stowage are the spaces between containers of irregular shape, space filled with dunnage and the space over the last tier of cargo into which no cargo can be fitted.



Broken stowage must always be added to the stowage factor to get the realistic space that the cargo will occupy.

For example: If a cargo of motor cycles was to be stowed in a hold whose stowage factor is 4.0 and the broken stowage is 15%, what realistic capacity would you apply for each motorcycle.

SF of motor cycle is: 4.0 m^3/tonne
Broken stowage is 15%
Space occupied by each motorcycle = 4.0 + 15% = 4.6 m^3/tonne.

17) **Load density**: This is the maximum weight that can be safely loaded on a unit area. It is expressed as tonnes/ m^2. On board a ship every space like the lower hold, tween decks, hatch covers, and main deck has a weight limit according to the strength of the deck which means that the weight of cargo loaded in those spaces should never exceed that particular figure. The permitted load must exceed the load density of the unit area under the point load so for example when loading locomotives, long wooden bearers or rails must be placed under the wheels so that the whole locomotive weight is spread over a larger area and not just the point load under the wheels.

> Load density is the maximum weight that can be safely loaded on a unit area.

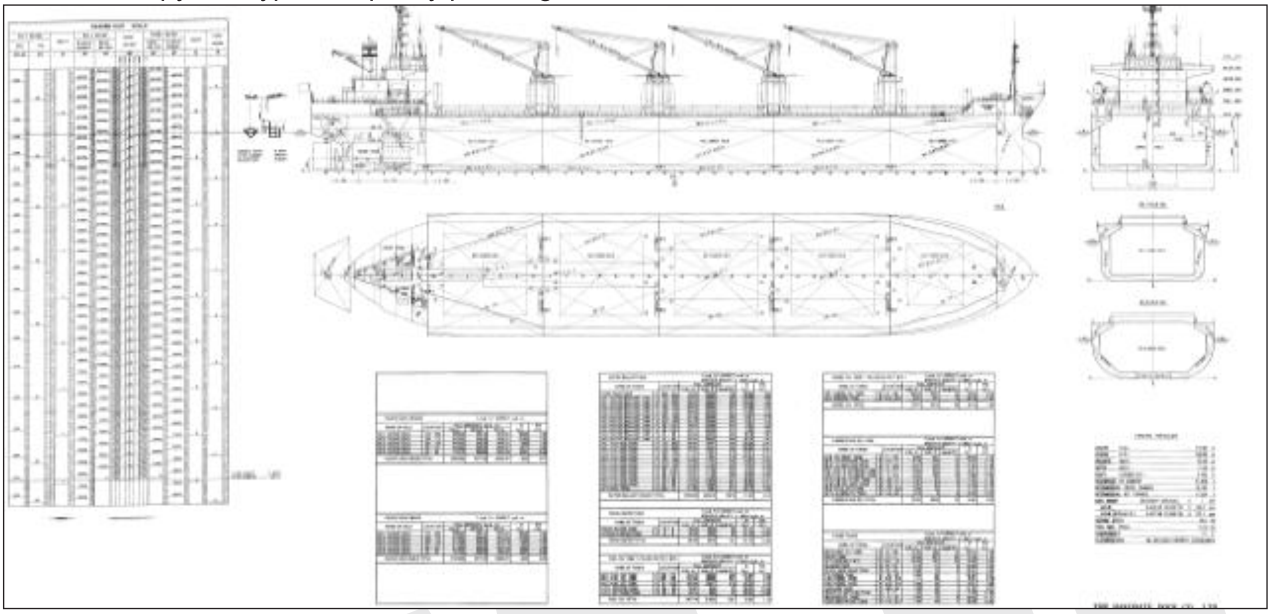
18) **Deadweight:** This is expressed in units of weight, usually the metric ton and is the difference between the loaded and light displacement of the ship. The light displacement of a ship is its weight without cargo, stores and fuel while the loaded displacement is its weight with cargo, fuel and stores.

19) **Calculation of cargo space:** Available, volumetric cargo space is calculated by physically measuring the vacant space and calculating the volume. We, however have to be careful of the size of the cargo to be loaded. When loading large packages, small spaces remaining will have to be disregarded. Ship's capacity plan is often referred to, when calculating empty spaces and the cargo that could be loaded.

20) **Capacity plan:** Each ship is provided with a capacity plan, which gives the complete layout of the ship accurately, including all cargo and bunker spaces. It is very important to know the ratio to which the plan has been made so that accurate dimension of hold spaces could be obtained. When using copied plans, it must be ensured that the plan has not been reduced or enlarged during photocopying. In addition to the capacity plans, ships may be provided with information, which directly give dimensions of each hold.

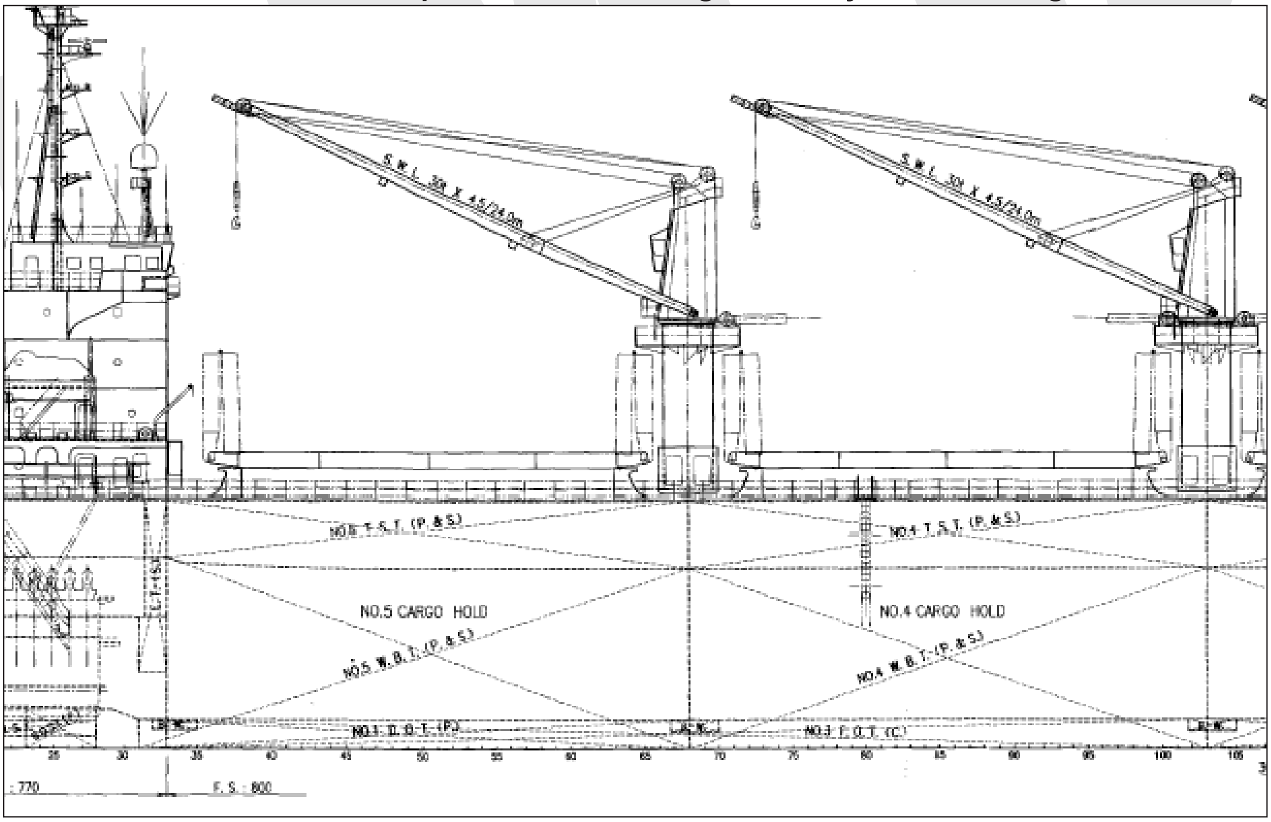
Thus, a capacity plan gives information relating to the location of all cargo compartments, their volumes, measured as bale and grain capacity for each space. It also gives details about the location of ballast tanks, fuel oil tanks and cargo tanks (on tankers) along with their cubic capacities.

A copy of a typical capacity plan is given below:

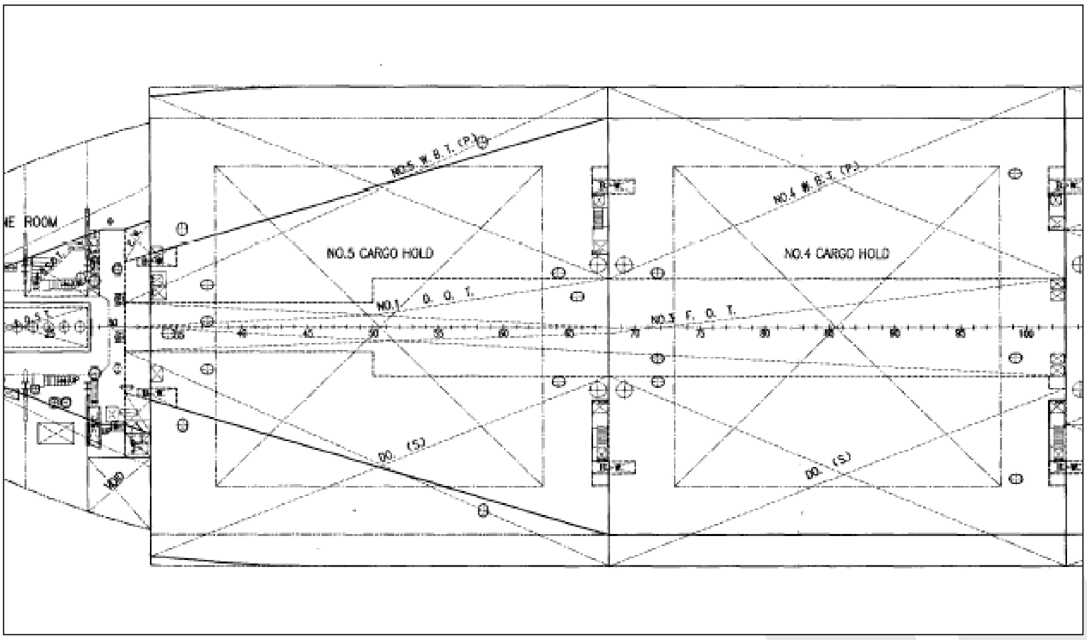


(Capacity Plan)

Some sections of the plan have been enlarged for easy understanding:



(Capacity plan section showing the layout of the cargo holds and ballast tanks)



(Plan Elevation showing, holds, tanks and other spaces)

CARGO HOLD (GRAIN)		1 cub. ft = 0.028317 cub. m				
NAME OF HOLD	LOCATION	FULL CAPACITY (cub. m) HOLD	HATCH	TOTAL	·G (m)	KG (m)
NO.1 CARGO HOLD	173 – 205	5662.49	253.72	5916.21	−82.95	7.88
NO.2 CARGO HOLD	138 – 173	8424.32	505.89	8930.21	−37.83	7.95
NO.3 CARGO HOLD	103 – 138	8424.32	505.89	8930.21	−9.83	7.95
NO.4 CARGO HOLD	68 – 103	8424.32	505.89	8930.21	18.17	7.95
NO.5 CARGO HOLD	33 – 68	7747.14	505.89	8253.03	45.57	8.28
CARGO HOLD GRAIN TOTAL		38682.59	2277.28	40959.87	−6.34	8.01

CARGO HOLD (BALE)		1 cub. ft = 0.028317 cub. m				
NAME OF HOLD	LOCATION	FULL CAPACITY (cub. m) HOLD	HATCH	TOTAL	·G (m)	KG (m)
NO.1 CARGO HOLD	173 – 205	5590.55	253.72	5844.27	−83.03	7.85
NO.2 CARGO HOLD	138 – 173	8110.53	505.89	8616.42	−37.50	7.95
NO.3 CARGO HOLD	103 – 138	8112.29	505.89	8618.18	−9.50	7.95
NO.4 CARGO HOLD	68 – 103	8112.29	505.89	8618.18	18.50	7.95
NO.5 CARGO HOLD	33 – 68	7477.33	505.89	7983.22	45.97	8.28
CARGO HOLD BALE TOTAL		37402.99	2277.28	39680.27	−6.22	8.00

(Capacity plan extract showing full capacity of each cargo hold)

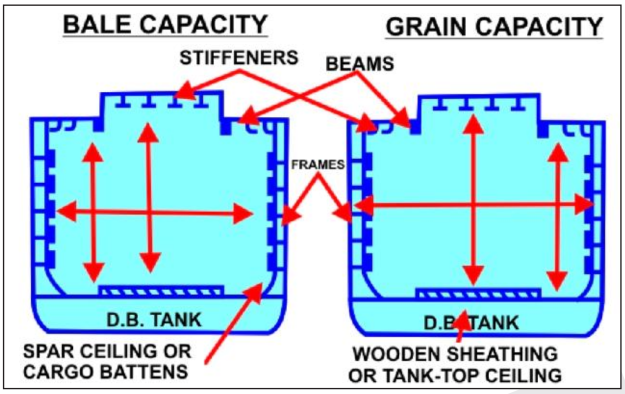
WATER BALLST TANK			1 cub. ft = 0.028317 cub. m SPECIFIC GRAVITY = 1.025 t/cub. m				
NAME OF TANKS		LOCATION	FULL CAPACITY cub. m	cub. ft	weight(t)	·G (m)	KG (m)
FORE PEAK TANK	C	205 – F.E.	720.28	25436	738	−80.88	7.02
NO.1 WATER BALLAST TANK	P	173 – 205	840.55	29684	862	−64.06	3.86
NO.1 WATER BALLAST TANK	S	173 – 205	840.55	29684	862	−64.06	3.86
NO.2 WATER BALLAST TANK	P	138 – 173	806.46	28480	827	−37.58	3.75
NO.1 TOP SIDE TANK	P	173 – 205	295.83	10447	303	−62.80	12.41
NO.1 TOP SIDE TANK	S	173 – 205	295.83	10447	303	−62.80	12.41
NO.2 TOP SIDE TANK	P	138 – 173	311.51	11001	319	−37.81	12.31
AFT PEAK TANK	C	A.E. – 8	211.83	7481	217	82.14	9.48
WATER BALLAST GRAND TOTAL			12556.00	443410	12870	−11.33	6.13

FRESH WATER TANK			1 cub. ft = 0.028317 cub. m SPECIFIC GRAVITY = 1.000 t/cub. m				
NAME OF TANKS		LOCATION	FULL CAPACITY cub. m	cub. ft	weight(t)	·G (m)	KG (m)
FRESH WATER TANK	P	−2 – 8	80.28	2835	80	81.70	12.40
POTABLE WATER TANK	S	−2 – 8	80.28	2835	80	81.70	12.40
FRESH WATER TOTAL			160.56	5670	161	81.70	12.40

FUEL OIL TANK (FILLING RATIO = 90 %)			1 cub. ft = 0.028317 cub. m SPECIFIC GRAVITY = 0.970 t/cub. m				
NAME OF TANKS		LOCATION	FULL CAPACITY cub. m	cub. ft	weight(t)	·G (m)	KG (m)
NO.1 FUEL OIL TANK	C	138 – 173	524.72	18530	458	−37.94	0.79
NO.2 FUEL OIL TANK	C	103 – 138	523.55	18489	457	−9.91	0.79
NO.3 FUEL OIL TANK	C	31 – 103	364.48	12871	318	25.44	0.79
H.F.O. SERVICE TANK	S	28 – 32	26.87	949	23	62.34	10.26
H.F.O. SETTLING TANK	S	28 – 32	28.14	994	25	62.34	10.46
FUEL OIL TOTAL			1467.76	51833	1281	−8.44	1.15

(Capacity Plan extracts showing capacity of each tank)

21) **Bale capacity**: This is the capacity of the space to load cargo like bales, bags, crates, cases, drums and general cargo which cannot be fitted in between the frame spaces. This capacity is the volume of the unobstructed space within a cargo compartment. It is the cubic capacity of a space when the breadth is taken from the inside of the cargo battens, the depth from the wood ceiling to the underside of the deck beams and the length from the inside of the bulkhead stiffeners or sparring where fitted.



22) **Grain capacity**: This is the capacity of the space to load free flowing cargo like grain, iron ore, coal, and fertilizers in bulk, which will occupy any available space even in between frames spaces and can flow in to all corners of the hold. This capacity is the volume of free space available in a cargo compartment. It is the cubic capacity of the space where lengths, breadths and depths are taken right to the plating. An allowance is made for the volume occupied by frames and beams.

Apply Your Knowledge

1. Find out the load density of various cargo spaces on board your ship. For example:-

No. 1 hold	:	tank top
	:	main deck
	:	hatch cover

Function: Cargo Handling and Stowage
Competence: Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

Task Reference No.: B1.3

Sub task Reference Nos.: B1.3.1, B1.3.2, B1.3.3, B1.3.4, B1.3.5

Topic: Cargo Operations

Task Heading

- Assist the supervision of loading and discharging of cargo. Assist in ensuring that cargo operations are proceeding as per cargo plan and that drafts, trim, stability, stresses, hogging and sagging are as per cargo plan at all times.
- Read the Chief Officer's standing and night orders.
- Assist in completing the ship-shore safety checklist prior to cargo operations and also with other cargo documentation.
- Read the drafts accurately and calculate freeboard on arrival and departure. Calculate hog and sag based on the draft readings.
- Take dock water density using hydrometer and calculate the dock water allowance.

Objectives

- Assist in watchkeeping at port
- Understand a cargo plan and be able to follow same
- Understand Chief Officer's standing and night orders
- Understand the importance of complying with ship shore safety checklist
- Be able to read draft, and calculate hog/sag
- Calculate freeboard using load line details from load line certificate
- Understand that 'density in air' is required for draft survey purpose and how it is different from "density in vacuum"
- Be able to read a hydrometer.

Index

1. Introduction
2. Chief officer's standing and night orders
3. Reading draft
4. Density observation
5. Dock water allowance
6. Taking over watch in port
7. Rounds on deck prior taking over
8. Cargo plan
9. Watch keeping in port
10. Ship shore safety checklist

Description

1) **Introduction:** Keeping a watch in port is no less important than a watch at sea. Arrangements for keeping a deck watch in port shall at all times ensure:
    - safety of life, of the ship, the port and the environment
    - safe operation of all machinery related to cargo operation;
    - compliance with international, national and local rules
    - order and the normal routine of the ship.
    - security related requirements are complied with as per vessel's Ship Security Plan and requirements of the port.

> In port, the duty officer may, at times be the senior most officer on board. Always, be aware of what to do in an emergency situation.

In port, the officer has the added responsibility of overseeing cargo operations. The operations vary according to ship type and also depend upon nature of cargo carried. The officer must always be abreast of what is happening and in control of the situation. Written and other orders of senior officers must be followed. Procedures for keeping port watches as detailed in company's SMS manuals must be complied with. An accurate record of all events and observations must be maintained.

> All officers must understand and be familiar with Chief Officer's orders.

2) Chief Officer's standing and night orders: Chief Officer is usually the officer in-charge of all cargo and in-port operations. His standing orders are written, to reflect his own particular requirements and the circumstances particular to the ship, her trade and experience of the officers of the ship. These orders must operate without conflict with the ship's SMS. Orders must be read by all officers upon joining the ship and signed/dated accordingly. A copy of these orders must be available readily to each deck officer, and on ships having a cargo control room, the standing orders must be posted there.

Master may also like to issue standing orders for port operations and but the orders must not be in conflict with each other.

In addition to the standing orders, specific instructions may be needed for special circumstances. Such instructions are written in the night order book which may also be called the "cargo order book" or by other similar name and used for issuing instructions by day or night.

> If draft is to be read over-side by ladder or otherwise, proper Risk assessment must be done and procedures followed.

3) Reading draft: The drafts are measured at the bow, stern and amidships. The scale may use traditional English units (Feet/inches) or metric units. If the English system is used, the bottom of each marking is the draft in feet and markings are 6 inches high. In metric marking schemes, the bottom of each draft mark is the draft in decimetres and each mark is one decimetre high. The vessel's stability booklet refers to draft at fore and aft perpendiculars. If the actual markings are not at the perpendiculars, a correction depending on trim of vessel will need to be applied.

In rough sea conditions, it may be difficult to read an accurate draft – a glass draft reading tubes are used to dampen surface oscillations. The draft marks are engraved but also must be painted in contrasting color. Drafts must be read and recorded on every arrival and prior every departure. Additionally, in port the draft must be read and recorded twice a day.

Many ships are fitted with remote draft display readings (automatic). Accuracy of these must be frequently compared with visual draft observations.

The mean draft is (ford draft + aft draft)/2 and the difference between the mean draft and midship draft determine hog and sag. If midship draft is greater than the mean draft, the vessel is said to be sagging and if it is lesser than the mean draft the vessel is said to be hogging.

Due to the breadth of the ship, it is obvious that the draft reading on port and starboard sides will be different unless the ship is exactly upright. The difference between port and starboard draft will be maximum at amidships and least at the ford end.

For proper cargo calculations, draft is thus obtained for 6 points (3 on each side). Irrespective of the midship marks being available, the midship freeboard must be measured and midship draft calculated.
Mean of Mean (M/M) drafts is the mean of (1) the fore and aft mean and (2) midship mean.

The mean of mean of means draft (M/M/M) is obtained as follows:
(M/M + Mid Draft)/2

The mean of mean of means draft (M/M/M) is used for referring to the displacement tables.

Draft surveys are used to determine the weight of cargo loaded onto, or discharged from, a vessel.

In principle, draft surveys require only a measurement of the water displaced by the vessel before and after the cargo is transferred, along with a measurement of the water's density. Water displacement is measured through draft marks on the ship. The difference between the weights of water displaced before and after the cargo transfer will equal the weight of the cargo within measurement accuracy limits.

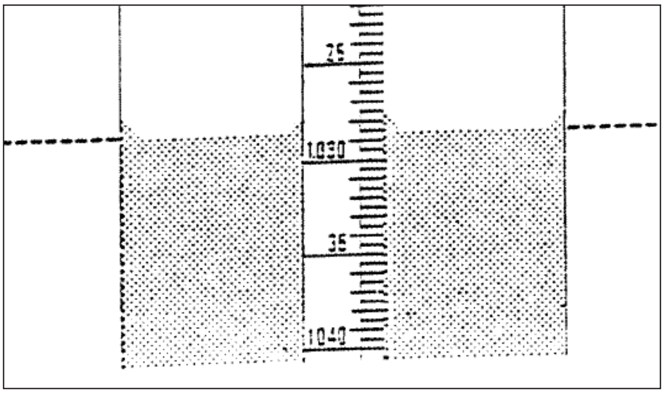
In practice, draft surveys are complicated procedures. Some or all of these factors may have to be taken in to account:

- The varying density of sea or river water
- Changes in quantity of ballast between initial and final draft readings
- Changes in consumables on the vessel between initial and final draft readings (fuel oil, potable water, etc.)
- Allowance for trim, list and hog/sag corrections
- Condition of the vessel's draft markings
- Weather and sea conditions at the time of reading
- Weather and day-light

4) **Density observation:** For purpose of calculating vessel's displacement, the density is observed using a hydrometer calibrated for density in air (kg/l). Weight is always measured in air thus 'density in air is used'. A common glass hydrometer used for density measurement is one of "Zeal" make. This is calibrated for 'density in air'. This is different than the brass load line hydrometer which is calibrated for relative density 60^0/ 60^0f or $15/15^o$c in vacuum as the load line convention uses 'relative density in vacuum.

Density is measured as follows:

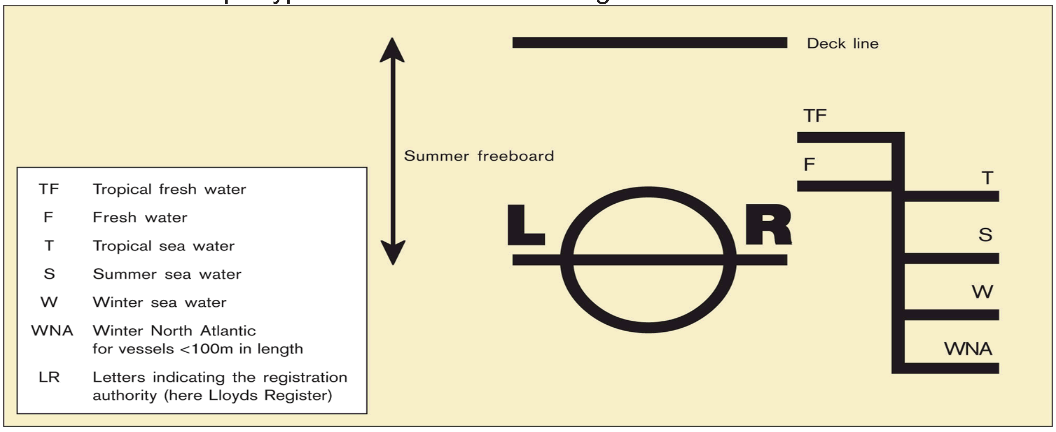
a. Obtain representative sample of sea water. This may have to be taken from different depths using a special container which can be opened at depth required.
b. The water should be put in a glass test jar after rinsing same with sample water.
c. Ensure that the glass hydrometer is clean
d. Hold the hydrometer stem vertically and gently lower it into the water till it floats freely
e. Take the hydrometer reading where the level liquid surface meets the graduated scale
f. Reading should be taken as soon as possible after drawing the water sample to ensure minimum change in temperature



(This indicates a reading of 1028.5 kg/l in air)

5) **Dock water allowance:** A ship will sink deeper in fresh water than in Sea water due to the difference in relative densities. Relative density of sea water is taken to be 1.025 against fresh water density of 1.000.

Each vessel is assigned load line marks, which are engraved and painted amidships on both sides of the ship. Typical load line marks are given below:



A ship assigned load line marks as shown above when in summer load line zone floating in seawater, of relative density 1.025 should not be submerged beyond the top of the 'S' line which is same as the top of the horizontal line running through the disc.

If the "S" line is submerged beyond the top edge, the vessel is said to be overloaded if other conditions are same as mentioned above.

In fresh water with relative density 1.000 the ship can be submerged till top edge of the "F" line.

> Load line hydrometers are made of brass – not glass

The distance between top edges of the "S" line and "F" line is the fresh water allowance (FWA) and is given in the load line certificate in millimeters (mm).

The "T" mark indicates the tropical zone mark and "W" the winter zone mark.

When floating in water having a relative density other than 1.000 or 1.025 the vessel's load lines are allowed to be submerged above or below the "S" mark. The amount of submersion, above or below the "S" mark is called the "Dock Water Allowance (DWA)" in millimeters.

DWA = (FWA (1.025-Dock water RD))/.025.
(Both FWA and DWA in mms)

6) **Taking over watch in port:** Prior to taking over the deck watch, the officer must be satisfied that he has at least the information given below. The information may be provided by the handing over officer/ senior officer or through written orders of chief officer or master.

> Before taking over watch, always satisfy yourself with respect to safety and security of vessel

- the depth of the water at the berth, the ship's draught, the tidal details, mooring/ anchor arrangement, and the state of main engines and their availability for emergency use
- details of cargo operations in progress and expected, including all work to be performed on board the ship, the nature, amount and disposition of cargo loaded or remaining, and any residue on board after unloading the ship
- the status bilges and ballast tanks
- the signals or lights being/ required to be exhibited or sounded
- the number of minimum crew members required to be on board and the presence of any other persons on board
- the status of fire-fighting appliances
- any special port regulations
- the master's/ chief officer's standing and special (night) orders;

- the lines of communication available between the ship and shore personnel, including port authorities, in the event of an emergency arising or assistance being required (contact list to be displayed)
- any other circumstances of importance to the safety of the ship, its crew, cargo or protection of the environment from pollution
- the procedures for notifying the appropriate authority in case of pollution
- any security related matter of significance

7) **Rounds on deck prior taking over:** Relieving officers, before assuming charge of the deck watch, must take rounds and verify that all is in order and confirm that:

> Rounds are taken to satisfy the taking over officer that all is in order

- the securing of moorings/ anchor chain is in order
- the appropriate signals or lights are properly exhibited or sounded
- safety measures and fire-protection regulations are being maintained
- cargo operations and other work are progressing on expected lines.
- he is aware of the nature of any hazardous or dangerous cargo being loaded or discharged and the appropriate action to be taken in the event of any spillage or fire
- no external conditions or circumstances imperil the ship and that it does not imperil others
- any special requirements as detailed in chief officer's/master's orders are complied with

8) **Cargo plan:** A duty officer must have with him a cargo plan expected to be followed during his watch. A plan is required to ensure that all operations in the port are carried out safely and efficiently.

> Cargo plan must be discussed with all officers on board prior arrival port.

The plan details the stowage of all cargo, sequence of loading/discharging from each compartment, expected, draft, forces and moments at each stage of operation, loading/ deballasting sequence and any other special operation.

It may be necessary to update a plan but all concerned on board and ashore must be kept informed. On taking over watch, the duty officer must be aware which stage of the plan is being executed. He must not hesitate to consult senior officer if he is of the opinion that execution of the plan cannot be done safely.

Given below are samples of loading/ unloading plans of a bulk carrier. Plans for tankers are discussed in detail under tanker section/s.

Distribution :
☐ File 14.7.2

BULK CARGO ~~LOADING~~ / DISCHARGING PLAN

M.V. .... Cargo RAW SUGAR Total 34894 MT Stowage Factor 42 cu.ft/MT Depth Available
Port .... Grade (1) Qnty (1) .... MT No. of loaders / dischargers 2 Max. (at High Water) ....
Date .... (2) (2) .... MT Load / Discharge rate 300 mt / hr. Min. (at Low Water) ....
Loading / Discharging DISCHARGING (3) (3) .... MT Ballast pumping rate 1300cu. m/ hr. Max. air draught ....
Estimated duration 5 DAYS (4) (4)

				6	5	4	3	2	1
Tonnes Grades				5816 MT,	6409 MT,	4927 MT,	5882 MT,	6413 MT,	5447 MT,

** BM & SF to be expressed as % of maximum permitted values, to be numbered 1A, 1B, 2A, 2B, etc. when using two loaders.

* Abbreviations : PI = Pump In GI = Gravitate In F = Full
PO = Pump Out GO = Gravitate Out MT = Empty

Warning: The maximum allowable limits for hull girder shear forces, bending moments and mass in holds (adjacent holds, block loading limits) are not to be exceeded at any stage of the voyage, including loading/deballasting operations, all passages between ports and discharging/ballasting operations.

	Cargo		Ballast Operations						Calculated Values						Observed Values					
									Draught						Draught					
Seq no	Hold No.	Tonnes	Tank	Oper *See Abbr.	Quantity	Sdg Upon Comp	Time Reqd Hrs.	Comments	FWD	MID	AFT	TRIM	SF** %	BM** %	FWD	MID	AFT	TRIM	Air drft	Time
1	2	3,000																		
	5	3,000							8.89	9.29	9.69	0.80	-22.6	-13.0						
2	3	3,000	5 WBT	GI	640	4.00														
	6	3,000	6 WBT	GI	772	4.00			8.19	8.19	8.20	0.01	-27.0	30.8						
3	1	2,882	1 WBT	GI	1044	4.00														
	3	2,882	3 WBT	GI	908	4.00			5.97	7.28	8.60	2.63	37.2	37.3						
4	2	3,413	2/3 WBT	PI	90%	14.30														
	5	3,409	5 WBT	PI	90%	14.40			5.35	6.44	7.54	2.19	-29.7	37.8						
5	1	2,565	FP	PI	650 MT	7.00														
	4	2,565	1 WBT	PI	90%	14.24			3.84	5.48	7.13	3.29	28.4	57.1						
6	4	2,362	AP	PI	100%	8.35														
	6	2,816	4/6 WBT	PI	90%			NO 4- 14.4 m/ NO 6P- 14.21/ 6S- 13.35	4.00	4.75	5.50	1.55	52.5	76.6						
Total		34,894		Total		Total		Final	4.00	4.75	5.50	1.55	52.5	76.6						

No Deviation from this plan without prior approval of Chief Officer

Acknowledged by ____________
Terminal / Stevedores

....
Chief Officer

9) Watchkeeping in port: All company's procedures must be complied with. It is the duty officer's responsibility to ensure that all operations are carried out safely and according to the cargo plan. Chief officer's/master's orders must be complied with and if there is any conflict between orders or it appears that the plan and specific orders are not in line, same must be clarified.

The draft, bending moments and shearing forces must always be within safe limits and as shown in the cargo plan.

The officer must be alive to what is happening on and around the vessel and be aware that he is also responsible for safety of all outsiders on board. The ship security plan must be strictly implemented.

To achieve above objectives the officer must:

- make rounds to inspect the ship at appropriate intervals
- pay particular attention to:
  - the condition and securing of the gangway, anchor chain and moorings, especially at the turn of the tide and in berths with a large rise and fall, if necessary, taking measures to ensure that they are in normal working condition
  - the draught, under-keel clearance and the general state of the ship, to avoid dangerous listing or trim during cargo handling or ballasting,
  - the weather and sea state,
  - the observance of all regulations concerning safety and fire protection,
  - the water level in bilges and tanks,
  - all persons on board and their location, especially those in remote or enclosed spaces, and
  - the exhibition and sounding, where appropriate, of lights and signals;
- in bad weather, or on receiving a storm warning, take the necessary measures to protect the ship, persons on board and cargo;
- take every precaution to prevent pollution of the environment by the ship
- in an emergency threatening the safety/security of the ship, raise the alarm, inform the master, take all possible measures to prevent any damage to the ship, its cargo

and persons on board, and, if necessary, request assistance from the shore authorities or neighbouring ships

- be aware of the ship's stability condition so that, in the event of fire, the shore fire-fighting authority may be advised of the approximate quantity of water that can be pumped on board without endangering the ship
- offer assistance to ships or persons in distress;
- take necessary precautions to prevent accidents or damage when propellers are to be turned
- enter in the appropriate log-book, all important events affecting the ship.

10) **Ship shore safety check list:** The purpose of a ship shore safety check list (SSCL) is to improve working relationship between ship and terminal, and thereby improve safety of overall operations. Misunderstandings may occur and mistakes can be made when ship's officers do not understand the intentions of terminal personnel, and same can occur when terminal personnel do not understand what the ship can and cannot safely do.

    Completing the checklist together is intended to help ship and terminal personnel to recognize potential problems, and be better prepared for them.

    SSCL used on tankers is dealt with, under different sections of the record book.

    SSCL are also used for bulk carrier operations and may also be used on other trades depending on industry requirements.

Apply Your Knowledge

1. Calculate DWA (Dock Water Allowance) for any four ports during your stay on board.

Function: Cargo Handling and Stowage

Competence: Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

Task Reference No: B1.5

Sub task Reference No: B1.5.1, B1.5.2, B1.5.3

Topic: Cargo Ventilation

Task Heading

- Take and record hold temperatures and maintain a record of hold ventilation. Identify when a cargo hold should be ventilated based on dew points and temperatures.
- Trim ventilators.
- Operate ventilator fans.

Objectives

- Understand why hold ventilation is required
- Understand "cargo sweat" and "ship sweat"
- Understand importance of recording ventilation details
- Understand how forced ventilation is better than natural ventilation

Index

Description

1. Introduction

Cargo carried in the hold is liable to get damaged due to various factors. Holds are totally closed before proceeding to sea to prevent any external elements like bad weather and water directly affecting the cargo. Indirectly, however transfer of heat through the hold plating due to change in outside air and sea temperatures can affect the temperature of hold atmosphere. This can affect the cargo inside and major claims can arise due to 'condensation'.

When the voyage is long, keeping the hatch totally closed can cause various other problems besides 'condensation' such as:

- Accelerated corrosion of the ship's structure
- Harm to persons and property due to presence of a dangerous gaseous atmosphere in the hold
- Deterioration of cargo due to gases emitted

> Beware of condensation whenever carrying cargo sensitive to water/ moisture damage

Ship's officers must know the property of each cargo carried and know how best to ventilate the compartment to prevent any damage to the cargo and ensure that any dangerous gases emitted are ventilated and replaced with fresh air. Especially before man entry, it must be ensured that no dangerous gas is present in the hold and the oxygen content is at least 20.9%.

For conditioning of the hold atmosphere it is essential that the officer is aware of the temperature inside the hold. Some cargoes are prone to spontaneous combustion if the cargo temperature rises, for example, coal. For this purpose, temperatures of cargo holds are taken on a daily basis and recorded (preferably twice daily when carrying cargo prone to spontaneous combustion).

Hold temperatures are taken through specially provided perforated temperature pipes both at the fore and after end of the cargo hold.

2. Observing and recording cargo hold temperatures

> Cargo hold temperatures must be recorded in the log book

- Cargo hold temperatures are taken with hold thermometers graduated up to 100 degrees C. These thermometers are enclosed in a metal casing, so that they are not damaged when lowering or hoisting from the hold (They are meant for rough usage)
- As mentioned earlier, temperatures of the holds are to be taken when the ship carries cargoes that are liable to combustion when temperature rises.
- Hold temperatures are measured through temperature pipes situated both at the fore and aft section of the hold. On some ships "remote distance reading temperature sensors" are fitted which gives the temperature of the holds at any instant on a digital readout. These may be fitted at different levels and a plan is provided to give sensor location.
- When taking hold temperatures using manual thermometers, the temperature of all holds should be taken at least at 3 different levels from each temperature pipes.
- Any drastic change (change of over 10-15°C) from the normal temperature is an indication of local heating and this should be investigated.
- A record of hold temperatures taken during a voyage should be maintained on board. A column can be made in the deck log book for these to be recorded if dedicated space is not provided.

3. Importance of ventilation

If we do not ventilate the cargo spaces there will be an increase/ decrease in the temperature of the hold atmosphere. The deck which is exposed to the sunlight will heat up and by conduction the temperature of the air inside the hold will begin to rise. An increase in the sea water temperature will also have the same effect on the shipside plating and consequently on the hold temperature.

Conversely when going from hot to cold areas, the hold atmosphere may cool down.

a. Effect on some cargoes due to heating

> Remember, coal can rapidly self-ignite if allowed to heat.

- Cargoes like grains or seeds will start to germinate, a process accelerated by heat.
- Certain cargoes like coal, oil cakes, wet hides by themselves produce heat due to exothermic reaction. The excess heat may cause the atmosphere inside the hold to become flammable, increasing the chances of spontaneous combustion.
- With perishable cargoes like fruits and flowers - heat could cause ripening and deterioration at a faster rate.
- Due to heat certain organic cargoes like molasses and green sugar will start fermenting, evolving alcoholic vapors and carbon dioxide gas which are dangerous for persons entering the holds to inspect the cargo and the lashings.

b. Other uses of ventilation besides removing excessive heat

- Ventilation minimizes toxic and inflammable gas accumulation inside the cargo spaces. Certain cargoes have a natural tendency to evolve gases and if these spaces are not ventilated the gas will remain inside the hold causing associated problems.

Dew point of outside and inside air is an important factor in determining if sweat could form in a hold

- To prevent damage to cargo due to sweat, especially if the cargo is hygroscopic in nature. Ventilation helps to remove damp moist air from inside the hold.
- To prevent contamination of cargoes due to odour. Certain cargoes have natural odours like tea, coffee, tobacco, incense. These odours could penetrate other cargoes loaded such as food products making them unfit for human consumption - hence the need to ventilate.
- Due to the continuous process of oxidation, the oxygen inside the hold is used up as steel has a very high affinity for oxygen. This may cause a reduction in the oxygen level inside, making the hold unsafe for human entry. Hence prior to entry in the hold we must ventilate it thoroughly.
- Sweat and condensation of moisture in the hold of a ship carrying steel products can cause rust stains to form on the cargo. This condensation can occur if ventilation is not carried out properly.

As you can see from these points ventilation is very important for prevention of damage to cargo. However, it is even more important to know when to ventilate and when not to since more claims are caused as a result of incorrect ventilation than from no ventilation at all.

c. Formation of sweat

The atmosphere at sea is very humid, meaning it contains a large quantity of water vapour. Condensation will form on any relatively cold surface (that is relative to the temperature of the surrounding air). On a ship this may be either the ship's shell plating or the cargo inside the hold. On the other hand, when the air in the hold is cooled below its dew point, the water vapour condenses into water droplets which may deposit on cargo or on the ship's structure. The former is known as "cargo sweat" and the latter is known as "ship's sweat". The intention on board, must be to stop both, ship and cargo sweat from occurring.

The amount of water vapour concentration contained in a parcel of air depends on the temperature of the air. The parcel is said to be saturated if it has the maximum amount of water vapour it can hold at that temperature. If this parcel is further cooled excess water vapour will condense in the form of "sweat".

d. Cargo sweat

Consider the following case:
A ship has loaded steel cargo at Antwerp in January for shipment to Singapore. Antwerp in January has low temperatures. As the cargo spaces would be sealed after completion of loading, the cargo and the air temperature inside the hold will be cold. During the voyage to Singapore the outside atmospheric temperature will rise as the ship passes from winter areas to the tropical areas. Compared to the volume of air inside the hold, the volume of air brought into the hold through the ventilator ducts at any given time is small.

- If ventilation is permitted - the warm moist air entering the cold cargo space will be cooled and if cooled below its dew point will condense on the cold steel cargo surface causing cargo sweat. This can cause the steel to rust.
- Here the solution is to restrict ventilation. Do not ventilate when passing from a cold area to a warm area, always allow the air and cargo in the hold to warm up naturally.

e. Ship’s sweat

- Now, consider a ship having loaded cargo in a warm region proceeding towards a cold region. For example: bagged rice is loaded in Bangkok, in November, for shipment to Inchon in South Korea. At the time of loading, the ambient temperature in Bangkok could be in region of 26 degrees C. The cargo and the air inside the cargo hold is warm and moist and would continue to remain so for some time after the hold is sealed. Air and seawater temperature starts to drop as the voyage progresses. As the seawater and the outside air cools the air inside the hold which is in close contact with the steel plates also cools. When this parcel (air inside the hold adjacent to the steel plates) is cooled below its dew point, water vapour is given out which condenses on the ship's structure forming "ship's sweat". This does not directly cause a cargo problem but when the moisture droplets run down the beams and drips onto the cargo, which it invariably does, it may result in cargo damage and subsequent claims.

- To prevent this ventilate the compartment freely. The rule is to ventilate when travelling from a warm area to a cold area.

4. General notes on ventilation

It may not be always possible to restrict ventilation for sweat reason alone. Some cargoes give off odour or obnoxious gases which may damage or taint other cargoes. Here ventilation may become necessary. In such cases where ventilation has to be done - Air should be passed through de-humidifying units. This will ensure that condensation does not take place inside the hold. De-humidification is carried out by using chemicals like silica gel or activated alumina which have a high affinity for water and absorb all the moisture in the air. The same chemicals can be heated to dry out the absorbed moisture and can be reused.

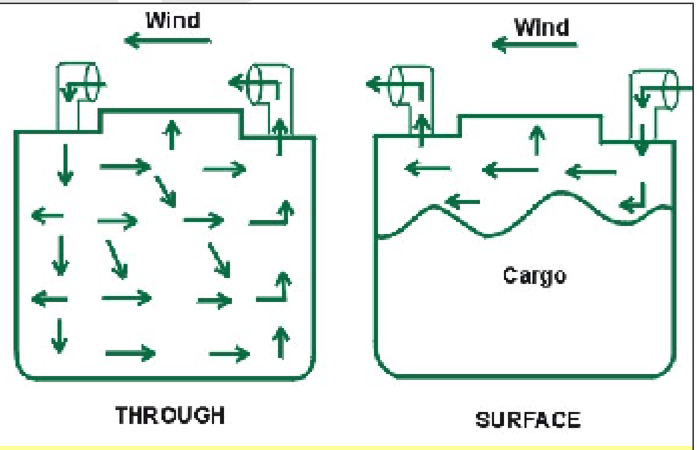
RULE OF THE THUMB: "HOT TO COLD, VENTILATE HOLD
COLD TO HOT, VENTILATE NOT"

- If the dew point of the outside air is higher than the dew point of the inside air, restrict ventilation. Method of obtaining dew point is explained in another module.
- If the dew point of the outside air is less than the dew point of the inside air, ventilate the compartment.
- Local weather conditions are subject to change. Shut ventilation during rain or just before a thunderstorm.

5. Surface/through ventilation

Depending on nature of cargo, ventilation may be required only over the surface or through the cargo stow.

- **Through ventilation**: In this case air is passed through the entire area of the hold right down to the bottom. This can be achieved by means of ducts, double layering of the bottom dunnage and use of side battens to allow free flow of air. The air entering through one set of ventilators reaches the bottom of the compartment via trunkings, rises upwards through the cargo and finally exhausts out of another set of ventilators. In case of natural ventilation this is achieved by turning the leeward ventilator into the wind and the windward ventilator away from the wind, thereby achieving a greatest air flow rate which is required for through ventilation. Some cargoes like Rice bags are stowed in blocks to encourage through ventilation.



Natural through ventilation using cowl ventilators

- **Surface ventilation**: Certain cargoes like coal give off flammable gas and generate heat due to exothermic reaction. If the heat generated over a period of time is sufficiently high, then the presence of the flammable gas and the atmospheric oxygen in the right proportion could lead to spontaneous combustion. Hence it is important that the flammable gas is expelled but at the same time too much oxygen should not be injected into cargo. This is achieved by only ventilating the cargo on the surface known as surface ventilation.

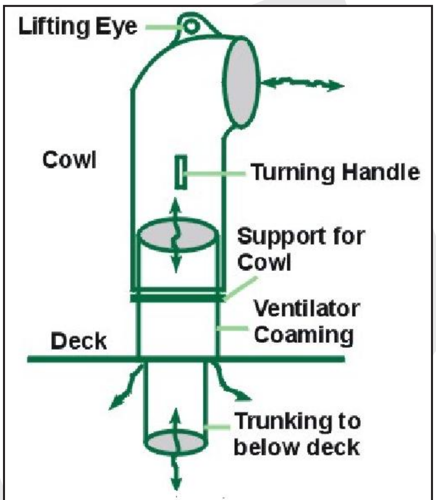
This is achieved by trimming the windward side natural ventilator to the wind and the leeward side ventilator away from the wind giving a very easy flow to the wind. If the ventilator has trunkings which lead to the bottom of the hold - it should be kept shut. This type of ventilation also helps to control the rise in temperature of both the cargo and the hold spaces. Cargoes requiring surface ventilation must be compactly stowed.

6. Ventilation methods

Ventilation is carried out either naturally or mechanically. Mechanical ventilation is also called forced ventilation.

a) Natural ventilation

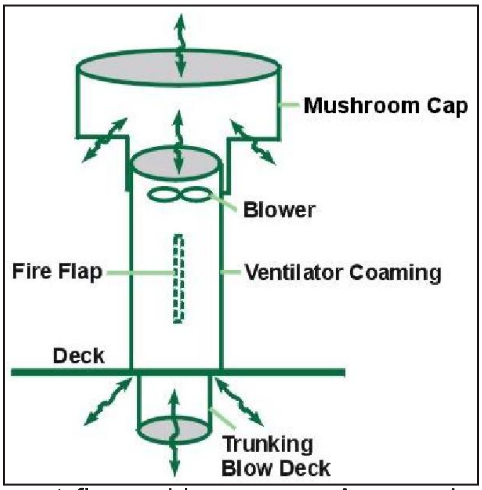
This is carried out using cowl ventilators as shown in the diagram. This type of ventilation depends on the direction of the wind and its natural force. There are no mechanical blowers to force air flow. This type of ventilation is suitable for surface ventilation. Normally cowl ventilators are fitted on the four corners of the cargo compartment and these cowls could be directed towards the wind. The leeward ventilators are placed facing the wind and the windward ventilators away from the wind. Constant check has to be maintained on the direction of the wind and the cowls need to be turned as the wind direction changes. Turning of vents into or away from wind is called “trimming of vents”. In case ventilation to the compartment is to be completely restricted, the cowls are removed, the opening is plugged by a wooden disc and ventilator pipe is closed by a canvas cover.



Cowl Ventilator

b) Mechanical or forced ventilation

Forced Ventilators are in the form of mushrooms either placed on all the four corners of the compartment or one each forward and aft close to the centreline. They have an electrical blower which is capable of being used either for supplying the air or for drawing out the existing air. These ventilators overcome the drawbacks of natural ventilators and hence are very efficient for through ventilation. The shape of the ventilator (mushroom cover) is such that these ventilators cannot be used as a natural ventilator. Normally when there are 4 blowers provided for each compartment, then only two are used either on "exhaust" or "supply". The other two act as natural vents. The greatest disadvantage of this type of ventilation is in case of cargoes which give out flammable vapours. Any spark created by the motor may lead into an explosion or fire and hence the electrical motor and any electrical arrangement should be made intrinsically safe and flame proof. On modern ventilators a wire mesh is provided to act as a spark arrestor.



Flaps are provided below the blowers on the ventilator which can be closed to seal the entire compartment. The flaps will need to be closed in case of fire in the compartment or

when ventilation needs to be restricted to avoid "sweat". These flaps are also known as "fire flaps" or “fire dampers”.
Complete records of all cargo hold ventilation carried out detailing time fans on/off and mode (supply/exhaust) must be maintained for each hold.

Apply Your Knowledge

1. Your ship is on a voyage from Cape Town to Rotterdam carrying steel cargo in the holds. The hold and ambient temperatures were recorded daily. No. 2 cargo hold temperatures recorded are as follows:

Day	Ambient Temp (dry bulb)	Ambient Temp (wet bulb)	Hold temp	Dew Point	Ventilation status
1	25°C	20°C	25°C		
2	26°C	22°C	25°C		
3	30°C	26°C	26°C		
4	34°C	33°C	28°C		
5	36°C	31°C	29°C		
6	23°C	20°C	27°C		
7	17°C	17°C	24°C		

Calculate the dew point temperature and state for each day whether or not you will ventilate the hold and, if you do ventilate, whether you will used forced ventilation or natural ventilation. Justify your answer. Assume good weather- slight seas and no rain.

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: B2.1.1, B2.1.2, B2.1.3, B2.1.4, B2.1.5

Topic: Inspection of Cargo Spaces, Hatch Covers and Ballast tanks

Task Heading

- Inspect cargo spaces and holds on completion of cargo discharge prior to sailing and report defects and damage.
- Assist in maintenance of hatch covers.
- Assist with the opening, closing, battening down and securing of hatch covers.
- Inspect hatch covers and report defects and damages.
- Demonstrate understanding of precautions to be taken whilst opening and closing hydraulic and mechanical hatch covers.

Objectives

- Familiarize yourself with the operation, inspection and maintenance of hatch covers; Task C2.1.3 shall be read in continuation to these tasks.

Index

1. Operation of hatch covers
   a) Care, precautions and safe practices to be followed when operating hatch covers
2. Maintenance of hatch covers
   a) General maintenance
   b) Procedures for checking the weather-tightness of the hatch covers
   c) Hatch cover leaks
3. Inspection of cargo spaces and hatch covers and reporting of damages/ defects
   a) Reasons for damage
   b) Care during discharge operations
   c) Inspection of hold on completion of discharge

Description

1) Operation of hatch covers

a) Care, precautions and safe practices to be followed when operating hatch covers

Some points to note during the operation of hatch covers are:

> Ensure all cleats are removed prior opening hatch covers.

- All personnel involved in operating hatch covers should be properly trained. Read and follow manufacturer's instructions.
- When operating hatch covers ensure that all cleats are removed.
- Before turning on the power, ensure that the correct switch for that particular hatch cover is switched on. Also your hands should be dry when switching on to avoid getting a shock. In the case of hydraulic pumps ensure that there is sufficient oil in the hydraulic tank, prior to switching on the pump.
- Ensure that there are no obstructions on the track way. They should be clear of all loose cargo, garbage and dunnage.
- Lifting appliances should be attached to hatch covers from a safe working position (if applicable and required).
- Ensure that the hauling wire (check wire) used on a single pull hatch covers is in good condition and well lubricated. The position of lead and snatch blocks should be such that

the wire reaches the warping drum of the winch in the correct way and does not go over sharp edges or bends. The wires should not show any signs of rusting, fraying, compression or damage.

❖ The rubber gasket packing resting firmly on the compression bar provides weather tightness. The sealing properties will be lost if the bar is grooved or damaged due to presence of paint, rust or loose cargo. So ensure that the compression bar is clean and undamaged. The rubber gasket packing should neither be too soft or too hard. It should not be exposed to paint, chemical or other sharp objects.

❖ Personal safety equipment like hard hats and safety shoes should always be worn. There should be at least 2 persons involved during operation of hatches. One operating the system and other watching the hatch covers from the opposite side to ensure smooth operation.

❖ Personnel handling wires should always wear leather gloves to protect hands from any injury due to any snags in the wire.

❖ All persons should keep well clear of the hatches when closing or opening and the hatch cover stowage area must be checked to ensure it is clear before the operation starts.

Never ride on a hatch cover when it is being opened or closed.

❖ Hatch pontoon wheels and rollers should rotate freely without any strain.

❖ The drain channels are provided along the top of the hatch coaming and in between hatch pontoons where they interlock. This is meant for draining out any water coming on the hatch cover and the coaming due to shipping seas or rain. The channel should be kept clear so that the water drains off instead of accumulating and finding its way into the cargo space through some place where the hatch sealing is weak.

Hydraulic ram of a folding hatch cover

❖ When hatch covers are of the type which have to be raised hydraulically before being opened (like in the single pull type), ensure that all the hydraulic jacks are fully raised prior operating the 'OPEN' lever.

❖ Attention should be paid to the trim of the ship when handling mechanical hatch covers. The trim should not exceed that given in the manufacturer's instructions. As a general guideline hatches should not to be opened if the ship is heeled 5º or more or trimmed 1.5º or more. They should never be opened in case the vessel is rolling.

One type of locking arrangement for folding hatch covers in open position

❖ The locking bar should be applied when pontoons are stowed in the open position in the stowage area. This prevents accidental slipping of hatch cover when in open position. It should be removed prior closing the hatch covers. The safety chain on single pull Macgregor type hatches does a similar job.

❖ It is dangerous to keep folding or rolling type hatch covers partly or halfway open.

❖ In the case of side rolling hatch covers, additional turnbuckle lashings may need to be taken when hatch covers are opened at sea for hatch cleaning purposes. They should never be opened in case the vessel is rolling.

- With single pull hatch covers pulled by chains - ensure that the length of the chain on each side of the coaming is the same and the length of the chain in between the hatch covers is also the same. This can be adjusted by means of a bottle screw provided at the end of each chain.
- Frequently check for chain stretching by marking a length of about 2 meters by means of seizing wire when the chain is new. Chain should be renewed when stretched over 15%.

2) Maintenance of hatch covers

a) General maintenance

Attention should be paid to the following points:

- The manufacturer's literature should be studied and fully understood regarding the operation and planned maintenance of the hatch cover system.
- Coaming drain plugs to be kept clear at all times.
- Before closing hatch covers great care should be taken to ensure that the hatch coamings, the compression bar and the cross-joints are thoroughly cleaned and scraped and any cargo removed.
- Care should be taken to ensure that the quick acting cleats (QAC's) and the top cleats on the hatch covers are properly lubricated. The steel nut used for adjusting at the bottom of the cleat should be kept greased at all times. Check the neoprene rubber washer for compression, wear and tear and elasticity.
- Grease hatch fittings regularly - including the hatch cover wheels, grease points and moving parts.
- It must be noted that no matter how well the hatch covers are secured in place, there is always a little movement of the covers relative to their coamings due to the movement of the ship in the seaway. As the main load of the hatch covers is taken by the resting pads on the hatch coamings, these pads must be regularly given a coat of grease so that their wear and tear is minimized.
- Over a period of time the rest pads could get worn down to such an extent that the hatch cover lip begins to touch the hatch coaming face plate. This could cause:
  - The hatch cover lip to make a groove in the hold coaming face plate
  - The rubber packing to compress excessively, causing it to take on a permanent groove which can be in excess of 6mm.

  To avoid this happening, the rest pads need to be built up to the manufacturers recommended height by welding flat plates of the requisite thickness on the rest pads.
- Care and maintenance of hydraulic jacks and motors must be carried out according to the manufacturer's manual.
- In single pull hatches, which are pulled by chains - regular inspection of chains should be carried out.
- The lead blocks and snatch blocks should be overhauled according to the ship's maintenance plan (usually, once in at least 6 months) and should be regularly inspected for cracks and other damages (if applicable).
- The trackway should be regularly chipped and painted. Sometimes grease is applied on the trackway so that the pontoon rollers move smoothly. But this is not a good idea as grease, dust and cargo accumulates on the trackway obstructing the movement. It is better to keep the trackway dry and clean.
- Hatch pontoon wheels should be overhauled according to the ship's maintenance plan (usually, once in at least 6 months). Internal bearings of the wheels should be inspected and if damaged, should be replaced.

b) Procedures for checking the weather-tightness of the hatch covers

The weather tightness of the hatch covers can be checked in many ways. This topic has been covered under task C2.1.3 which shall be read in continuation.

c) Hatch cover leaks

- Some visual signs of hatch cover leaks to look for
  - Water marks (seepage) on the inside of the hatch coamings.
  - Water lines or spots on top of the cargo on completion of a voyage.
  - Entry of daylight into a sealed hold with hatch covers closed and battened.
  - Slack marks or streaks of IG soot along the coaming flat bar (In case of OBO's and O/O carriers).

- Emergency measures that can be taken in case of hatch cover leaks

  If hatch covers are found to be leaking the following measures can be taken:

- Open the hatch cover, remove any debris or loose rust on the flat plate which might be the reason for poor sealing and close hatch cover again. Ensure the cross-joints of the two pontoons at the centre are flush against each other. Start cleating at the ends and work towards the centre. Tighten the cleat nuts at the areas where the leak was observed.

- Ramnek tape can be used in places where leaking is suspected to ensure no water enters the hold. Although in the long run it is damaging to the hatch covers (the bond is so strong that it removes the paint when peeled off), it helps the ship to defend against cargo claims as it indicates that the ship has exercised due diligence and had taken all necessary precautions.

- Some bulk cargoes and also some general cargoes can be covered with plastic sheeting with the top sheet overlapping the bottom sheet and any water due to leak or even due to condensation in the hold is collected on top of the sheet and removed prior to discharge.

- Silicon sealant can be applied along the packing where leaks are found. This is only a temporary measure and should be applied to only very minor leaks.

3) Inspection of cargo spaces and hatch covers and reporting of damages/ defects

a) Reasons for damage

During carriage and cargo operations, especially bulk cargoes, damage can occur to the internal structure of the hold or the cargo within, due to various reasons. These include

i. Rough handling of cargo during discharge- for example:
ii. Corrosion
iii. Cracks, buckling & deformation due to excessive stresses

b) Care during discharge operations

During discharging, the duty officer should be alert and watchful for any damages occurring either to ship or to the cargo due to improper operation of the cargo handling equipment. Any damage noticed should be brought to the notice of the stevedore foreman and to the chief officer who would put up a protest for claim and repairs against the stevedores - "Stevedore damage report".

c) Inspection of hold on completion of discharge

On completion of discharge of each hold the duty officer should inspect the hold to see if any part of the structure is damaged. This should include both damage due to physical contact and gradual deterioration of parts of the structure caused by stress or corrosion.

- **Wear and tear :** Small damage like gauges, scrapes, indentation of less than 2 cm are usually accepted as normal wear and tear, which may never need to be repaired and where a claim even if made is unlikely to succeed.

- **Minor damage:** These are the damages that do not impair operational efficiency of the ship and can be repaired by the ship's staff without spending too much time and money. There is no point in making a stevedore damage claim as administration work may far exceed the cost of the repair.
- **Serious damage:** These are the damages which impairs the safety or efficiency of running of the ship, but which does not affect seaworthiness or structural integrity of the ship. For this a "Stevedore Damage Report" must be handed over to the stevedores and an acknowledgement received. The damages can be made good in owner's time but at stevedores cost.
- **Major damage:** These are the damages that affect seaworthiness or violate class requirements. Repairs must be completed prior leaving port. All expenses will be on stevedores account. Stevedore Damage Reports should be substantiated with photographs.

During the inspection, pay particular attention to:

- Hold ladders
- Tank top
- Cracks in plating, frames, web and other strengtheners
- Leakage from top side tanks
- Piping system in the Hold
- Shipside frames and transverse bulkheads
- Connection of the bulkhead with upper stool shelf plate, especially at the swaged end of the corrugation.
- Connection of the bulkhead to topside sloping plate.
- Corrugation bulkhead in entirety for buckling/distortion.
- Connection of ballast trunk to shell plating, topside and hopper tank.
- Connection of bulkhead with lower stool, lower stool shelf plate and shedder plate. Check shedder plate carefully for cracks in way of crossing of shedder plate in adjacent hold and for any cracks in the bulkheads.
- Lower stool bulkhead and its connection to tank top and side hoppers.
- Connection of curtain plate/diaphragm between corrugations with corrugated bulkheads.
- Access ladders and platforms condition including handrails.
- Manhole doors to lower stools for any leakage.
- Welds- check for any decay or breakdown of welds
- Breakdown of paint coatings
- Structural damages
- Hatch coamings and hatch end beams - pay particular attention to:
    - Check hatch coaming brackets/stays connection to the main deck for any cracks, especially stays close to centre line and at extreme ends of the coamings.
    - Check hatch coaming flats for any grooving in way of resting area of hatch covers, cracks in way of hatch cover wheel lifting plates and cut outs for cleats.
    - Check all hatch corners (inside) for cracks in the deck plating and in the coaming.
    - Check for cracks in main deck plating and top stool shelf plate in way of hatch entrances.
    - On hatch end beams, check for cracks in way of knuckles, grain filling holes, hatch end beam connection to top side tanks and end connection of hatch end beams to top side tank sloped plate.
    - Cross deck underside longitudinal brackets connections to hatch end beam and top stool vertical bulkhead.

Apply Your Knowledge

1. Assist the chief officer in preparing a stevedore damage report in the format specified by your company for this purpose. Attach the report.

Semester 3

Function 3: Controlling the operation of the ship and care for persons on board and Ship Security

Sr. No.	Topic	Task No.	Task Description	Page No.
	and requirements			
22.	Safety of personnel and ship	C7.1.1	Attend tool box meetings prior to carrying out various jobs.	105 – 106
23.	Safety of personnel and ship	C7.1.2	Demonstrate understanding of the use of various checklists (wherever applicable) and precautions required for various critical jobs such as: ❖ Entry into enclosed spaces ❖ Working aloft ❖ Working over-side ❖ Carrying out hot work ❖ Using power tools ❖ Manual lifting and carrying	107 – 119
24.	Safety of personnel and ship	C7.1.3	Identify the personal protection equipment (PPE) available on board and its use for various jobs.	120 – 124
25.	Ship security	D1.1.1	Recognize the three security levels.	125 – 128
		D1.1.2	Understudy the Ship Security Officer with regards to his duties and responsibilities.	
		D1.1.3	Identify the Company Security Officer and his contact details. Explain his duties and responsibilities.	

Function: Controlling the operation of the ship and care for persons on board.

Competence: Ensure compliance with pollution prevention requirements.

Task number: C1.1

Sub-task Reference number: C1.1.1, C1.1.2, C1.1.3

Topic: Bunkering procedures

Task Heading

- Plug deck scuppers effectively.
- Participate in bunkering operations and assist in taking fuel oil tank soundings.
- Locate and check inventory of all pollution control equipment at designated location(s) and assess condition.

Objectives

- To familiarize with the bunkering operations and pollution control equipment.

Index

1. Introduction
2. General bunkering procedures on board
    (i) Pre-bunker planning and operations.
    (ii) Operations during bunkering
    (iii) Operations after completion of bunkering
3. Other bunkering precautions

Description

1) Introduction

Bunkering refers to the transfer of petroleum base products from one vessel to another vessel for the purpose of replenishing fuel for vessel propulsion, lubrication while at anchor or dockside. Bunkering may take place offshore, at anchor or alongside. It may be pumped from road tanker, bunker barge or another tanker or ship.

Bunkering (the operation of taking on board fuel oil) is a major cause of oil pollution incident on all types of ships. Since bunker fuels are likely to be viscous and slow to dissipate, the damage caused by a bunkering spill are often high in proportion to the volume spilled. Whenever a ship takes on bunkers, the operation must be carefully planned and executed by persons who are familiar with the valve and pipeline systems on board.

Bunkering is an extremely vital operation for any ship as the consequence of an oil spill during bunkering can cause major pollution disaster adding to financial consequences to the owner and the company, besides the heavy penalties imposed on the individual(s) responsible for same.

To minimize operational spills, qualified personnel should conduct 'bunkering' or 'fuelling' strictly in accordance with set procedures. In this module we will discuss the procedures that must be followed during bunkering and precautions to be taken during the entire operation. We will also look into the responsibility of the deck and engine officers when carrying out bunkering operations.

2) General bunkering procedures on board

This part could be divided into three sections:

(i) Pre-bunker planning and operations
(ii) Operations during bunkering
(iii) Operations after completion of bunkering

The chief engineer is responsible for the entire bunkering operation. He will not delegate this responsibility to any other engineer and will be available on board through out the entire operation. He will have a team of engineers and officers to assist him under his guidance.

(i) Pre-bunker planning and operations

A detailed bunker plan should be made and displayed at prominent location especially at the bunker station. This plan should include the tanks into which the bunkers are to be loaded, the topping off ullage or the maximum sounding, the lines diagram and important valves in the bunker line.

A pre-bunker safety meeting should be held as discussed under task C1.1.5.

The bunkering team should not be given any other duties except monitoring the fuel transfer during the bunkering operation. If an engineer and an assistant are not available exclusively for this work, then fuelling should be deferred until they are available.

Scuppers must be plugged prior bunkering operations.

All ships today have a bunker checklist which needs to be completed before, during and after the operation. The items on the checklist should be duly scrutinized by a responsible officer before being signed. Some companies may have different checklists for prior, during and after bunkering operations or in some cases only one checklist might incorporate all the requirements. A sample checklist is shown under task C1.1.4.

Check that all scuppers are plugged. Scuppers could be plugged with ready made compression plugs of various types available in the market or using a wooden plug and cementing the scupper after placing the wooden plug. One of the plugs, probably the after most one, should be arranged to allow any rain water to drain during the operation. This is important as in the event of an overflow or spill, the oil will float on top of the water and will find its way over the ship side faster.

Different types of scuppers used on board

Connection of hoses must be done under the supervision of a responsible officer.

Pre-transfer conference should be held with the officer in charge of the bunkering barge or terminal supplying the bunkers. This should include:

Quality of bunker supplied to meet ship's specifications
Sequence of grades to be supplied should be given to the shore facility in writing.
Agreed pumping rate:

- during commencement of bunkers
- maximum during bunkering
- at completion stage and during topping off

(Units must be clearly agreed - MT or bbls or m^3)

Emergency stop procedures should be agreed in writing.

Means of communication between ship and shore should be agreed in writing. Communication methods by hand signals should be agreed.

Sampling requirements and methods clearly agreed.

Check and make sure that all valves are shut prior to opening the manifold for hose connection.

Check unused manifold - they should be properly blanked with a good gasket and all bolts in place.

If sampling equipment is provided, fit this.

Empty all drip trays and save-alls and if required place portable drip trays under hose couplings. All the drip trays should be plugged after emptying.

Check soundings of all bunker tanks and calculate the on board quantity prior to commencement of bunkers. Stop ullage or soundings should be clearly marked near the sounding pipe of the bunker tanks in which the bunkers are taken.

Oil absorbent material, such as sand, absorbent booms, pads should be immediately available at relevant points to soak up small spills.

> SOPEP equipment must be available for immediate use.

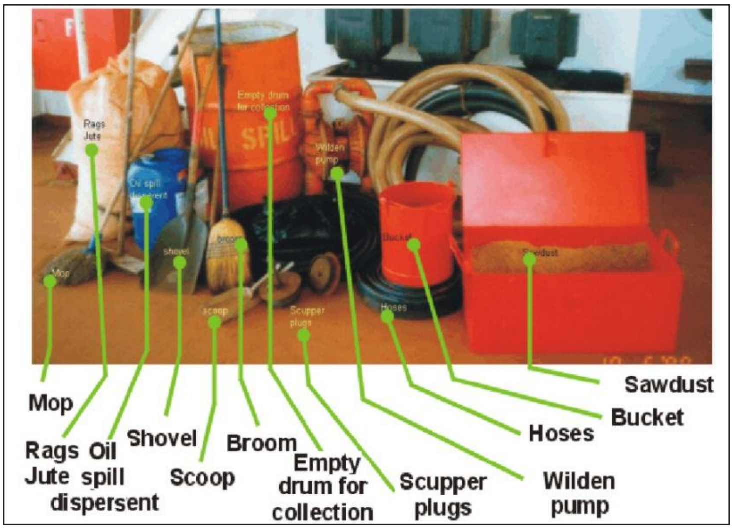
Pollution prevention and containment equipment like portable pump, empty drums and scoops should be kept ready for immediate use at the bunker manifold or at any strategic location.

A 'Bravo' flag during day and red light during night should be displayed throughout the bunkering operation.

> Raise Bravo flag during day and switch on the red light during night during bunkering operations.

Communication between ship and terminal or barge should be tried out.

The chief engineer will complete the ship's bunkering check list with a representative from the suppliers. The office may have to sign this to verify that he has completed all procedures.



The following spill response equipment must be maintained on board.

1.	Air Driven Pump (Wilden type)	1
2.	Sawdust	100kg
3.	Rags	50kg
4.	Spill dispersant	200 ltrs
5.	Shovels	6
6.	Buckets	6
7.	Brooms	10
8.	Scoops	4
9.	Scupper plugs	1 for each plug
10.	Storage/garbage bags	100
11.	Protective clothing	6
12.	Mops	6
13.	Drip trays/save alls	
14.	Drums for disposal of oily material	
15.	7 Barrel spill responses kit	1

(ii) Operations during bunkering

The responsible deck officer and engineer should be present on deck supervising the entire operation. Adequate personnel for assistance should be available at all times during the operation.

Own ship should be properly moored and if bunkers are being received from a barge, ensure that the barge is moored properly. Check moorings both of own ship and bunker barge frequently.

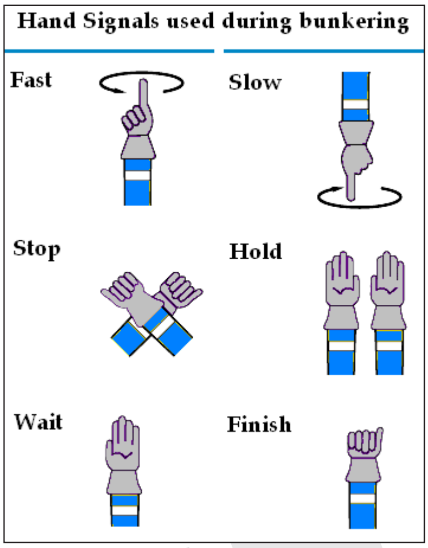
All crew should be informed about the bunker operation so that the ship's emergency response plan can be activated without any delay.

Rig fire wires forward and aft if local regulations warrants it.

Set lines and open the required valves needed to fill the tank. The manifold valves should be the last one to be opened. All unnecessary valves should be kept shut. Setting of lines should be done under the direct supervision of a responsible engineer.

Commence bunkering at a slow rate. Check for leaks at manifold connections and at hose joints. Ensure that oil is loaded only in designated tanks. Monitor the supply line pressure.

The responsible deck officer or chief officer should ensure that there is no drastic change of list or trim during the entire bunkering operation.



Once satisfied that all is in order, inform the barge or terminal to increase rate to that agreed mutually. At the same time monitor the line pressure, flow in the tank and sounding of the tank.

Check the soundings of all bunker tanks frequently and calculate the rate at which the bunker is being received.

'Topping up' operations require particular care and are a major cause of spills. Bunker suppliers must be notified to slow the pumping rate in adequate time.

Sufficient ullage space should be left in the last tank for line blowing (this is the quantity of oil in the line after completion).

Close the valves as each tank is completed.

Persons involved in bunkering operations must have no other task assigned to them.

If it rains during bunkering operation, the officer on watch must ensure that accumulations of water on deck and in the save-alls, are drained away regularly, and drains resealed.

(iii) Operations after completion of bunkering

Ensure that all hoses are completely drained. Usually on completion of bunkers the hoses are blown through with compressed air to drain the hose.

Close all valves in the bunker line and disconnect the hoses from the bunker manifold.

Close and blank all manifold connections. Blank all disconnected hose couplings.

Sound all tanks and calculate the oil received on board taking into consideration list, trim and temperature of the oil.

Check tanks for any water content.

Ensure that the bunker receipt details are correct. If there are any discrepancies as regards to quantity or quality issue the appropriate letters of protest and inform all parties concerned.

Samples collected should be clearly marked with date, time and place of bunkering and should be signed by both ship and shore representatives. If necessary these samples should be landed to be sent for analysis.

All scuppers re-opened, all pollution and containment equipment should be stowed back in proper location on completion of the operation.

Make the appropriate entry in the oil record book.

3) Other bunkering precautions

Prior to loading new bunkers, take samples of the bunker remaining on board (old bunkers) and test them for compatibility with the new bunkers.

As far as possible do not mix the old and new bunkers - load them in different tanks.

Before loading, take and retain samples of the existing bunkers. Be sure to follow the sampling and labelling procedures.

As mentioned above, if it is practically possible, then try avoiding using the new bunkers until the laboratory report is available and always use the old bunkers before using new bunkers.

The bunker receipt should be scrutinized thoroughly and quantity received on board should be within tolerable limits of that declared by the supplier. If not, lodge a note of protest and inform all concerned parties.

Explosimeter readings of the ullage space in each bunker tank should be taken and recorded along with the temperature. If the gas reading exceeds more than 50% LEL, it is an indication that the tank may be contaminated with a cargo leak (especially on tankers). NOTIFY THE TERMINAL, P&I CORRESPONDENT AND OWNERS FOR FURTHER ADVICE.

Apply Your Knowledge

1. Discuss the precautions required during bunkering.

Function: Controlling the operation of the ship and care for persons on board.

Competence: Ensure compliance with pollution prevention requirements

Task number: C1.2

Sub-task Reference number: C1.2.1, C1.2.2, C1.2.3, C1.2.4

Topic: Pollution prevention regulations

Task Heading

- Demonstrate understanding of vessel's operational requirements under the International Convention for the Prevention of Pollution from Ships (MARPOL) annexes to prevent pollution.
- Locate vessel's garbage management plan and demonstrate understanding of contents, color coding of receptacles, etc.
- Demonstrate understanding of the regulations for segregation of garbage and disposal of garbage at sea (special and non-special areas) in compliance with MARPOL.
- Locate vessel's garbage record book and make entries under supervision.

Objectives

- To understand the requirements on board to comply with pollution prevention by garbage, as per MARPOL annex V.
- To identify the importance of garbage management plan on board the vessel.
- To understand the requirement for segregation of garbage and disposal of garbage at sea (special/ non-special areas) in compliance with MARPOL
- To be able to identify the different entries required to be filled in the garbage record book.
- This task should be read in conjunction with task C1.2.8.

Index

1. Introduction to MARPOL
2. Vessel's operational requirements under MARPOL to prevent pollution
3. Prevention of pollution by garbage from ships
4. **Garbage management plan**
5. Garbage record book

Description

1) Introduction to MARPOL

The MARPOL convention is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively and updated by amendments through the years.

The International Convention for the Prevention of Pollution from Ships (MARPOL) was adopted on 2 November 1973 at IMO and covered pollution by oil, chemicals, and harmful substances in packaged form, sewage and garbage. The protocol of 1978 relating to the 1973 International Convention for the Prevention of Pollution from Ships (1978 MARPOL Protocol) was adopted at a Conference on Tanker Safety and Pollution Prevention in February 1978 held in response to a spate of tanker accidents in 1976-1977. As the 1973 MARPOL convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent convention. The combined instrument is referred to as the International Convention for the Prevention of Marine Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78), and it entered into force on 2 October 1983 (Annexes I and II).

2) Vessel's operational requirements under MARPOL to prevent pollution

What is marine pollution?

"The introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities""

The MARPOL convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes:

Annex I	Regulations for the Prevention of Pollution by Oil
Annex II	Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk
Annex III	Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form
Annex IV	Prevention of Pollution by Sewage from Ships
Annex V	Prevention of Pollution by Garbage from Ships
Annex VI	Prevention of Air Pollution from Ships (entry into force 19 May 2005)

3) Prevention of pollution by garbage from ships

Companies have Zero tolerance to any marine pollution.

- **"Garbage"** is defined as all kinds of food wastes, domestic wastes and operational wastes, all plastics, cargo residues, cooking oil, fishing gear, and animal carcasses generated during the normal operation of the ship and liable to be disposed of continuously or periodically except those substances which are defined or listed in other annexes to the present convention. Garbage does not include fresh fish and parts thereof generated as a result of fishing activities undertaken during the voyage, or as a result of aquaculture activities which involve the transport of fish including shellfish for placement in the aquaculture facility and the transport of harvested fish including shellfish from such facilities to shore for processing.
- **"Domestic wastes"** mean all types of wastes not covered by other annexes that are generated in the accommodation spaces on board the ship. Domestic wastes do not include grey water.
- "**Operational wastes"** means all solid wastes (including slurries) not covered by other annexes that are collected on board during normal maintenance or operations of a ship, or used for cargo stowage and handling. Operational wastes also include cleaning agents and additives contained in cargo hold and external wash water. Operational wastes does not include grey water, bilge water, or other similar discharges essential to the operation of a ship, taking into account the guidelines developed by the Organization.
- **"Cargo residues"** means the remnants of any cargo which are not covered by other Annexes to the present 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.

Disposal criteria for garbage – revised annex V of MARPOL

With effect from 1st Jan 2013, the regulations for disposal of garbage from ships as covered under Annex V of MARPOL are revised. The MARPOL convention and domestic law prohibit the discharge of most garbage from ships. Only the following garbage types are allowed to be discharged and under the specified conditions.

- **Outside special areas designated under MARPOL Annex V**

- Comminuted or ground food wastes (capable of passing through a screen with openings no larger than 25 mm) may be discharged not less than 3 nautical miles from the nearest land.
- Other food wastes may be discharged not less than 12 nautical miles from the nearest land.
- Cargo residues classified as not harmful to the marine environment may be discharged not less than 12 nautical miles from the nearest land.
- Cleaning agents or additives in cargo hold, deck and external surfaces washing water may be discharged only if they are not harmful to the marine environment.
- With the exception of discharging cleaning agents in washing water, the ship must be en route and as far as practicable from the nearest land.

- **Inside special areas designated under MARPOL Annex V**

- More stringent discharge requirements apply for the discharges of food wastes and cargo residues

The disposal requirements are shown in the following table:

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]	≥3 nm, en route and as far as practicable	≥12 nm, en route and as far as practicable[3]
Food waste not comminuted or ground	≥12 nm, en route and as far as practicable	Discharge prohibited
Cargo residues[5, 6] not contained in washwater	≥ 12 nm, en route and as far as practicable	Discharge prohibited
Cargo residues[5, 6] contained in washwater		≥ 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	≥ 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) Garbage management plan

Every ship of 100 gross tonnage and above, and every ship which is certified to carry 15 or more persons, and fixed or floating platforms shall carry a garbage management plan which the crew shall follow. This plan shall provide written procedures for minimizing, collecting, storing, processing and disposing of garbage, including the use of the equipment on board. It shall also designate the person or persons in charge of carrying out the plan. Such a plan shall be based on the guidelines developed by the organization and written in the working language of the crew

5) Garbage record book

Every ship of 400 gross tonnage and above and every ship which is certified to carry 15or more persons engaged in voyages to ports or offshore terminals under the jurisdiction of another party to the convention and every fixed or floating platform shall be provided with a garbage record book. The garbage record book, whether as a part of the ship's official logbook or otherwise, shall be in the form as specified in the appendix to revised MARPOL Annex V.

With effect from 1st Jan 2013, garbage is grouped into categories for the purpose of the garbage record book as follows:

- A Plastics
- B Food wastes
- C Domestic wastes
- D Cooking oil
- E Incinerator ashes
- F Operational wastes
- G Cargo residues
- H Animal carcasses
- I Fishing gear

RECORD OF GARBAGE DISCHARGES

Ship's name: ______________________

Distinctive No., or letters: ______________________

IMO No.: ____________

Garbage categories:

A. Plastics
B. Food wastes
C. Domestic wastes (e.g., paper products, rags, glass, metal, bottles, crockery, etc.)
D. Cooking oil
E. Incinerator Ashes
F. Operational wastes
G. Cargo residues
H. Animal Carcass(es)
I. Fishing gear

NEW TABLE LAYOUT AS BELOW:

Date/ Time	Position of the Ship/Remarks (e.g., accidental loss)	Category	Estimated Amount Discharged or Incinerated	To Sea	To Reception Facility	Incineration	Certification/ Signature

Master's signature:______________ Date: ____________________

Apply Your Knowledge

1. What MARPOL equipment is provided on your ship to enable compliance with Annex I requirements.
2. Write down the entries made in vessel's garbage record book over a period of two days at sea.

Function: Controlling the operation of the ship and care for persons on board

Competence: Ensure compliance with pollution prevention requirements

Task Reference No.: C1.3

Sub task Reference Nos.: C1.3.1

Topic: Bilge and ballast operations

Task Heading

- Assist deck officers carry out ballasting and deballasting operations.

Objectives

- Understand the need for ballasting and de-ballasting.
- Understand the procedure and precautions to be taken during ballasting and de-ballasting operations.

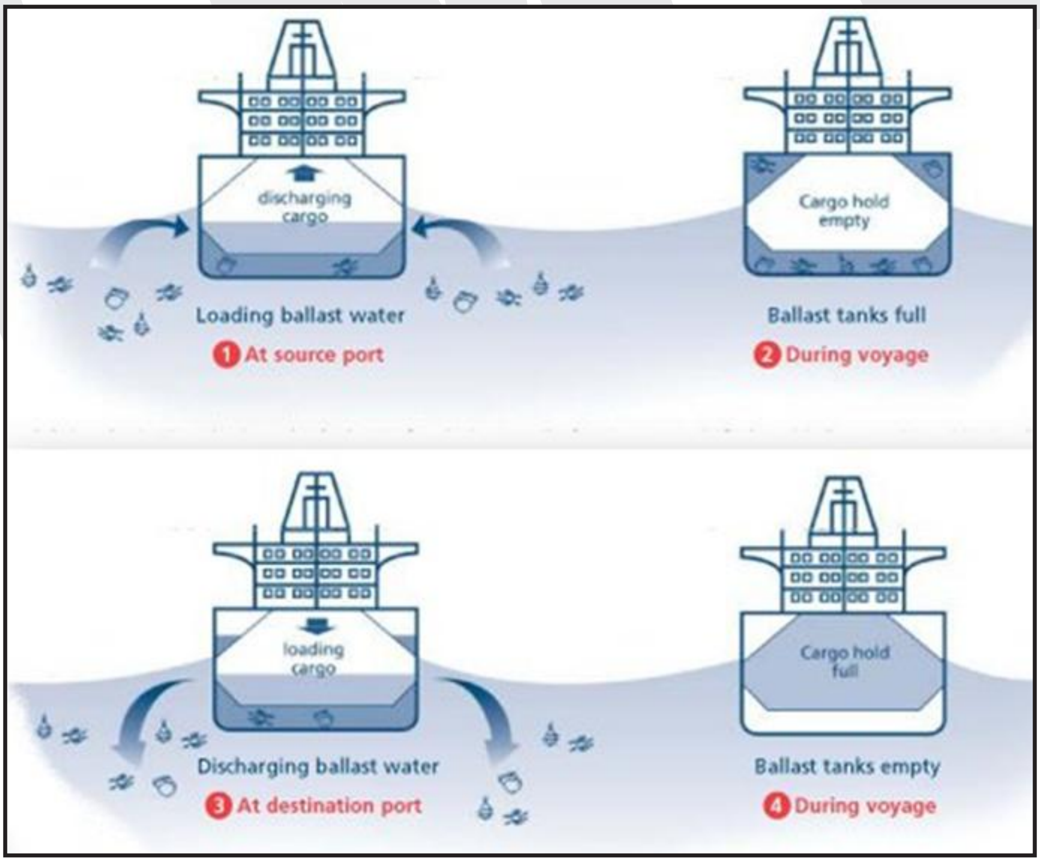
Index

1. Introduction
2. Ballasting/ de-ballasting operations
3. Precautions during ballasting / de-ballasting operations.

Description

1. Introduction

Ballast is any material used to weight and/or balance an object. One example is the sandbags carried on conventional hot-air balloons, which can be discarded to lighten the balloon's load, allowing it to ascend. Ballast water is therefore water carried by ships to ensure stability, trim and structural integrity.



Ballast water is carried in unladen ships to provide stability. It is taken on board at the port while discharging the cargo, for stability purposes, before the voyage begins and tiny stowaways, in the form of marine organisms, are taken on board with it.

The IMO has introduced the International Convention for the Control and Management of Ship's Ballast Water and Sediments. The convention brings about a uniform regime for ballast water management throughout the world, since some port states had established unilateral controls on the discharge of ballast water of foreign origin into their coastal waters.

2. Ballasting/ de-ballasting operations

Cadets understudying the deck officer in supervising a ballasting / de-ballasting operation should be familiar with the ship's pumping plan, positions of associated air and sounding pipes, positions of all compartments and tank suctions and pipelines connecting them to ship's ballast pumps, ballast sampling points and, in the case of use of the flow through method of ballast exchange, the openings used for release of water from the top of the tank together with overboard discharge arrangements. They should also familiarize with methods of ensuring that sounding pipes are clear and that pipes and the non-return devices are in good order. They must be familiar with the pumps, their capacities with time required to undertake the various ballast water exchange operations. Most importantly, they must be fully familiar with the lining up of the ballast lines and valves and with the safety practices associated with the ballasting / de-ballasting operation.

Loading and discharging of water ballast is carried out using the existing ballast system and pipeline provided on board the ship and are to be carried out as per established shipboard procedures laid down in the company's ISM manuals, checklists and the ship stability booklet. Most important thing to ensure before carrying out ballasting / de-ballasting operation is the stability of the ship at all given times during the operation. The stresses should be adequate/within limits at all stages during the operations.

Step by step procedure for carrying out ballasting / de-ballasting operations

a. Prior to every operation the chief officer prepares a sequence, which is also called the loading / unloading plan, ensuring that hull stresses including shearing forces, bending moments and torsional stresses as applicable are adequate and pre calculated, using loading computer and ship stability booklet. Hull stresses should be carefully monitored during cargo and ballast operations onboard vessel. Loading computer should be regularly updated for conditions on board. Where possible, comparison of actual and calculated draft & trim is also to be carried out in order to obtain warning of any unplanned or unobserved deviation from plan. Undue stresses on the hull shall be avoided and stresses shall be maintained within stipulated limits at all times.

   Asymmetrical emptying and filling of tanks must never be carried out. Ballast tanks must be emptied and filled in matched pairs, such as no.1 port & stbd DB hopper or topside tanks or no.3 port & stbd DB Hopper or Topside tanks. Asymmetrical emptying or filling of tanks (for example - no. 2 stbd tank and no. 4 port tank being emptied or filled simultaneously, while no. 2 port and no. 4 stbd tank remain untouched) creates torsional stresses which cannot be calculated, and are thus considered highly dangerous.

b. Ballasting / de-ballasting sequence to be discussed fully and clearly with the duty engineer. After discussion, a copy of the ballasting / de- ballasting instructions / sequence should be kept with the duty engineer in the engine control room with his signature on the original as acknowledgment.

c. Proceed with ballasting / de-ballasting operation as per pumping arrangement of individual ship.

3. Precautions during ballasting/ deballasting operations

a. Communication between deck officer and duty engineer should be left open and free throughout.

b. Ensure manholes for ballast tanks are shut.

c. Check soundings of tank(s) being ballasted/ deballasted frequently to confirm that ballast water is being filled/ removed to / from the right tank.

d. Check that air pipes float /flap are open and air is freely flowing in or out as the case may be.

e. When topping - off a tank, reduce the filling rate in order to prevent pressurizing the tank and reduce air pockets.

f. Where circumstances allow, check the cargo hold where the air escape pipes are passing through - in case of any leakage in those pipes or from any previous unnoticed damages on hoppers or tank top to prevent cargo damage.

g. Stop the pump or open the valve of the next water ballast tank, when tank is reached desired level. Do not overflow tanks through the air pipes. The air-pipes of the ballast tanks are not of sufficient size to allow continuous pumping of water into the tank without dangerously over-pressurising the tank.

h. Confirm that the valve of the completed tank is closed.

i. When de-ballasting with the main pumps, care must be taken not to let the pump run dry/lose suction. Duty engineer to stand-by the pump and throttle discharge valve to get maximum ballast out by the main pump.

j. When the main pump loses suction, change over to stripping with the eductor / bilge- ballast pump.

k. Strip one tank at a time, and confirm that the valve is firmly/ tightly closed after stripping.

l. The ballasting / de-ballasting sequence to be strictly followed in concurrence with cargo operations or during exchange of ballast at sea. In case ballasting/ de-ballasting falling behind schedule, duty officer must immediately inform C/O, who must check out the stress and take positive action to correct any alarming rise in the stress factor. It may necessitate stopping cargo work until ballasting / de-ballasting is back on schedule (C/O will consult master in case necessary to stop cargo-work)

All ballast / de-ballasting operation carried out must be recorded in the ballast log, ballast water record book and in the case of ballast water exchange, also in the ballast water reporting form.

There are port state regulations or controls that require the vessels calling at the ports of their states to carry out a mid-ocean ballast water exchange.

In line with this, the IMO has adopted Resolution A.868(20) on 27 November 1997, viz., “Guidelines for the control and management of ship’s ballast water to minimize the transfer of harmful aquatic organisms and pathogens” and further the International Convention for the Control and Management of Ship’s Ballast and Sediments.

There can be penalties for ballast overflow in ports which shall be checked.

Apply Your Knowledge

1. Attach the deballasting sequence followed at your last load port. List the precautions to be taken when deballasting a tank /hold.

Function: Controlling the operation of the ship and care for persons on board.

Competence: Maintain sea worthiness of the ship

Task number: C2.2

Sub-task reference number: C2.2.1

Topic: Ship Construction

Task Heading

- Identify various parts of the principal structural members of a ship.

Objectives

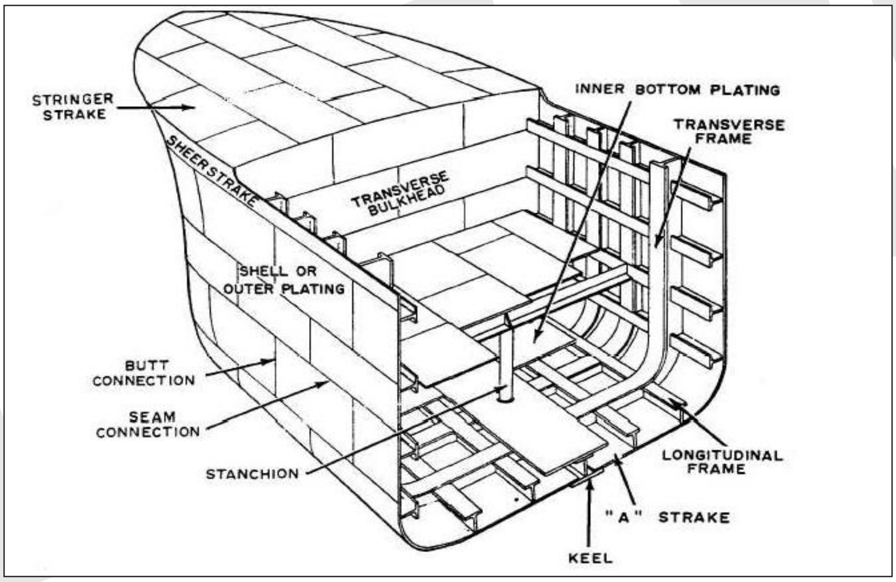
- To be able to Identify and learn the proper names of various parts of the principal structural members of a ship.

Index

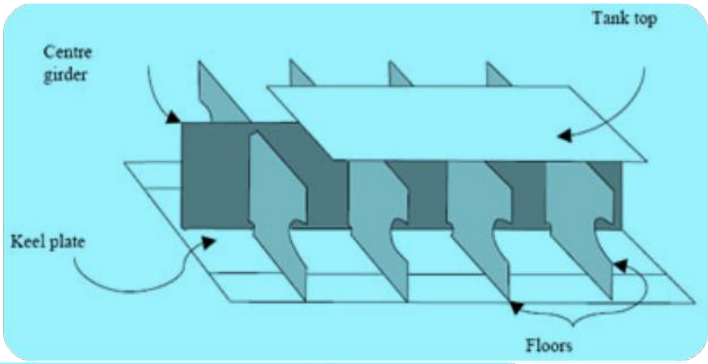
1. Definition of hull elements
2. Types of construction

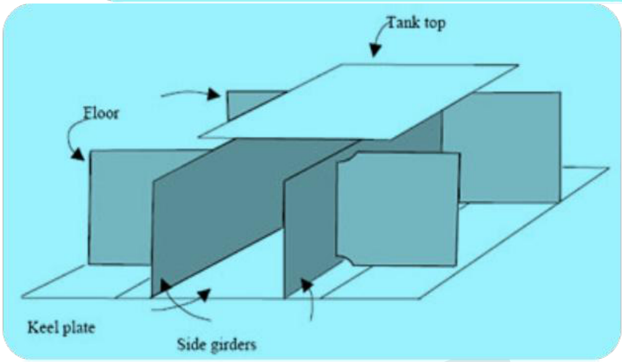
Description

1) Definition of hull elements



- **Keel**: the keel is a member, or series of members, running longitudinally that forms the structural base of a ship. The keel always corresponds to a ship's centreline. It is a major component in providing longitudinal strength and efficiently distributes local stresses when the ship is dry docked. There are two types of keels used to build ships of a certain size, the flat keel and the duct keel.

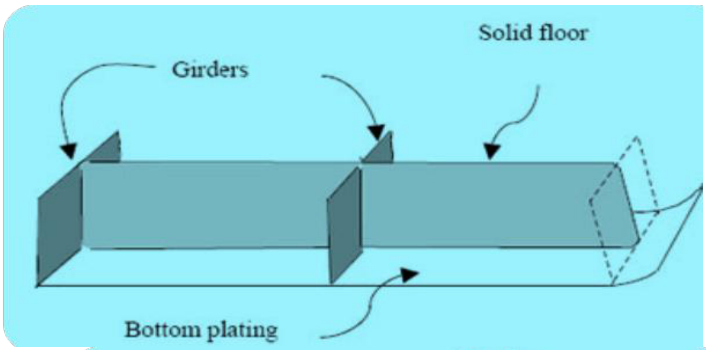


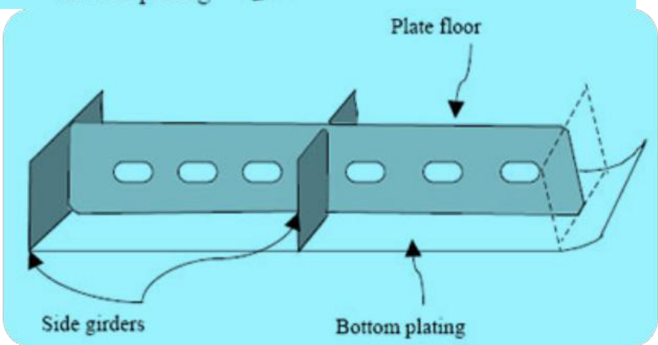


Flat keel Duct keel

- **Girders**: A girder is a longitudinal member used in the construction of the bottom of a ship. They can be solid or not and can be placed above the keel (centre girder) or spaced equal distances from it (side girders). They can be continuous or divided by floor sections (intercoastal side girders). The centre girder is always one continuous piece and must be fastened to the keel with a continuous weld. Girders must extend as far as possible from the forward to the aft end of a ship.

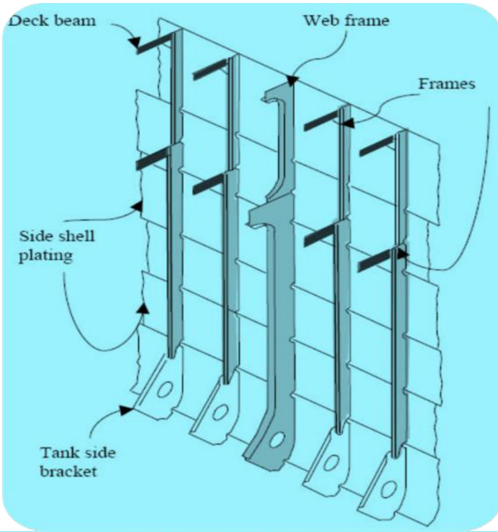
- **Floors**: These are made up of cross members that are mounted perpendicular to the keel and girders. There are three main types of floor: plate, solid and bracket.

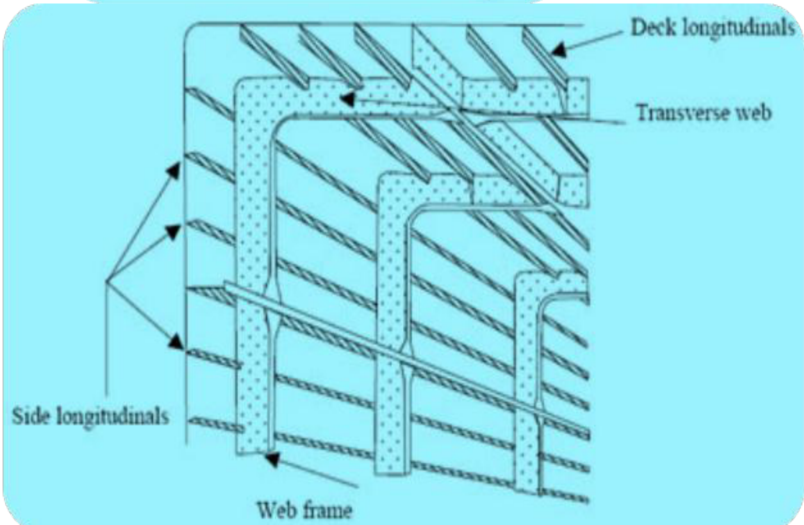




Solid floor ***Plate floor***

- **Frames**: These are vertical members that make up the framing of the vertical part of the hull. Frame type and spacing vary considerably depending on the ship's construction.





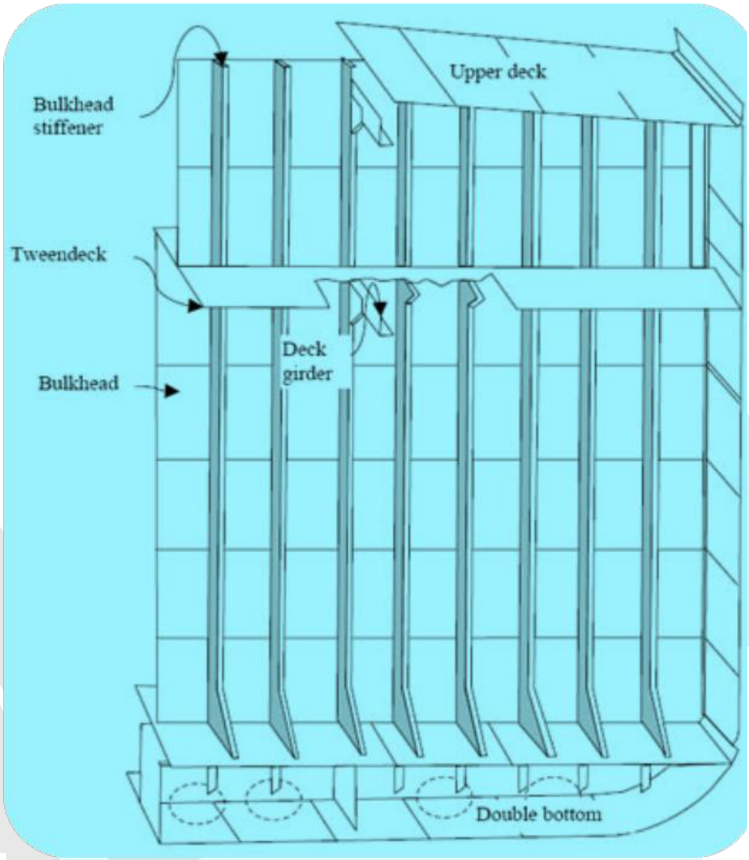
Shell framing ***Longitudinal framing, deck and shell***

- **Deck girders**: These are longitudinal members that combine with the beams to form the longitudinal framing of the deck.
- **Deck beams**: These are transverse members that connect the top ends of the frames, forming the transverse framing for the deck.
- **Longitudinals**: A very general term to identify any small longitudinal member that can be used for several purposes. This term is used more specifically in longitudinal framing.
- **Web frames**: Oversized members that replace a frame at certain locations on a ship.
- **Bracket**: A general term that identifies any part used to connect two members.
- **Beam knee**: Bracket located at the end of deck beams that connect the beam and frame to the shell plating.
- **Plating:** The plating of a hull is the series of plates that form the watertight shell of the hull. There is bottom plating, deck plating and side shell plating.
- **Bilge plating**: Longitudinal plating that connects the side shell plating to the bottom plating.
- **Tank top**: Watertight series of plates attached to a ship's bottom framework.
- **Double bottom**: The double bottom is the watertight space between the bottom plating and the tank top. Its height varies according to the size and type of ship, but it is generally between 0.75 and 1.5 metres. A double bottom is divided into several watertight

compartments by watertight floors and girders. These compartments can be used to store fuel, oil and ballast water. They are often used to adjust a ship's list and trim.

A double bottom maintains a ship's watertight integrity when the bottom is damaged. The tank top greatly increases a ship's longitudinal strength and forms a platform to carry the ship's cargo and machinery.

- **Watertight bulkheads**
  A watertight bulkhead is a transverse bulkhead mounted on the tank top and it must extend right to the uppermost continuous deck.



  Watertight bulkheads are installed to:
  - Divide the ship into watertight compartments and thereby limit flooding if the hull plating is damaged;
  - Improve the transverse strength of the structure;
  - Prevent distortion of the hull plating;
  - Support the deck girders and longitudinals;
  - Rigidly attach the tank top to the upper deck;
  - Greatly slow the spread of fire.

  The number and location of watertight bulkheads on a ship depend on the length and type of ship and the location of the machinery space. The SOLAS Convention determines the number and location of these bulkheads. But in general, there is a watertight bulkhead (collision bulkhead) at the bow that should be located between 0.05L and 0.075L (L = length between perpendiculars of a ship), a watertight bulkhead at the stern that should form a watertight aft compartment (after peak) that encloses the stern tube, and a watertight bulkhead at each end of the machinery space (where the aft bulkhead may be the after-peak bulkhead).

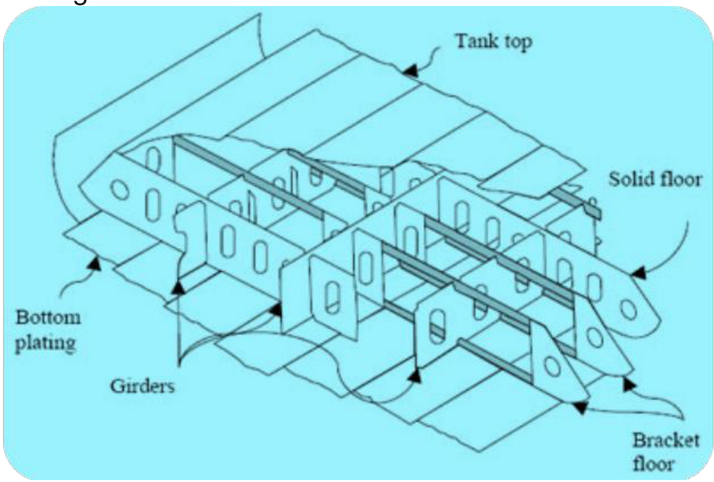
  All members that pass through a watertight bulkhead, such as ventilation ducts, piping and electric wiring, must be mounted so as to maintain the watertight integrity of the bulkhead. That is why remote controlled stopcocks are generally found on certain pipes that pass through watertight bulkheads.

- **Watertight doors**
  In some situations, it is necessary to pierce bulkheads to allow crew or passengers through. In this case, a sliding watertight door is installed. An example of this situation is the watertight door that is found on some ships between the machinery space and the shaft tunnel. Liners have many of these doors that allow passengers to go between the different sections of the ship. These watertight doors are usually hydraulically activated. Local control stations must be located on either side of the door. In addition, a remote control station (generally located in the wheelhouse) must be placed outside both compartments separated by the watertight bulkhead.

2) Types of construction

Transverse framing

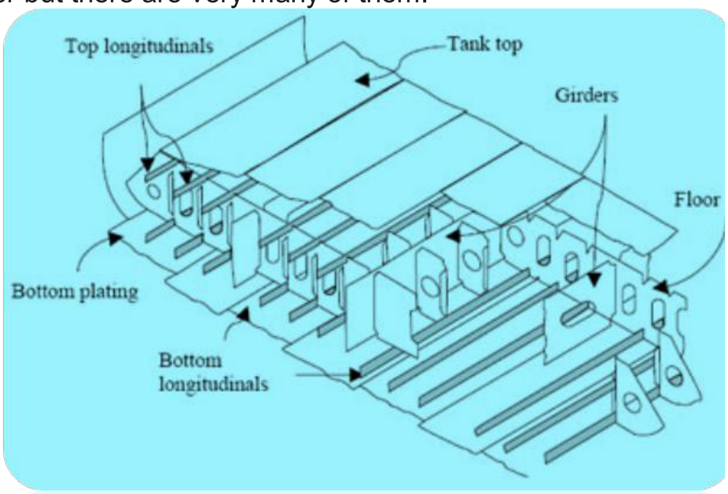
Transverse framing is used primarily for ships less than 120 metres in length. The floors, frames and beams form rings spaced closely together. Longitudinal strength is provided by the keel, centre girder, side girders, deck girders, the entire bottom, deck and side shell plating, and the tank top. Transverse framing ensures good cross sectional strength to handle overall stresses, vertical loads, rolling and dry docking. However, on very long ships, sheer stresses can cause deformations between the rings.



Transversely framed double bottom

Longitudinal framing

Longitudinal framing is mandatory for very large ships, oil tankers and bulk-ore carriers. The rings are formed of floors, deck beams and web frames that replace the frames. These rings are farther apart than in transverse framing. The longitudinal reinforcement members are deck girders, girders, the keel and a large number of deck, bottom and side longitudinals. The longitudinals are slender but there are very many of them.



Longitudinally framed double bottom

Mixed framing

Mixed framing combines longitudinal and transverse framing. One type of framing is used in one part of the ship and the other type is used in another part. The most common combination is longitudinal framing for the bottoms and the deck, and transverse framing for the sides.

Apply Your Knowledge

1. Draw the cross section of your ship and identify the principal structural members.

Function: Controlling the operation of the ship and care for persons on board.

Competence: Maintain sea worthiness of the ship

Task number: C2.3

Sub-task Reference number: C2.3.1, C2.3.2, C2.3.3

Topic: Securing vessel for sea

Task Heading

- Demonstrate ability to rig safety lines and guard rails.
- Check and confirm that all equipment in stores, deck and mooring area are properly stowed and secured and that all water and weather tight openings are closed tight prior to departure.
- Assist the crew in securing gangway.

Objectives

- This module is an entirely practical module that is self-explanatory. The cadets will need hands-on training in performing these tasks. Some notes are given for guidance purposes. The objectives are to familiarize the cadet in proper stowing and securing of equipment and stores, rigging of safety lines and securing of gangway prior departure.

Index

A) Stowing and securing of equipment prior departure
B) Rigging of safety lines and guard rails
C) Securing gangway

Description

A) Stowing and securing of equipment prior departure

Stowing and securing of equipment is a practical task. All equipment must be secured and kept in proper place on board.

Company's safety management system also has a checklist for securing the equipment and preparing the vessel for sea.

> Remember
> There is a place for everything on board and everything must be in place.

01	**Anchors housed fully (ensure flukes tightly resting on the hull) and secured with wire lashing (proper & sufficient for the heavy seas that may be encountered).**	
02	Spurling pipe covers 'ON' and Spurling pipe cemented.	
03	**Chain Locker doors to be securely shut and watertight.**	
04	All Tunnel doors / Hold entrance doors in tunnel to be closed (Container ships).	
05	**Mooring ropes on winch barrels lashed and covered with canvas covers. Other mooring ropes lowered into rope store.**	
06	Floating Blocks of all Davits / Cranes to be secured against any movement.	
07	Lifeboat and Life rafts securing arrangements to be checked if tight.	
08	Accommodation ladders & MOT ladders to be secured for sea and additional lashings taken as provided. All loose gear removed & stowed back in locker.	
09	All booby and access hatch lids checked and secured tightly by butterfly nuts.	
10	All sounding pipes checked for caps tightly secured.	
11	Drip trays and save alls cleaned and drain plugs opened.	
12	All Deck Scupper Plugs removed and stowed inside store room.	
13	Pilot ladder taken in, covered and secured on deck or in the store.	
14	Deck lifeline rigged Fwd to Aft at least on one side.	
15	Relevant Floodlights, pumps & motors, etc exposed to the sea / spray to be covered with canvas.	
16	All Watertight doors, stores and void space vents "SHUT".	
17	All stores checked for unlashed items. Loose items to be lashed.	

18	Deck squared up, all loose material (including FFA for Cargo) stored away securely.	
19	**All doors leading into the accommodation stoppered from inside as anti-piracy measures.**	
20	**Ensure garbage drums and covers adequately secured to prevent any garbage from accidentally escaping overboard.**	
DRY CARGO SHIPS :		
21	Hatch covers checked – fully battened down, Ramnek tape applied as per instructions from AESM / charterers.	
22	Deck Cargo lashings confirmed tight and secure.	
23	Loose lashing gear to be removed and placed in secure bins.	
TANKERS / GAS CARRIERS :		
24	Ullage ports, Cargo and Ballast Tank lids / valves, forepeak, after peak, covers and ventilators should be securely closed. Cargo, Bunker, cofferdam and pump room openings secured. (Lifelines rigged on safety walk on gas carriers).	
25	Cargo & Booster pumps motors to be covered with canvas cover.	
26	Manifold reducers, Blanks, Tools, Flags, Hose handling Equipment and Supports secured.	
27	Draft gauges & sounding / Float gauges to be kept in wind up position.	
28	STS Equipment, Fenders etc to be secured.	

B) Rigging of safety lines and guard rails

- Safety lines are rigged on board on the weather deck to assist people in moving on deck at all times.
- Guard rails serve the same purpose as safety lines. The guard rails are usually rigid railings permanently fitted over large openings. Portable guard rails are also rigged at times over small openings like tank manholes to safeguard persons against accidental falling.

> Safety lines are rigged on main deck and assist people in moving on deck especially in rough weather if required.

C) Securing gangway

Securing of gangway's and accommodation ladders must be carried out prior departure. Additional lashings must be taken as required.

Gangway motors must be covered with canvas.

Apply Your Knowledge

1. You are sailing out on a long ocean voyage. Discuss the arrangements to be made prior departure to secure the vessel for sea.

Function: Controlling the operation of the ship and care for persons on board.

Competence: Maintain sea worthiness of the ship

Task number: C2.4

Sub-task Reference number: C2.4.1

Topic: Seamanship practices

Task Heading

- Make various knots, bends, hitches and whippings.

Objectives

- Familiarize yourself with various knots, bends, hitches and whippings.

Index

1) Introduction
2) Definitions
3) Important knots at sea
4) Important bends at sea
5) Important hitches at sea
6) Whippings
7) Seizings

Description

1) Introduction

Practice making all the knots, bends and hitches described in this module.

On a ship your life and survival often literally hangs on a rope. So, for this reason, it is of utmost importance that rope work and seamanship are learnt right from day one at sea. Some of the most important knots, bends and hitches are discussed below along with their diagrams. Practise and get to know them. Do remember that knots and hitches tend to reduce the strength of the rope locally by as much as 40% to 60%. **This should always be borne in mind as it may affect safety of life and property at sea.**

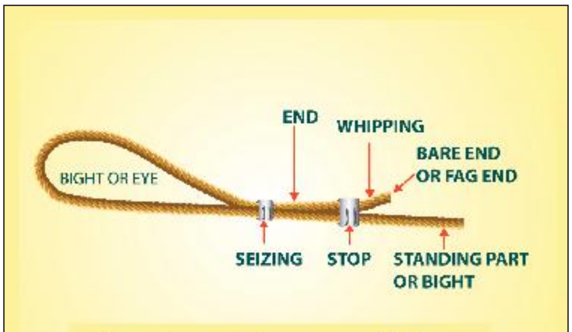
2) Definitions

A knot: involves use of only one rope and generally used to prevent the rope from unreeving.

A bend: is a method of temporarily joining two ropes or ends of two ropes together.

A hitch: is used to attach a rope to a structure or a ring or eye pad. It may also be used to join two ropes (not at the ends).

Bight: is the term used for the middle part of the rope for example: a rope suspended between two points is said to be hanging **"in a bight".**



Some terms in bends and hitches

Standing part: is that part of the bight nearest to the eye.

End: is the short length at the extremities of the rope. It is also the left over short piece of rope after making a knot, bend or a hitch.

The Running end: is that part of the rope which first comes out of the coil or which moves through the pulley.

Whipping: A rope is whipped at the end using twine so that the ends do not fray.

Seizing: Is used to end a knot or to bind two ropes by tying a twine to the standing part and the running end.

The above definitions are only a guideline and need not be adhered to strictly.

3) Important knots at sea

The overhand knot: This is the simplest of all knots and for this reason it is hardly ever used on its own. It is usually used to start off another, more complicated knot. This knot may be used on a rope to give a good holding grip for hands.

The figure of eight knot: This knot is larger, stronger and easier to untie than the overhand knot. It is used most commonly as a stopper knot. This knot is generally used in the lifelines of the lifeboat davits as a foot hold and also in the gripes of the boat. It may also be used to prevent the rope from unreeving from the block.

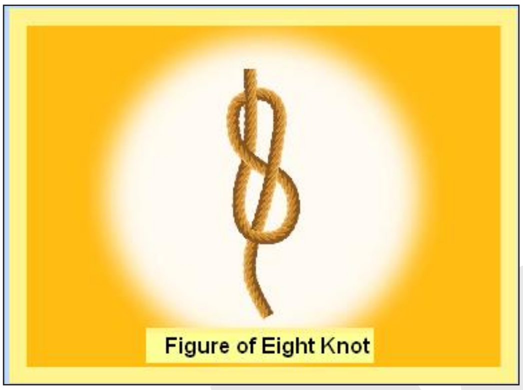
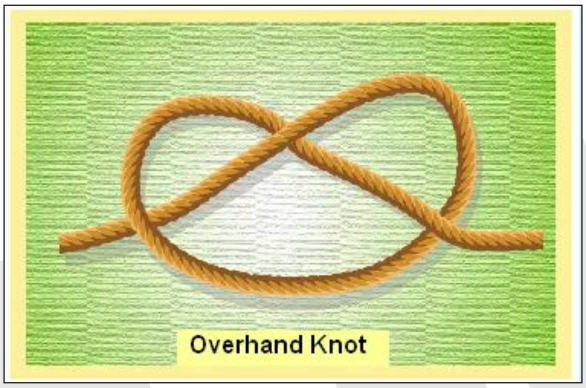
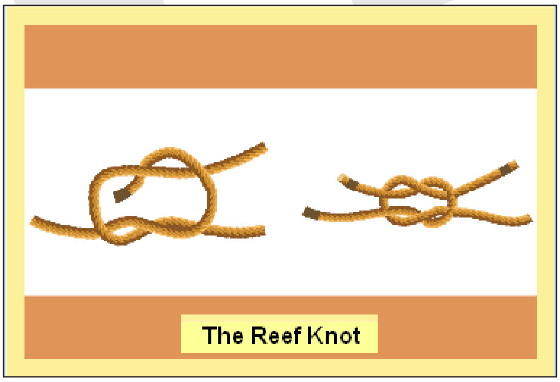


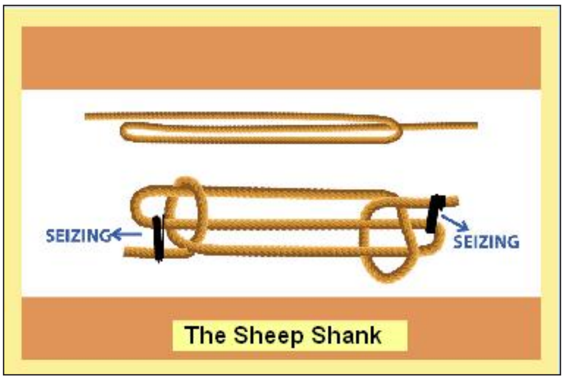
Figure of Eight Knot


Overhand Knot

The reef Knot: The reef knot is only useful in simple applications. It is easy to tie and will not jam, so it is always easy to untie. It is used for binding rolled sails, tying packages and as a base for the shoe-bow. It can be used as a trustful knot on most occasions, unless there is jerking on the line. The reef knot is used to join two ropes of equal size and which does not come under too much strain. It cannot be used to join two ropes of unequal size. It consists basically of 2 overhand knots but care must be taken when putting the knot that the ends are crossed in the opposite way each time, that is, left over right and right over left and vice versa.

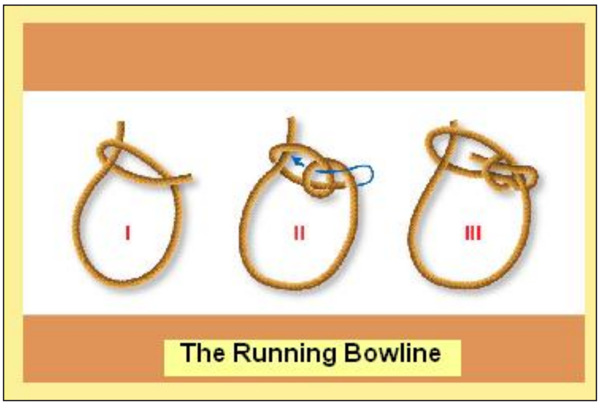
The sheep shank: is generally used to shorten the bight of a rope or for strengthening a part of the rope without cutting it. The bights should be lashed with the standing part.


The Reef Knot

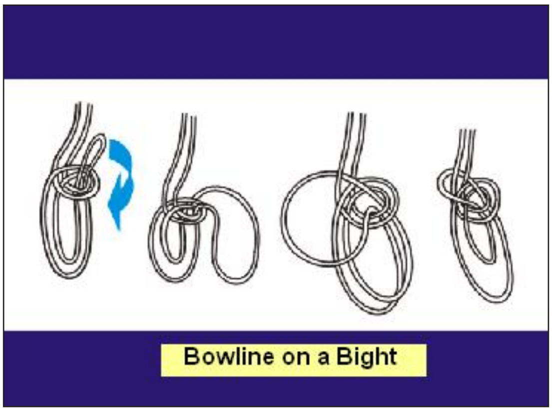


The Sheep Shank

The bowline: The bowline is probably the most widely used knot. It is useful for making a temporary eye in the end of a rope, to be put around or through anything.



The Running Bowline


Bowline on a Bight

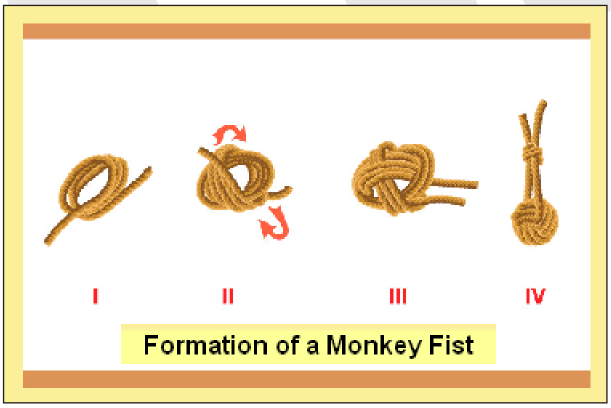
The running bowline: An ordinary bowline used to make a running eye at the end of the rope. It should never be used around a man's waist.

Bowline on the bight: is similar to the normal bowline but it is made on a loop or a bight and not on the ends. This is very useful to make a bowline on a rope when both the ends are already secured. This knot may be used in emergency like in place of a bosun's chair where the man can sit on one loop and puts the smaller bight under his arm for support.

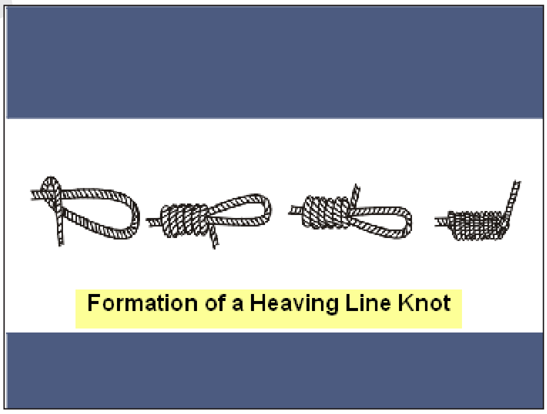
> Do not put any heavy objects inside the monkey fist.

The monkey fist: This is a good heavy knot similar in looks to the man rope knot but made differently. It is made on the end of the heaving line to weigh the heaving line to carry against the wind when throwing. The rope is first coiled around the palm of the hand for 3 rounds. The second set of 3 coils of the rope is taken perpendicular to the first set and then a third set of 3 rounds are taken perpendicular to the second set but under the first set. Once the rope is coiled properly the running end lands up near the standing part. Then the knot is made taut and sometimes a piece of rag or oakum is kept in the hollow of the knot before making it taut to act like a heart.

The heaving line knot: This knot is an alternative to the monkey fist and more simpler and quicker to make. Make a big bight (loop) at the end of the rope approximately 1.5 meters away and start trapping the ends around both parts of the bight until the entire bight is covered except for a small portion near the end of the bight. Pass the end of the rope through the loop and haul on the standing part to make it taut.

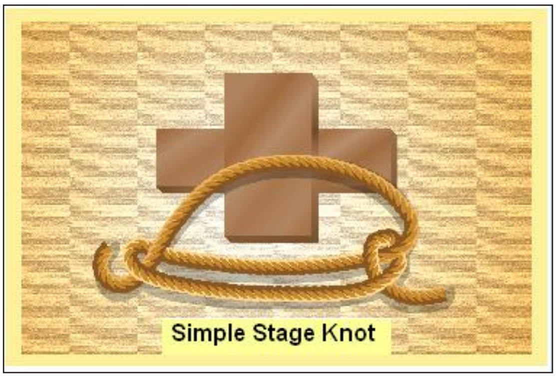


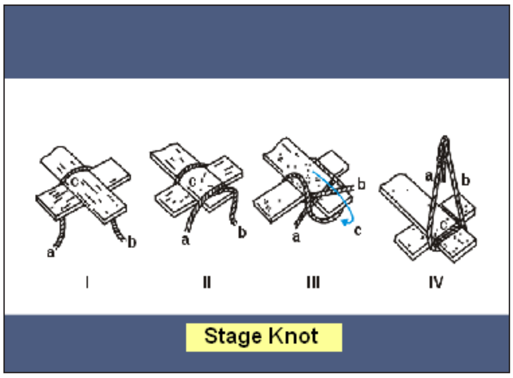
Formation of a Monkey Fist


Formation of a Heaving Line Knot

The stage knot: A stage is rigged on board ships for maintenance purposes. It is very important that the knot tied on the stage should be extremely secure and safe for persons to work on stage. There are many ways to tie a stage knot - the most popular 2 ways are shown:

First method: involves making a marline-spike hitch in the bight of the stage rope and slipping it over the cross pieces of the stage as shown.





Second method: is the true stage knot. The diagram shows how to make the knot in 4 stages. To make a stage knot:

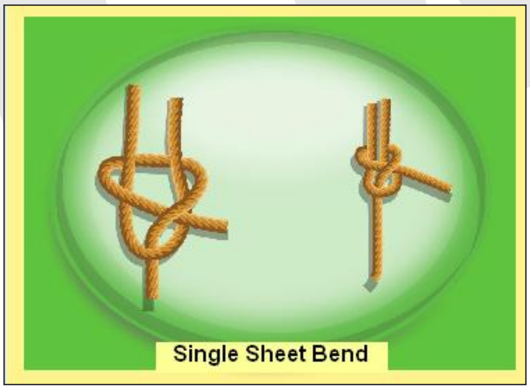
- First lay the bight of the gantline over the stage inside the cross ties.
- Cross the “a” and “b” ends of the gantline below the cross ties and bring them up at the end of the stage outside the cross ties.
- Lay the ends “a” and “b” on top of the stage over the cross ties.
- Pull the initial bight formed 'c' towards yourself and put it over the ends “a” and “b” and under the stage plank.
- Now tighten the parts “a” and “b” - ensure that both “a” and “b” are of equal length before securing.
- Secure the free end to the standing part using a bowline.

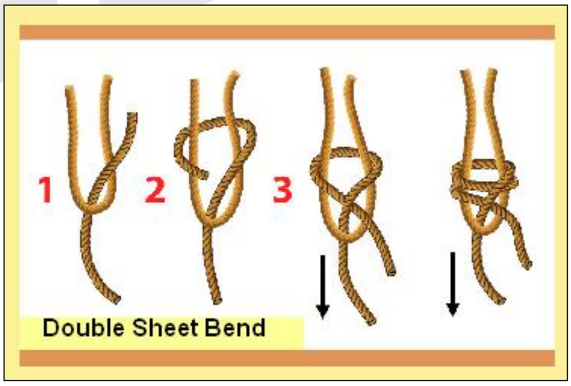
4) Important bends at sea

Bends are used to join 2 ropes temporarily.

Single sheet bend: is used to bend or join 2 ropes of unequal sizes, for example a halyard to the flag when no hook is available, a rope to the thimble of the wire or a sheet to the clew of the sail.

Double sheet bend: is a more secure way of accomplishing the same purpose as the single sheet bend. It is the only hitch accepted to secure a gantline to a bosun's chair.

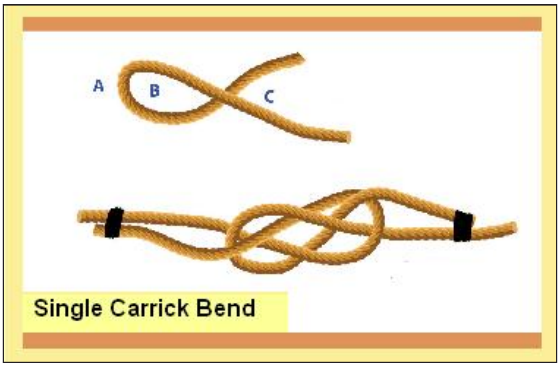




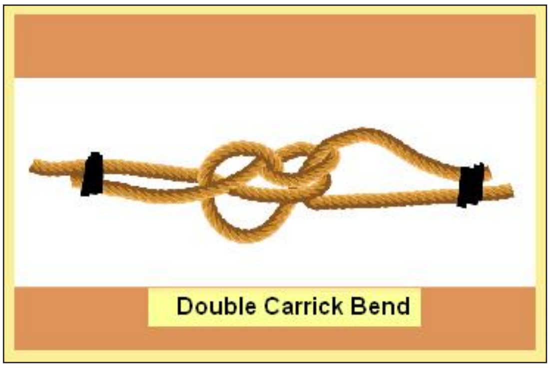
Carrick bend: is used to join two hawsers when the joint has to pass over a winch or a capstan. The end of the bend has to be seized with the standing part.

The first hawser is made to form a loop. The end of the second hawser is then passed under A, brought above through loop at B, passed through C and brought up again through loop B and over A. The end is seized to the standing part.

The double carrick bend - is similar to single carrick bend except a full round turn is taken across the first hawser at C before bringing back the end to A and seizing this to the standing part.



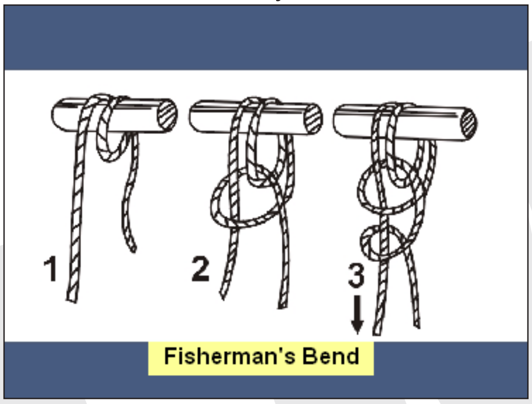
Single Carrick Bend


Double Carrick Bend

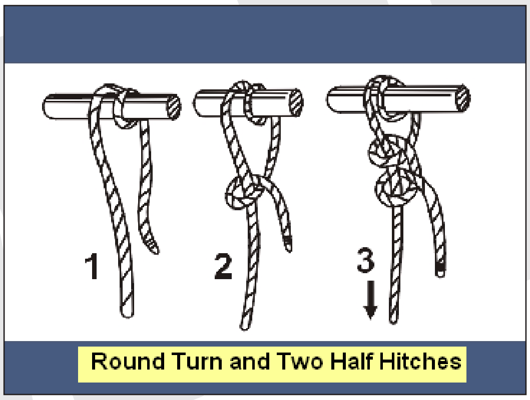
Fisherman's bend: This is used to tie a rope or hawser to a ring or an anchor and generally used in small fishing boats. An alternative to this bend is the **round turn and two half hitches**. In this hitch the running part is taken from inside the round turn.

5) Important hitches at sea

Round turn and two half hitches: This is very similar to the fishermen's bend except that the running end is taken from outside the round turn. This hitch will never jam and can be cast off quickly. Usually it is used to tie a heavy load to a spar, ring or a shackle. It is also used to tie a hawser to the breeches buoy.



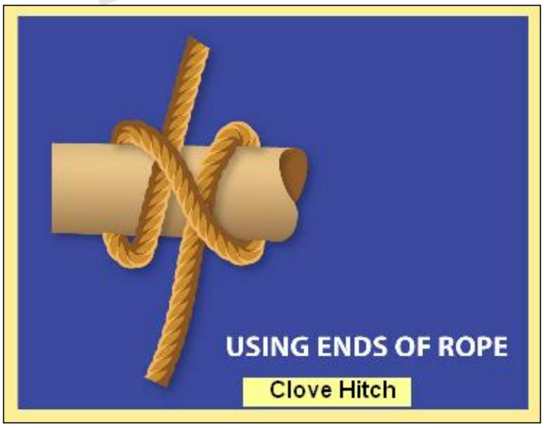
Fisherman's Bend



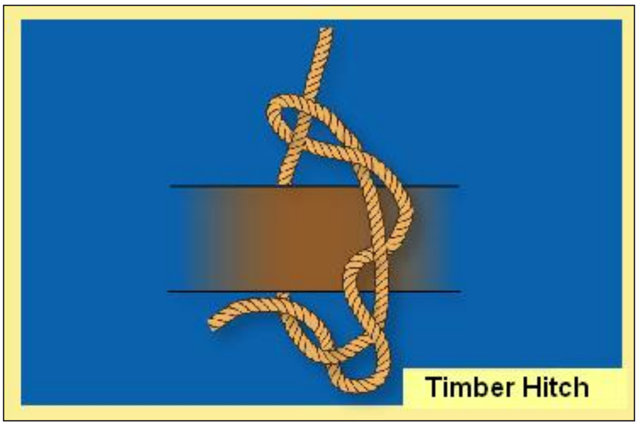
Round Turn and Two Half Hitches

Clove hitch: This is one of the most common hitches used at sea. It can be made either with the end or with the bight of the rope. It is generally used to tie a rope to a spar or a railing. It tends to slip if pulled sideways. When this hitch is formed using a bight of the rope - a loop and a reverse loop are closed together and slipped over the object to be secured.

Timber hitch: is a very simple hitch, used for tying the end of the rope to a spar or a bale either for hoisting or for dragging.

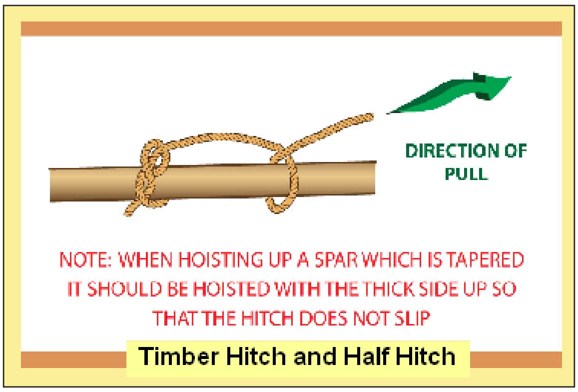


Clove Hitch

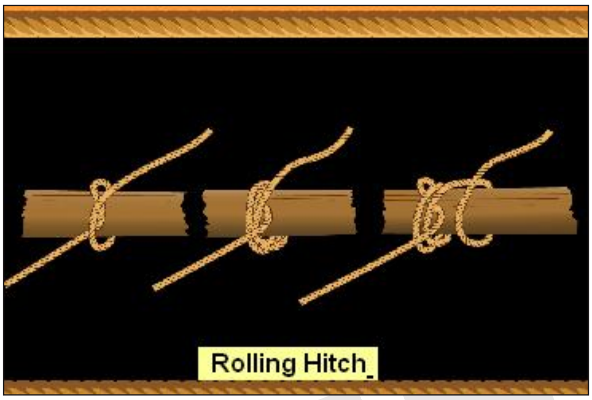

Timber Hitch

A timber hitch and a half hitch: is a modification of the timber hitch used for lifting long timber pieces or spars. The timber hitch is made on one end and a half hitch towards the lifting end.

Rolling hitch: This hitch is also used to bend a rope to a spar or to a larger rope. It is made by passing the end of the rope twice (known as the riding turns) around the spar - riding the second turn over the first and finishing with a half hitch on the other end. Hauling will be in the direction of the riding turns. When compared to the clove hitch it has an additional turn and used generally as a stopper for mooring ropes.

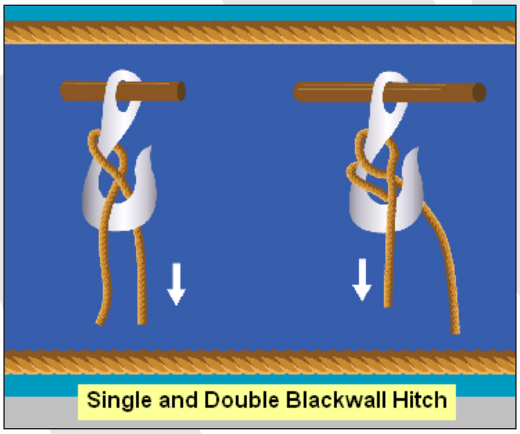


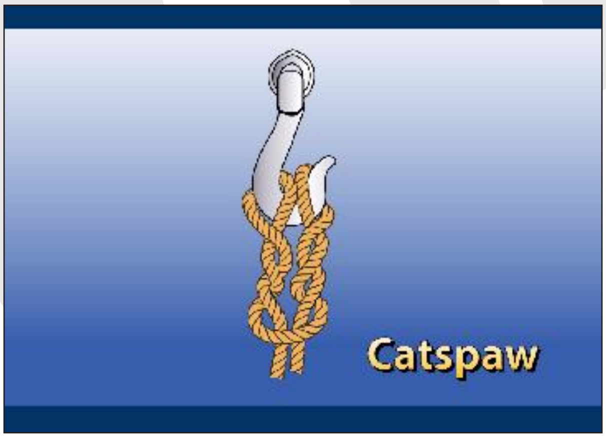
Timber Hitch and Half Hitch


Rolling Hitch

The blackwall hitch: is the easiest hitch which secures a line to the hook. They are not entirely reliable as they tend to slip. When the standing end is stressed it jams the bare end as the bare end is below the standing end. A single blackwall hitch is used when the rope and hook are of the same size and a Double Blackwall Hitch is used when the sizes are different.

The cat's paw: is formed by making two bights in a rope - one with each hand and twisted in the opposite direction. It is used to shorten a sling or to make a temporary eye to attach a block or a hook.

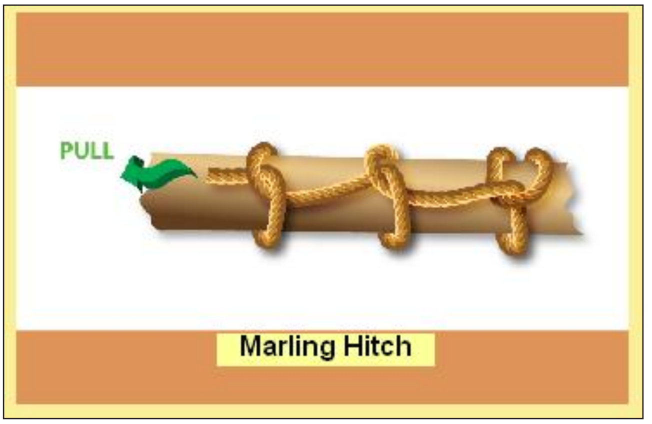

Single and Double Blackwall Hitch


Catspaw

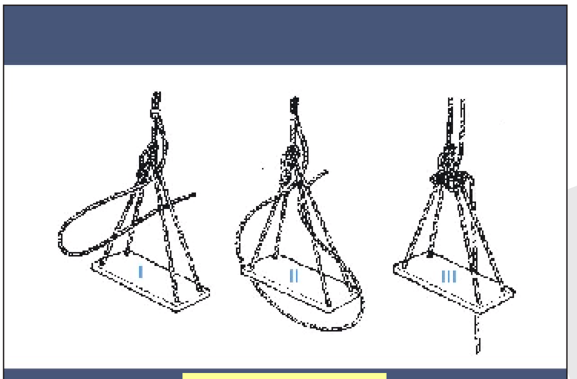
The marling hitch: is used to tie bundles of sail or tarpaulins. It may also be used to tie a rope to a spar. The end eye can be either a bowline or a timber hitch.

The lowering hitch: This hitch is used to lower a bosun's chair by the same person using it. It saves the need of another person to be standby for lowering purposes. A bosun's chair is used for variety of purposes on board a ship specially to wash down the outside bulkheads of the accommodation, wire greasing of topping lifts of cranes and derricks, cleaning and painting the funnel. A bosun's chair itself is a piece of wood about 457mm x 127mm x 25.5mm having two holes at each end through which a strop is roved and spliced underneath. A gantline is roved through it and made fast using a double sheet bend.

When the person is working on top of the mast **it is advisable to have one person below lowering the man on the chair as required.** Once the person is sufficiently down - in the lower mast he can self-lower himself as required using the lowering hitch.



Marling Hitch



Lowering hitch

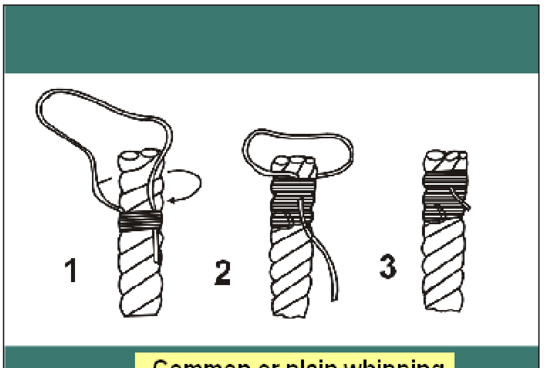
6) Whippings

Whippings are used on the end of the ropes to prevent it from fraying or unlaying whereas **seizings** are simply small lashings used to hold together two parts of a rope or two separate ropes. Both use twine over the rope and each one.

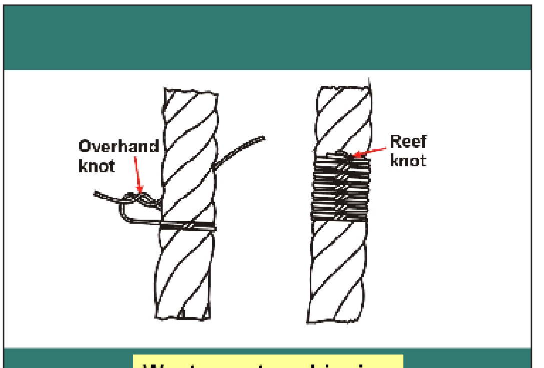
The following types of whipping are generally in use at sea:

The common or plain whipping: This whipping can be either used at the end or the bight of the rope. Lay the twine along the rope pointing towards the end of the rope and then make several turns around it *against the lay of the rope.* These turns should be taut and when the turn reaches the first end of the twine a bight or loop is formed by the running end of the twine and several tight turns are taken. Finally the second end is hauled tight. The running end is then cut off.

The west country whipping: is the simplest of all the whippings. In this type of whipping the twine is centered with both ends having sufficient length. It is passed under the rope and one half knot taken. Similarly the twine is crossed on to the other side and another half knot taken. This process continues and finally the whipping ends with a reef knot.



Common or plain whipping

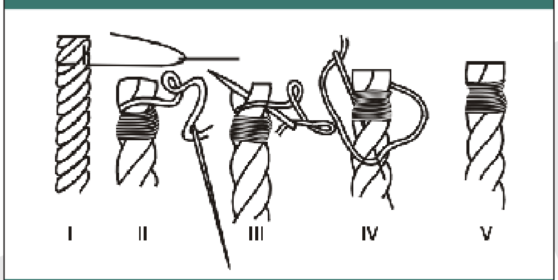


West country whipping

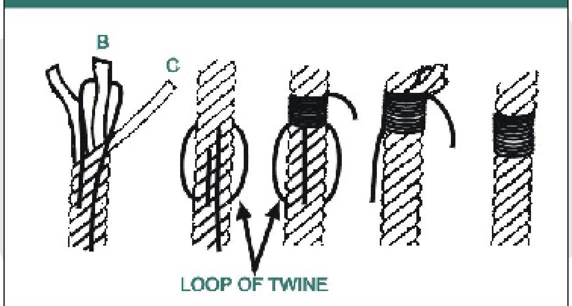
The palm and needle whipping: This whipping is more serviceable than the plain or the West Country whipping. The whipping is started by sewing into the heart of the rope, bringing the needle out on the other end on a long length of twine. The short end of the twine is left about 3 cm and several round turns are taken against the lay of the rope like in the plain whipping. The needle is then used to end the whipping by placing the twines obliquely in the groves between the strands over the turns of whipping.

The sailmaker's whipping: This whipping is very similar to the palm and needle whipping with the exception that instead of using a needle the strands of the ropes are opened initially, the twine passed as a loop and then the strands closed.

- The strands are initially opened and the twine is taken around one strand. One end of the twine is long and the other is short. On the other side of the rope the twine forms a loop.
- Once the twine is in place the strands are closed again.
- Turns are taken by the long end of the twine round the rope as in the plain whipping.
- Once sufficient turns are taken - the end of the rope is again opened up and the same strand around which the twine was taken initially is passed through the hanging loop - the shorter end of the twine pulled and loop made taut.
- The whip is ended with a reef knot taken by both the ends of the twine.



Palm and needle whipping



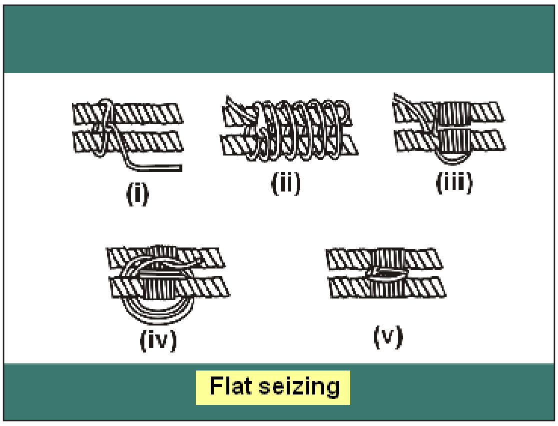
Sailmaker's whipping

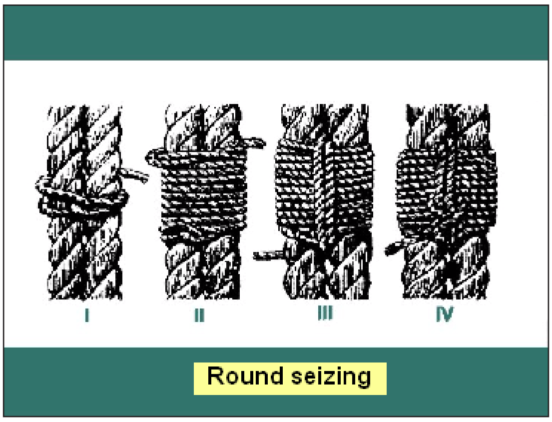
7) Seizings

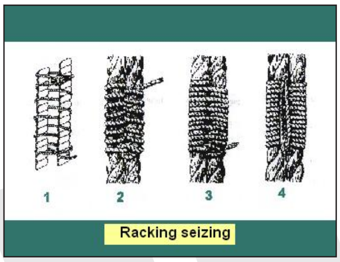
Seizings are simply small lashings used to hold together two parts of a rope or two separate ropes. Seizings are of the following kinds - flat, round, throat and racking.

Flat seizing: is to bind two ropes together. In this type of seizing - a small eye is spliced at the end of the Marline, spun yard or whatever material is to be used for seizing. This twine is passed around both the ropes with the other end of the twine passed through the eye. Several turns are taken and kept loose so that the running end could be passed in between the turns and back through the eye at the end of the seizing. Once the running end is passed through the eye all the turns are pulled taut. The running end is then used to make a pair of frapping turns around all parts and finally it is clove-hitched around all parts.

The round seizing: This seizing is started off similar to the flat seizing except that after the first set of turns are taken - a second series of turns known as the riding turns are taken over the first. The second set of turns is not made taut since this might displace the turns of the first set of turns. Two crossing turns are taken between the ropes and the twine is pulled taut and hitched.







Racking seizing: This seizing is started of very similar to the first two by making an eye splice on the twine. Instead of taking normal round turns around the ropes, the twine is passed around several times in **'figure of eight'** fashion. Once the required number of turns is taken - the end of the twine is worked back towards the eye to make round turns to fill in between the figure of eight turns (Riding turns taken to fill in between the figure of eight turns). Once the eye is reached - the end of the twine is passed through the eye and round turns taken around all the parts and the seizing ended as with others by hitching.

Apply Your Knowledge

1. Practice knots (heaving line knot, monkey fist, bow line, bowline on a Bight), bends (sheet bend, carrick bend), hitches (clove hitch, round turn and two half hitches), whippings and seizings.

2. Write down where and when each of the following knots should be used.

Reef knot	
Sheet bend	
Double sheet bend	
Bowline	
Bowline on the bight	
Clove hitch	
Timber hitch	
One round turn and two half hitches	
Monkey fist	
Carrick bend	
Slip Knot	

Function: Controlling the operation of the ship and care for persons on board.

Competence: Maintain sea worthiness of the ship

Task number: C2.4

Sub-task Reference number: C2.4.2, C2.4.3, C2.4.4

Topic: Seamanship practices

Task Heading

- Locate all the sounding pipes, filling pipes and air pipes on board and draw up a location plan.
- Observe and record the daily soundings of tanks, bilges and other compartments.
- Use calibration/sounding tables for determining ballast tank quantities after applying various corrections.

Objectives

- Familiarize yourself with taking soundings of tanks, bilges and other compartments and using sounding tables.

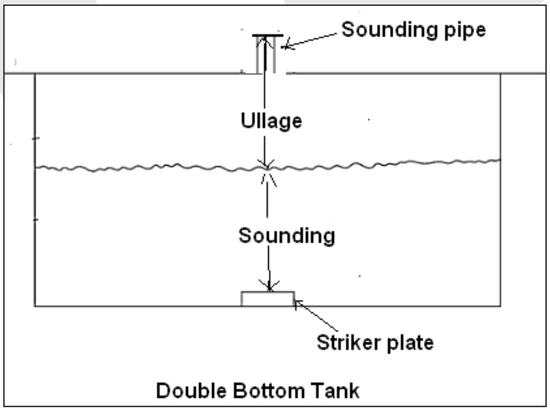
Index

1. Introduction
2. The need for taking daily soundings on board
3. Sounding/ calibration tables

Description

1) Introduction

Sounding pipes are the pipes fitted to the tanks to enable soundings (depth of the liquid in the tank) to be taken. Sounding is the vertical distance between the base of the tank and the surface of the liquid. The quantity of the liquid present in the tank is then calculated as per tank calibration tables. Sounding pipes are generally made as straight as practicable and are led above the bulkhead deck. Some form of a self-closing device is fitted in case the sounding pipe does not emerge above the bulkhead deck. A striking plate is fitted at the bottom of an open pipe where sounding rod falls.



It is advisable to take soundings for ballast tanks and fresh water tanks, while for fuel oil tanks- it is generally advisable to take ullage readings. Ullage is the vertical distance between the surface of the liquid and the top of the ullage plug or the top of the sounding pipe. The following diagram describes the relationship between sounding and ullage

Soundings may be taken by using steel measuring tape with a weighted end, calibrated glass tube, Whessoe gastight tank gauge or Saab radar tank gauge.

Some points to note are:

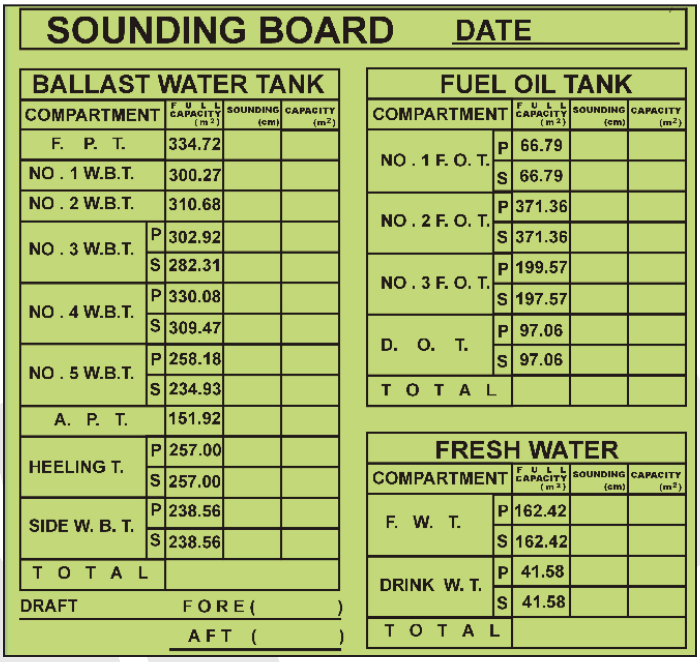
- All ballast tanks, double bottom tanks, hold bilges and peak tanks should be sounded every day on board. Even the bunker tanks are usually sounded once every day unless they are provided with automatic gauging system or a remote readout system.

Take soundings diligently on a daily basis.

- Soundings should also be taken of the bilges, the forepeak stores, the chain locker and the fresh water tanks on a daily basis. It does not matter whether the tanks are full or partly full or empty.
- All these soundings should be recorded in the sounding log book.
- A quick look at the sounding book reveals a lot of information.

2) The need for taking daily soundings on board

Soundings of all ballast tanks, fresh water tanks, hold bilges and other spaces must be taken on a daily basis. Some of the reasons are:



SOUNDING BOARD DATE

BALLAST WATER TANK

COMPARTMENT		FULL CAPACITY (m³)	SOUNDING (cm)	CAPACITY (m³)
F. P. T.		334.72		
NO . 1 W.B.T.		300.27		
NO . 2 W.B.T.		310.68		
NO . 3 W.B.T.	P	302.92		
	S	282.31		
NO . 4 W.B.T.	P	330.08		
	S	309.47		
NO . 5 W.B.T.	P	258.18		
	S	234.93		
A. P. T.		151.92		
HEELING T.	P	257.00		
	S	257.00		
SIDE W. B. T.	P	238.56		
	S	238.56		
T O T A L				

DRAFT FORE( ) AFT ( )

FUEL OIL TANK

COMPARTMENT		FULL CAPACITY (m³)	SOUNDING (cm)	CAPACITY (m³)
NO . 1 F. O. T.	P	66.79		
	S	66.79		
NO . 2 F. O. T.	P	371.36		
	S	371.36		
NO . 3 F. O. T.	P	199.57		
	S	197.57		
D. O. T.	P	97.06		
	S	97.06		
T O T A L				

FRESH WATER

COMPARTMENT		FULL CAPACITY (m³)	SOUNDING (cm)	CAPACITY (m³)
F. W. T.	P	162.42		
	S	162.42		
DRINK W. T.	P	41.58		
	S	41.58		
T O T A L				

- The soundings of the hold bilges will reveal if any water has leaked into the bilges from the previous sounding that could mean water entering the bilges from the cargo or from any other source.
- If the bilges have just been pumped out an increase in hold bilge levels could also mean that the non-return valve in the bilge line is not holding and some water has flowed back since the pump was stopped.
- The soundings of the fresh water tank would reveal the consumption of freshwater and the amount of freshwater generated on board.
- Any significant change in the sounding of ballast water tanks can be an indication of an emergency or a problem.
- The record of soundings on board the ship should be made available in case of an enquiry following an accident or an incident.

Most ships also have a sounding board positioned either on the bridge or in the alleyway next to the ship's office on which the daily soundings are written.

3) Sounding/ calibration tables

It is necessary to allow for list and trim to obtain an accurate volume, and tonnage, of liquid in the tank. Sounding / calibration tables are used for determining the tank quantities after applying corrections for list and trim. The Sounding pipe should ideally be located at a point within the tank where it will always provide the correct sounding applicable to the sounding tables, regardless of the ship’s trim. However, this position is not always possible to achieve and correction tables for trim should be made available to the ship. These corrections are calibrated for every half meter of trim, by head and by stern. It is necessary to interpolate carefully for these corrections in the calibration tables.

If no trim corrections are available, then they can be calculated manually.

$$\text{Correction to Sounding} = \frac{\text{Distance from sounding pipe to the tank centre} \times \text{Trim}}{\text{LBP}}$$

Sign convention as follows:

Trim	Sounding forward of tank centre	Sounding aft of tank centre
Head	-ive	+ive
Stern	+ive	-ive

Similarly, list correction must also be allowed for in order to calculate an accurate volume of liquid in the tank. It is necessary to interpolate carefully for list corrections in the calibration tables.

Apply Your Knowledge:

1) Locate the sounding pipes and air pipes of all the tanks on board your ship, including ballast tanks, bunker tanks, cofferdams and peak tanks.
2) Locate the sounding pipes of hold bilges.

Function: Controlling the operation of the ship and care for persons on board.

Competence: Maintain sea worthiness of the ship

Task number: C2.4

Sub-task Reference number: C2.4.5

Topic: Seamanship practices

Task Heading

- Assist in lubrication of deck equipment and understand lubrication techniques.

Objectives

- This module is an entirely practical module that is self-explanatory. The cadets will need hands-on training in performing these tasks. Some notes are given for guidance purposes. The objective is to familiarize the cadet with the basic knowledge of lubrication techniques.

Index

1. Greasing tools
2. Personal protective equipment
3. Greasing of deck equipment

Description

1. Greasing tools

A grease gun is commonly used for lubrication on board. The purpose of the grease gun is to apply lubricant through an aperture to a specific point, usually on a grease fitting. The channels behind the grease nipple lead to where the lubrication is needed. The aperture may be of a type that fits closely with a receiving aperture on any number of mechanical devices. The close fitting of the apertures ensures that lubricant is applied only where needed. There are three types of grease gun:

a. Hand-powered, where the grease is forced from the aperture by back-pressure built up by hand cranking the trigger mechanism of the gun, which applies pressure to a spring mechanism behind the lubricant, thus forcing grease through the aperture.
b. Hand-powered, where there is no trigger mechanism, and the grease is forced through the aperture by the back-pressure built up by pushing on the butt of the grease gun, which slides a piston through the body of the tool, pumping grease out of the aperture.
c. Air-powered (pneumatic), where compressed air is directed to the gun by hoses, the air pressure serving to force the grease through the aperture.

The grease gun is charged or loaded with any of the various types of lubricants, but usually a thicker heavier type of grease is used.

2. Personal protective equipment

Ensure that PPE requirements by the company are taken care of whilst greasing. A typical requirement is given below:

When working:	Safety Helmets	Safety Boots / Shoes	Coveralls / Boiler suits	Gloves	Buoyancy Aids	Safety Harness	Safety Goggles	Visor	Ear Defenders	Respiratory Filters	Chemical Suits	EEBD
Painting / Greasing	R	R	R	R	G	O	R	O	G	O	G	G

R- Required.
O- Consider
G- Unlikely

3. Greasing of deck equipment

Greasing and lubrication of the deck equipment must be carried out as per planned maintenance system (PMS). Lubrication schedules and plan must be followed.

Windlass and winches

Effective lubrication of the mooring winch / windlass and other such equipment can be best achieved while the equipment is running (rotating). 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. All safety precautions must be taken while greasing with the equipment running. Level and condition of oil in the gear case should be checked and replenished as per the lubrication schedule.

Steel wire mooring ropes

It is essential to grease or oil steel wire mooring ropes at frequent intervals as rusting will reduce the strength of the wire in a very short time, however, many terminals take exception with the sheen left on the water by this practice.

While greasing wire, excess lubricant must be removed in exposed areas to ensure that the wire underneath has not suffered any deterioration. Effectiveness of greasing is enhanced using pneumatic greasers. Where provided, prior use, a detailed risk assessment must be conducted to ensure adequate control measures are in place.

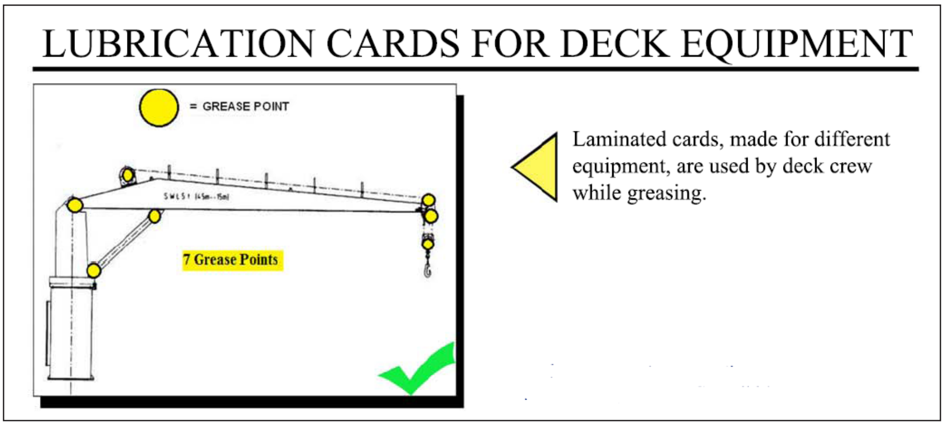
Gangways

Both lower and upper rotating platforms are to be maintained free and checked regularly for rotation. The swivel pins for the same must be kept well lubricated at all times and the load-bearing surface to be checked for wear.

Hinge pins must be maintained free and well lubricated.

Cranes and davits

Lubrication schedule is to be followed each month.



Apply your Knowledge:

1. Discuss the procedure of greasing a crane wire and/or a mooring wire.

Function: Controlling the operation of the ship and care for persons on board.

Competence: Maintain sea worthiness of the ship

Task number: C2.4

Sub-task Reference number: C2.4.6

Topic: Seamanship practices

Task Heading

- Breakout new coils of ropes and wires. Correctly stow wires and ropes with due regard to their preservation.

Objectives

- Learn the correct way to break out new coils of rope and wire.
- Understand the care, maintenance and stowage of natural, man-made and wire ropes

Index

A) Break out new coils of rope and wire
1. Introduction
2. Opening a new coil of fiber rope
3. Uncoiling a new wire rope

B) Stow wire and ropes
1. Care, maintenance and stowage of natural fibre ropes
2. Care, maintenance and stowage of man-made fibre ropes
3. Care, maintenane and stowage of steel wire ropes

Description

A) Break out new coils of rope and wire

1) Introduction

Generally the lay of the rope is either **right handed** or **left handed**. This is common for both natural fibre cordage and man-made fibre cordage.

Right handed lay means the final laying up of the strands, regardless of the rope's construction, is the same as a screw thread. This is also known as a ***Z-twist.***

Left handed lay is the reverse of a right handed lay and also described as a ***S-twist.***

It will be noticed that the fibres and the strands have the same **twist**, but the yarns have a reverse twist. So in a right-handed rope the fibres are twisted together right-handed, the yarns are twisted left-handed, and the strands are laid up right-handed.

> Lay of a rope is either Right handed (Z-twist) or Left handed (S- twist).

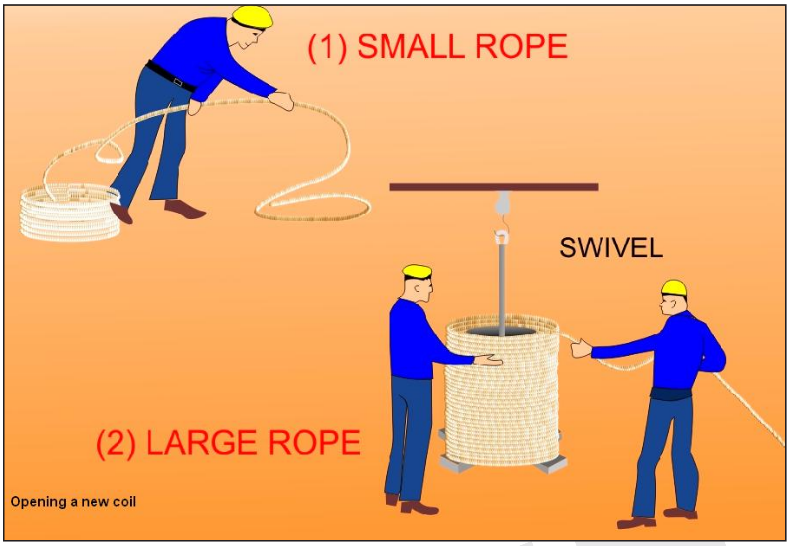
Ropes are generally manufactured combing selected **fibres** into long ribbons known as slivers, which are later twisted up into **yarns**. These **yarns** are twisted into **strands**, three or four of the latter being finally laid up into the finished rope.

2) Opening a new coil of fiber rope

This holds good for both natural fibre and man-made cordage. Rope is supplied to the ship in a compact, machine-wound coil, bound with yarns or strands. Generally the length of a coil is 220 meters.

If the diameter of the rope is less than 48 mm:

- Roll the coil over until the outside end of the rope is at the top and directly pointing at you.
- Cut open the lashings and pull out the inner end of the rope.
- For a right handed lay the rope should uncoil anti- clockwise when the inner end is pulled and for a left handed lay the rope should uncoil clockwise.



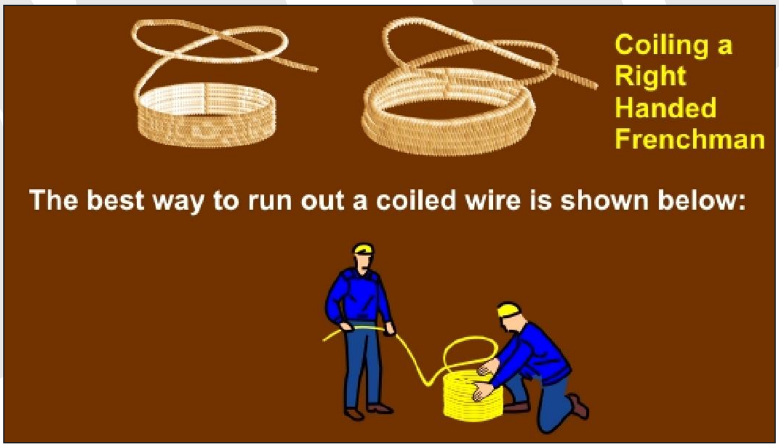
An easier way to remember: Lay the coil flat on the deck and before cutting out the lashing remove the inner end and uncoil 2 turns. If the rope is right handed lay and if it uncoils anti-clockwise then the rope is being uncoiled correctly. Cut the lashing and continue uncoiling. If not, turn the coil upside down and then remove the inner end.

For ropes of 48 mm diameter or larger:

- The above procedure is not acceptable as it involves twisting of the rope and hence the coil is unwound in the opposite way of how it was coiled.
- The coil is placed on a turn table, slung with a sling and uncoiled with its outer end being pulled out first.

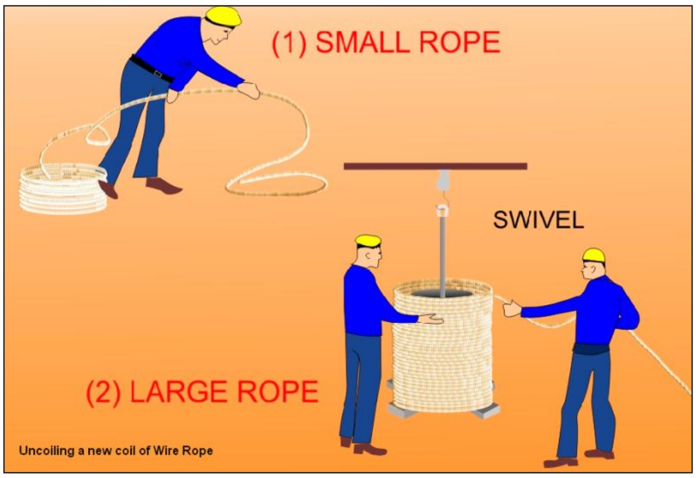
The diagrams show uncoiling of both small and big ropes.

Wire ropes: Wire rope especially long lengths should be stowed on reels, but where this is not practicable it must be coiled down. As wire ropes are less flexible than fibre ropes its all the more important to have the uncoiled length free to revolve. Where this is impossible an alternative is to use left-handed loops, called a ***Frenchmen,*** in the coil as shown in diagram. These Frenchmen serve to counteract the twists put in by coiling down right-handed.



3) Uncoiling a new wire rope

New ropes are supplied either in machine-wound coils or on cable drums (reels). They must be taken off the coils or drums in the correct manner, or kinks will develop quickly.



- For small coils of wire, cut off the strops and uncoil the wire slowly by rolling it on deck, vertically.
- For large coils of wire or wires which are heavy - a turn table is used at the bottom, and the top of the coil is lashed down with 2 strong cross battens so that the wire does not slip from the top.
- To unreel the wire from a drum, pass a shaft (usually a large diameter pipe) through the centre of the coil and support

the shaft so that the drum is free to rotate. Then cut the straps and unreel the wire.

- Wire ropes used as runners of cargo gear are extremely expensive and can get damaged very easily during uncoiling. Extreme care must be taken to avoid kinks or turns during uncoiling of the rope.

B) Stow wire and ropes

1) Care, maintenance and stowage of natural fibre ropes

- They are easily damaged by acids and alkalis - hence do not let the rope come in contact with such substances.
- They absorb moisture when wet and lose strength by about 25%. They do not fully recover their strength and hence care should be taken to keep them as dry as possible.
- Since natural fibre ropes are not very elastic, once stretched beyond limits - they elongate. This leads to reduction in diameter and strength. Hence never overstrain the ropes.
- Heat also damages the vegetable fibres. Avoid unnecessary exposure to sunlight and do not stow the rope in hot and damp places such as in the vicinity of boilers or heaters. Cover the ropes with tarpaulins or stow them below deck**.**
- Stow the ropes in an adequately ventilated space.
- Do not stow the rope when wet as the rope will rot quickly. If there is no time to dry the ropes - stow them in a well ventilated space on top of a wooden grating to allow water to drain out.
- When using the rope for moorings or for some rigging - avoid sharp edges and bends. The diameter of the sheaves over which the rope passes should be at least 6 times the diameter of the rope.
- Always keep the rope ends whipped. If the strands are allowed to open out - it can be never be laid back satisfactorily.
- The rope should always be inspected before use for any damage, rot and fatigue. Hold the rope with both hands about 8" apart and twist them in opposite direction. Observe the core of the rope - if rotten and damaged then discard rope.
- Many rust removers have phosphoric acid in them and they tend to damage the natural fibre ropes. Care should be taken that the ropes are not exposed to such contamination. Stow the rope away from paint, chemicals, detergents, oils, and rust removers.

Coiling of mooring ropes
on gratings

- In cold weather, where the temperatures are likely to be sub-zero, it must be borne in mind that these ropes are liable to get damaged due to ice formation within their yarns and strands. The ice tends to cut through the fibres thus weakening the ropes.

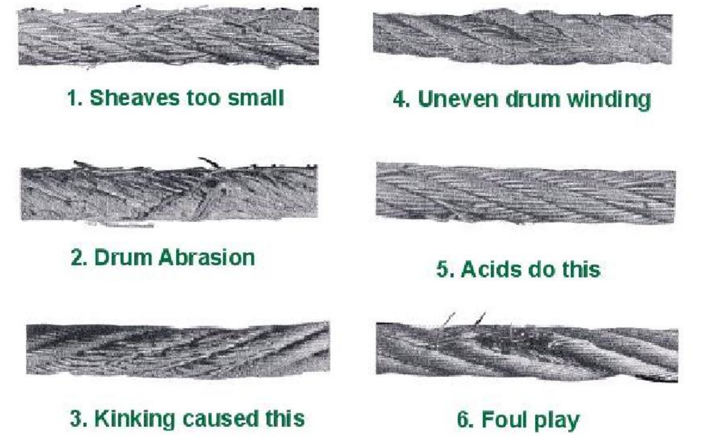
2) Care, maintenance and stowage of man made fibre ropes

- Most of the precautions for natural fibre ropes also apply for man- made fibres.
- Man-made fibre ropes should not be exposed unnecessarily to sunlight.
- Care to be taken to avoid contamination by fumes and chemicals.
- Ropes should not be stowed where there is excessive heat - like near a steam pipe or adjacent to the boiler space.
- Man-made fibre ropes are resistant to water and hence do not get damaged when wet. However when coiled man-made fibre ropes should be stowed on raised boards in such a way as to allow free circulation of air beneath as well as around the rope.

- Although man-made fibre ropes are virtually unaffected by very low temperatures, when a rope is iced it must be thawed carefully at a moderate temperature before stowing.
- Unlike natural fibre ropes, man-made fibre ropes give little or no audible warning of approaching breaking point. Hence it is very dangerous to exceed the safe working load of the rope or subjecting the rope to undue stress beyond its limit.
- Man-made fibre ropes may easily be damaged by melting if frictional heat is generated during use. Too much friction on a warping drum may fuse the rope with consequential sticking and jumping of turns, which can be dangerous. To avoid fusing, ropes should not be surged unnecessarily on winch barrels. For this reason, a minimum of turns should be used on the winch barrel; three turns are usually enough but on whelped drums one or two extra turns may be needed to ensure a good grip; these should be removed as soon as possible.
- When splicing a man-made fibre rope ensure that the splice has four full tucks and protruding tails of three rope diameters at least. Man-made fibre ropes should be frequently inspected for wear externally and internally. A high degree of powdering observed between the strands indicates excessive wear and reduced strength.
- When using stoppers on man-made fibre ropes use only stoppers made of the same material (except nylon).
- Do not let the rope come in contact with sharp metal edges. Avoid bad leads and sharp bends. The diameter of the sheaves, drums and bitts should be not less than three times the diameter of the rope.

3) Care, maintenance and stowage of steel wire ropes

- Wire ropes should be regularly inspected and treated with suitable lubricants. These should be thoroughly applied so as to prevent internal corrosion as well as corrosion on the outside. The ropes should never be allowed to dry out. For this purpose it is very important to ensure that the wire rope lubricant being applied should be fairly free flowing and not very viscous like thick paste. A lubricant which is like a paste will not penetrate the core of the wire and will give a false impression that the wire has been lubricated.
- Wires should never be subjected to sharp nips, bends and reverse bends as kinks will occur and the wires will be permanently damaged.
- Wires should be stowed on reels or coiled down when not in use. These coils should be place on top of wooden grating in a well ventilated space.
- As sea water is extremely corrosive, wire reels should never be exposed to sea water more than needed. Care should be taken to regularly lubricate the wire to prevent corrosion from setting in and to cover the wire ropes stowed on winches and other exposed areas with a good canvas cover or tarpaulin when at sea.
- If during use the rope becomes wet by sea water, wash off the salt by fresh water and apply oil before storing it away. Wire brush the rope occasionally and coat it with wire rope preservatives (there are numerous brands available).
- Everyone who handles wires should wear leather palm gloves to protect their hands from snags.
- Wires must be examined regularly for wear, stranding, dry core, kinks, and excessively flattened areas. They must be replaced if the number of broken strands (snags) exceeds 10% of the strands in any length equal to eight diameters, or if any other serious defects are found.



Damage to Wire ropes

- Never use a shackle or ring to change the direction of the lead of wire. If the wire rope has to pass over a sheave, its diameter should be at least 19 times the diameter of the rope. The diameter of the bitts and the warping drum should be at least 13 times the diameter of the rope.
- Certain acids and chemicals affect wire ropes especially if the rope is soaked. They might damage the inner core and this will not be readily apparent on inspecting the rope visually. So stow away from such chemicals.
- Boiler fumes, gases and funnel gases can have a corrosive effect on the external coating of the wire ropes.

Apply Your Knowledge:

1. Two new coils of wire rope are received on the ship. List the information provided regarding the wire in the Wire Rope Certificate. Attach a copy of the certificate. Detail the procedure for breaking a new coil of wire rope (32 mm diameter on a reel) on board your ship.

Function: Controlling the operation of the ship and care for persons on board.

Competence: Maintain sea worthiness of the ship

Task number: C2.4

Sub-task Reference number: C2.4.7, C2.4.8, C2.4.9

Topic: Seamanship practices

Task Heading

- Assist in receiving fresh water from ashore and from barges.
- Rig clusters and portable lights.
- Assist with maintenance of stays and aerials.

Objectives

- This module is an entirely practical module that is self-explanatory. The cadets will need hands-on training in performing these tasks. Some notes are given for guidance purposes. The objectives are to familiarize the cadet with the procedures for receiving fresh water from shore, rigging cargo clusters and maintenance of stays and aerials.

Index

1. Receiving fresh water
2. Assist with rigging of cargo clusters and portable lights.
3. Assist with maintenance of stays and aerials.

Description

1) Receiving fresh water

Please pay attention to the following points:

> Take FW soundings prior, during and after receiving fresh water to ensure exact quantity is received in correct location.

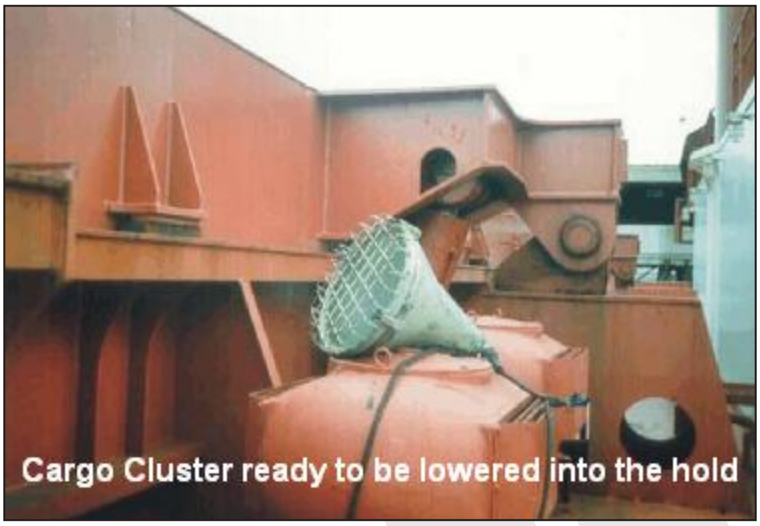
- Ensure that all the hoses used are clean, in good condition with no holes.
- The joining flanges should be tight and leak proof.
- Preferably wash the hoses with fresh water prior using them.
- If a meter is provided on the shore side, note down the meter reading prior to receiving fresh water.
- Sound the ship's tanks prior to starting fresh water; this will enable you to calculate quantity received on completion.
- If the ship has two fresh water tanks, then preferably the tank being filled should not be used for consumption during the filling process.
- When starting fresh water let some amount of fresh water run through the hose in order to remove any dirt or mud particles.
- Taste the water to ensure it is drinkable prior putting the hose into the tank.
- When rigging the hose, please ensure that there are no sharp bends or other constrictions which would restrict the flow of water.
- Once receiving water is finished, calculate the quantity received on board, unrig the hose connection, clean the hoses and re-stow them.

2) Assist with rigging of cargo clusters and portable lights

Portable lights and cargo clusters are used very commonly on board ships for various jobs. They are used:-

- During cargo work to illuminate holds during night cargo operations.
- When working in a dark area with insufficient lights like in enclosed spaces or bilges and
- When carrying out maintenance jobs at night.

These are basically large portable electrical lamps with a wire cord attached so that they can be plugged into the ship's power supply when needed. Some precautions that need to be taken are as follows:



- The wire and the electrical socket attached to the light should be in good condition and should be undamaged. Broken or defective lights should be reported to the responsible person and repaired as soon as practicable.
- The cargo clusters and the portable lamp should have a wire mesh covering the lamp.
- It would be an unsafe practice to directly connect the wire to a socket without a plug.
- When working in an area where the atmosphere is suspect, only "certified" and ' intrinsically safe" lamps should be used.
- Never hang a cargo cluster or a portable lamp by its wire. A securing rope should always be kept permanently attached to the lamp. This should be used to secure the portable lamp.
- The wires should not be left lying loosely on deck as the persons moving may trip and fall.
- The wires should not pass through such areas where it is liable to be damaged by any moving objects like gantry wheels or hatch covers.
- Read and follow the "**CODE OF SAFE WORKING PRACTICES**" when rigging portable lights and cargo clusters.

Never use the cargo cluster without a plug.

3) Assist with maintenance of stays and aerials

- **Maintenance of stays**

Maintenance must be carried out as per planned maintenance system and proper records to be kept.

Stays are wires or ropes from the deck to the head of a mast or samson post to provide support or prevent movement.

The condition of the stay wire and the tightness must be checked frequently.

- **Maintenance of aerials**

Maintenance must be carried out as per planned maintenance system and proper records to be kept.

The condition of the aerials and insulators must be checked every month.

The common findings evident during safety radio surveys regarding aerials are:

I. Deteriorated aerials
II. Broken aerial insulators
III. Improperly rigged aerials for very high frequency equipment.

On tankers and gas carriers, the transmitting aerials should be in “earth” position during cargo operations. Main radio transmitter aerials should be grounded prior bunkering on all ships.

Also remember that before any work is commenced in the vicinity of radio aerials, the officer responsible should inform the person responsible for radio equipment so that no transmissions are made whilst there is a risk to personnel and appropriate warning notices must be displayed as required.

Apply Your Knowledge:

1. Discuss the procedure for taking fresh water from a barge/ ashore on your ship.

Function: Controlling the operation of the ship and care for persons on board

Competence: Prevent, Control and fight fires on board

Task Reference No.: C3.1

Sub task Reference Nos.: C3.1.1, C3.1.2

Topic: Operation and Maintenance of FFA

Task Heading

- Read and discuss the contents of the FFA Training Manual on board.
- Locate the fire control plan and identify equipment included in the plan.

Objectives

- Familiarise with FFA training manual
- Understand importance of all safety related drawings and plans
- Understand importance of keeping plans and manuals ship specific and updated.
- Understand reading and gathering information from fire control plan

Index

1) Introduction
2) Fire training manual
3) Fire safety operational booklet
4) Contents of a training manual
5) Fire control plan

Description

1) Introduction

Every person on board must be familiar with all the safety equipment provided on board. He must not only know the location but also be aware of how to use it in an emergency. Imagine, a fire in the cabin and the person first sighting it not knowing what to do. A small fire can easily be controlled by using the nearest fire extinguisher after raising an alarm.

2) Fire training manual

Fire training manual is provided on each ship to enable crew to familiarize with, at least:

- General fire safety practice and precautions related to the dangers of smoking, electrical hazards, flammable liquids and similar common shipboard hazards.
- General instructions on fire-fighting activities and fire-fighting procedures including procedures for notification of a fire and use of manually operated call points;
- Meanings of the ship s alarms;
- Operation and use of fire-fighting systems and appliances;
- Operation and use of fire doors;
- Operation and use of fire and smoke dampers; and
- Escape systems and appliances.

Always ensure that the training manuals are ship specific and updated.

To provide easy access to crew, the training manual/s are provided in each crew mess room and recreation room or in each crew cabin. It is written in the working language of the ship and may comprise several volumes, and contains the instructions and information in easily understood terms and illustrated wherever possible. Any part of such information may also be provided in the form of audio-visual aides in lieu of the manual.

Besides giving general instructions, fire-training manual contains ship specific information – it is very important that use of all ship specific fire fighting equipment is covered in this manual. Every time new equipment is added or equipment is removed the manual must be updated. You must familiarize yourself with this manual soon after joining a ship so that you are aware of how to use each fire fighting equipment.

3) Fire safety operational booklet

This booklet is often combined with the training manual

Fire safety operational booklet contains the necessary information and instructions for the safe operation of the ship and cargo handling operations in relation to fire safety. The booklet includes information concerning the crew's responsibilities for the general fire safety of the ship while loading and discharging cargo and while underway. Necessary fire safety precautions for handling general cargoes are explained. For ships carrying dangerous goods and flammable bulk cargoes, the fire safety operational booklet also provides reference to the pertinent fire-fighting and emergency cargo handling instructions contained in specific codes i.e. the IMSBC Code, the International Bulk Chemical Code, the International Gas Carrier Code and the International Maritime Dangerous Goods Code, as appropriate.

This booklet may be combined with the fire training manual and be provided in each crew mess room and recreation room or in each crew cabin. If this is an independent booklet, you must familiarize yourself with this manual also, soon after joining a ship so that you are aware of how to use each fire fighting equipment provided specifically for particular ship type or for the cargo being carried.

4) Contents of a training manual

A fire training manual is a controlled document. The typical contents of a fire training manual of a ship are given below:

Section	Contents
ROC	Ship Specific Record of Changes
Intro	Introduction
01	Fire Safety Practices and Precautions
02	General Instructions on Fire Fighting Activities and Fire Fighting Procedures
03	Meaning of Ship's Alarms
04	The Operation and Use of Fire Fighting Systems and Appliances on Board.
0401	Fire Extinguishers
0402	Fire Hoses, Nozzles and Couplings
0403	International Shore Connection
0404	Foam Making Equipment
0405	Fire Bucket / Sand Box
0406	Fireman's Outfit
0407	Helideck Equipment
0408	Fire Blanket
0409	Fire Detection and Alarm Systems
0410	Fixed Gas Fire Extinguishing Systems
0411	Sample Extraction Smoke Detection System
0412	Fixed Water Fire Extinguishing System
0413	Fixed Foam Fire Extinguishing System
0414	Fixed Powder Fire Extinguishing System
05	Fire Doors
06	Fire and Smoke Dampers
07	Escape Systems and Appliances

Explanation regarding use of all fire fighting equipment in the manual must be simple and for easy understanding, illustrations could be used.

5) Fire control plan

All vessels have a fire control and safety plan drawn up in accordance with SOLAS regulations. The plan is normally formulated on a standard general arrangement drawing which include number and location details of all safety and fire fighting equipment on board. Some ships may have separate plans for LSA and FFA equipment while some have one common plan. Plan is approved by the flag state or its representative. IMO issued updated symbols are used with fire control and safety plans. The approved plan is required to be displayed conspicuously in alleyways. It gives exact location of LSA/ FFA equipment and its capacity etc. A summary of total equipment available is also provided. LSA/FFA equipment on board must always be positioned as shown in this plan.

A copy of the fire plan is also required to be kept outside the accommodation block in a weather tight container

Apply Your Knowledge

1. Check the contents of the fire wallet.

Function: Controlling the operation of the ship and care for persons on board

Competence: Prevent, Control and fight fires on board

Task Reference No.: C3.1

Sub task Reference Nos.: C3.1.3, C3.1.4, C3.1.6, C3.1.7

Topic: Operation and Maintenance of FFA

Task Heading

- Demonstrate use and donning of self contained breathing apparatus (SCBA) set after carrying out all required checks. Identify different parts of a SCBA set.
- Demonstrate use of safety harness and line including the signals used.
- Recognize the difference between a SCBA set and an emergency escape breathing device (EEBD).
- Locate and demonstrate the use of EEBD.

Objectives

- Familiarise with protective clothing
- Familiarise with a SCBA set.
- Be able to don a SCBA set after carrying out all checks
- Understand use of safety harness/ line used with a SCBA set
- Understand difference between SCBA and EEBD
- Be able to don a EEBD set

Index

1) Introduction
2) Breathing apparatus
    a. The forced air breathing apparatus (smoke helmet)
    b. Self-contained breathing apparatus
3) Emergency escape breathing devices
4) Differences between SCBA and EEBD

Description

1) Introduction

A major hazard when involved with a fire is smoke. It can suffocate a person in no time. To overcome smoke whenever in vicinity of a fire we must use equipment that will supply breathable air without interruption. A fire fighter or a person inadvertently caught near a fire is always in danger of being overcome by smoke. On board, we have breathing apparatus sets which are used for firefighting and emergency escape breathing devices (EEBDs) which are used for escaping through an area filled with smoke.

2) Breathing apparatus

A breathing apparatus is used to supply fresh air for human breathing when a person is entering any space where the atmosphere is suspect and may not support human life. These include:

- When entering into an enclosed space
- When entering into a space to fight fire
- When entering into a space not enclosed but has been kept closed for a long period of time.
- Entering any other space where the atmosphere is a suspect.

Breathing apparatus are of two types:

a) The forced air breathing apparatus (smoke helmet):

This apparatus consists of a face mask with an integral speech diaphragm, rubber breathing tube, terylene harness assembly with shackle, hemp covered wire rope life-line, signal plate, air hose and double acting foot operated bellows.

- Fresh air is provided by the bellows.
- An exhaling valve allows escape of excess and exhaled air.
- The bellows can be hand, foot petal or power operated and should be situated in fresh air.
- A second person is required to operate the bellows to supply air to the wearer.
- The air hose is usually of sufficient length that the wearer can reach any compartment with the bellows kept on the open deck near the compartment.
- For each breathing apparatus an approved fire proof life-line of at least 30m length shall be provided capable for being attached by means of snap hook to the harness of the apparatus or to a separate belt.

Apart from the fact that the life line is used as a guidance rope for the wearer of the breathing apparatus, life line is also used as a means of communication between the wearer and the attendant. Though modern communication means allow use of microphone in the face mask, – this method also should be learned for use in case of emergencies.

The table below gives the signals that are universally used between the wearer and the attendant.

SIGNALS WHEN USING THE FORCED AIR BREATHING APPARATUS OR THE SMOKE HELMET

No. of Pulls	Wearer	Attendant
1 Pull	Give more air	Giving more air
2 Pull	Give more slack on the line	I am giving more slack on the line
3 Pull	Help me out immediately	Come out immediately

Disadvantages of a smoke helmet

- Constant supply of air is dependent on the second person.
- Distance from bellows is limited by the length of hose.
- Air tubing being long, has to be trailed, it may get stuck between ladders or rungs, it restricts the wearer in his movements limiting his circle of operation.
- The air tubing may get cut or can be damaged thereby endangering the wearer during operation.
- The apparatus is bulky.
- Toxic fumes and smoke could be introduced into the air supply if the bellows are not placed in a safe environment.
- There is a large commitment on personnel resources if the equipment is to be used effectively. This situation is significantly exacerbated by reduced crew numbers.
- The equipment restricts freedom of movement since the entry and exit points must be the same.
- Maintenance and procurement of spare parts is difficult.

b) Self-contained breathing apparatus (SCBA)


Self contained breathing apparatus

This equipment is designed on an open-circuit system. The exhaled air is discharged to the atmosphere and the wearer of this apparatus gets his fresh air from the air bottle attached to the equipment.

The equipment consists of:

- One or two cylinders containing air under pressure. All air cylinders for all breathing apparatus sets on board are interchangeable.
- A harness to mount the cylinders on the back of the person.
- A respiratory system which incorporates a means of reducing the pressure of the air from the cylinder and of supplying the wearer

on demand with air according to his requirements

- A face mask attached to a demand valve which maintains a positive pressure inside the mask at all times. Many sets can be used in positive supply and demand mode. Positive supply mode ensures that air may leak out but no toxic gases or smoke will enter through the mask sealing. Positive supply consumes more air.

There are various types of breathing apparatus in the market but the principle of operation is the same.

The arrangement of a typical apparatus is as follows:

- Volume of air contained in the cylinders shall be at least 1200 liters of fresh breathing air.
- The demand valve permits the use of the equipment as a positive pressure set. This ensures that the air pressure inside the face mask is higher than atmospheric pressure and so any leaks in the seals are outwards. That is, smoke or foul air cannot be drawn into the mask.
- An automatic valve releases the exhaled air from the face mask. A reducing valve is connected after the cylinders to reduce the pressure to approximately about 4 bars. This pressure is further reduced by the demand valve which is attached to the mask of the wearer. The demand valve supplies air to the wearer when he inhales and closes when he exhales.
- When approximately 10 minutes of air is left, a warning whistle will sound continuously – warning the user that his air supply would soon be over and he has to move out. This warning signal will sound continuously till the air in the cylinder is over.
- The face mask is made of moulded rubber with a series of adjustable rubber straps to secure it to the head of the wearer and fitted with quick release arrangements. The visor should have a good field of vision so that the wearer does not need to turn his head constantly.
- A gauge is provided to indicate the pressure of the air in the cylinder.
- **Life line**
  For each breathing apparatus an approved fire proof life-line of at least 30m length shall be provided capable for being attached by means of snap hook to the harness of the apparatus or to a separate belt. Apart from the fact that the life line is used as a guidance rope for the wearer of the breathing apparatus, life line is also used as a means of communication between the wearer and the attendant. Though modern communication means allow use of microphone in the face mask, – this method also should be learned for use in case of emergencies. The table below gives the signals that are universally used between the wearer and the attendant.

SIGNALS WHEN USING CABA OR SCBA:

No. of Pulls	Wearer	Attendant
1 Pull	I am alright	How are you?
2 Pull	Give more slack on the line	I am giving more slack on the line
3 Pull	Help me out immediately	Come out immediately

- **Preparation for use**

Connect the harness to the cylinder and then the air hose to the face mask. Briefly it will be as follows:

- Lay down the harness assembly with the pressure regulator and the warning device on the floor.

- Open the straps to hold the cylinder, so that the back plate of the harness is clear to keep the cylinder.
- Place a fully charged cylinder on the harness back plate such that the connector nut on the harness assembly fits into the cylinder head.
- Inspect the connector nut to ensure that the 'O' ring on the connector nut is not damaged.

> It is very important that the SCBA set is always stowed, connected and ready for use near the fireman's suit.

- Tighten the connector nut into the cylinder – make it hand tight.
- Place cylinder straps around cylinder, fit the bolts provided on the cylinder strap and tighten it. *(Securing arrangement may be different for some sets).*
- Adjust shoulder straps and waist belt to their full extent and as required by the wearer.
- Connect the face mask to the connection provided in the harness by means of the supply hose attached and quick connecting coupling.
- The SCBA is now ready to be used**.**

➢Checks that have to be carried out before using the apparatus

- On the demand valve there is a red button or a lever to ensure that the mask is maintained under positive pressure at all times when worn by the user. Ensure that this lever is kept off.
- **Check the cylinder pressure** – Open the cylinder valve slowly but fully and read off the pressure gauge. Pressure of the cylinder should be no less than 10% below the filling pressure i.e. in case the filling pressure is 200 bars then the meter reading should not be less than 180 bars. If it is less then replace the air cylinder with a freshly charged full cylinder. Please note since the apparatus has a restrictor fitted to protect the high pressure hose and gauge, it takes some time before the pressure gauge shows the full pressure. Hence it is necessary to wait about a minute in order to fully pressurize the system.
- **High pressure leak test**: Close the main cylinder valve and check for leakage in the system. The pressure gauge reading should not fall by more than 10 bars in one minute.
- **Check whistle warning unit**: Switch on the positive pressure facility by hand slowly and listen to the air flow. Keep a watch on the pressure gauge. When about 10 minutes usage time is remaining, the audible alarm will sound. The audible alarm will continue to sound till the pressure gauge comes to zero.

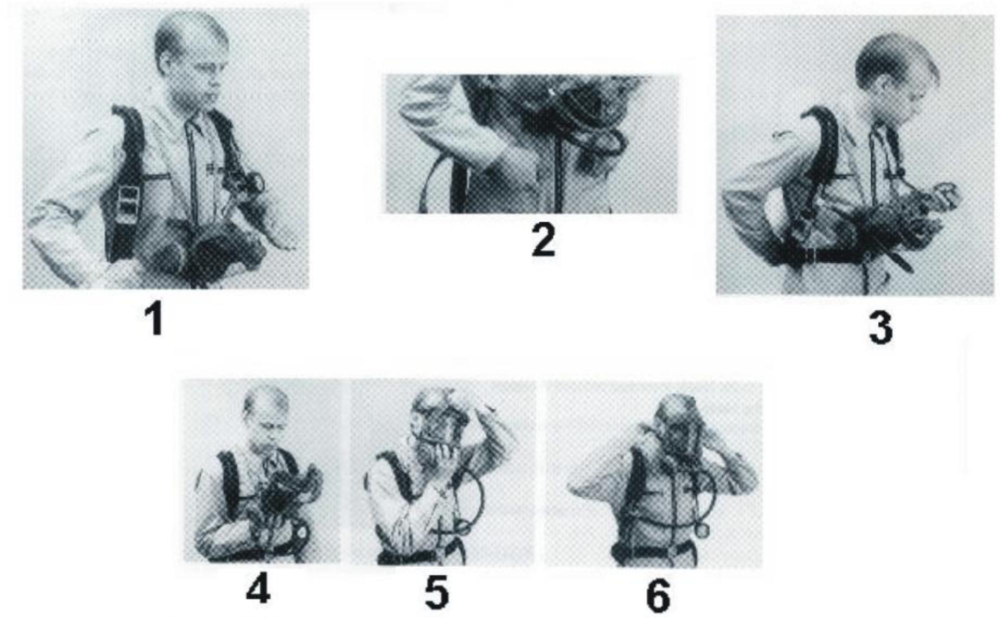
The above mentioned must be necessarily be carried out every time before using the apparatus to ensure that the apparatus is in good working condition.

➢Donning the apparatus

- Before donning, check that the shoulder straps are pulled back and the waist strap buckle is adjusted to suit the need of the wearer.
- Put on the apparatus in such a way that the cylinders valve should be downwards.
- Grip the shoulder straps free ends and pull down until the back plate fits comfortably. During this maneuver, it is preferable to relieve the weight of the apparatus by a little jump or resting the apparatus on something.
- Adjust and tighten the strap and buckle it up as required *(different models may have different types of securing arrangement)*
- Ensure that the positive pressure lever is switched off.
- Open the cylinder valve completely and allow the pressure to rise in the gauge.
- When the cylinder is opened, the audible warning will sound until the pressure reaches a level over the pre-determined setting of the whistle. This gives a check that the whistle is functioning.
- Put the face mask by first pulling the chin into the chin support and then pushing the head harness over the forehead and backwards.
- Tighten the head harness by first tightening the lower buckles. The last buckle to tighten is the forehead buckle.
- Inhale by taking a short fast breath to automatically switch on the positive pressure. Exhale and hold your breath. Listen for any leakage in the mask fitting. If there is a fitting leakage

first check that no hair is caught under the sealing edge of the face mask. Adjust if necessary.

- ❖ Check the positive pressure by holding your breath and insert two fingers under the mask sealing edge. Hold breath and an outward flow shall be heard.
- ❖ Now read off the pressure gauge. You are now ready to use the breathing apparatus.
- ❖ When using the breathing apparatus ensure that:
  - The wearer checks the pressure gauge from time to time keeping in mind that when the alarm goes or the pressure gauge indicates 50 bars – it is time to withdraw.
  - Ensure that the life line or any other equipment being carried with you does not get entangled with any other objects in the area.



Donning Instructions for SCBA

➢Precautions to take when using the breathing apparatus

- ❖ Breathing apparatus must be donned and started up in FRESH AIR. The practice of men rigging up in fresh air and not putting on their face mask till they reach smoky atmospheres and then starting up their sets is EXTREMELY DANGEROUS AND MUST NOT BE PERMITTED.
- ❖ The face mask is designed to prevent any external atmosphere from entering the respiratory system and it is exceedingly dangerous for the face mask to be removed when the wearer is in a smoky or toxic atmosphere.
- ❖ If the face mask is dislodged whilst the wearer is in a smoky or toxic atmosphere, it is vital that the wearer should hold his breath and immediately replace the dislodged mask. If for any reason, there is likelihood of delay in doing so, the wearer should be evacuated to fresh air at the earliest, even though he may not feel any ill effects from the few breaths of contaminated air which he has been forced to inhale.
- ❖ When working with breathing apparatus especially in areas of nearly zero visibility due to fog or high expansion foam etc, always work in pairs. Contact should be made by physical touch and speaking. Follow basic instructions given during your fire fighting training – move about by feeling by shuffling your legs or feeling by the back of the hand etc.
- ❖ Please note that when working in a compartment which is filled with high expansion foam, the audibility is also greatly reduced. Immersion in high expansion foam may therefore give a feeling of complete isolation and have effects similar to claustrophobia. One should always maintain physical touch and use the safeguards by guidelines.
- ❖ What happens if the wearer of the BA set is entrapped in a compartment having atmosphere not supporting human life:
  - Do not panic.
  - Raise alarm by the signal line or by the portable radio equipment.

- Relax in a comfortable position and breathe easy and shallowly and await assistance.

➢ **Care and maintenance**

After each use of a BA set it is necessary to ensure that it is stowed in a condition whereby it is ready again for immediate use.

- Clean the set thoroughly
- Clean the face mask and harness (this should be in warm soapy water). Check the face mask for any cracks.
- Inspect the complete set for damage and any loose fittings
- Fit a fully charged cylinder.
- Complete high pressure and low pressure tests
- Disinfect the facemask
- Check washers and "O" rings for any damage and replace these if found defective.
- Re-stow the equipment in a ready-to-use condition and complete all use and test records.

➢ **Air cylinders**

Every set of self-contained breathing apparatus must be provided with spares cylinders having a total free air capacity of 2400 liters. In practice this usually means that each set has two spare charged cylinders. There are however two exceptions:

- In ships with five or more sets the total spare capacity (for the whole ship) need not exceed 9600 liters.
- If the ship is able to re-charge the air cylinders with suitable breathing air, then it is necessary to carry only 1200 liters of spare breathing air per set: however the total spare storage capacity of free air provided (for the whole ship) need not exceed 4800 liters.

3) **Emergency escape breathing devices:** The emergency escape breathing device is a compressed air breathing set of limited duration of 10 minutes, only used for escape from a compartment that has a hazardous atmosphere. They shall not be used for fighting fires or entering oxygen deficient voids or tanks. In these events, a self contained breathing apparatus, which is suitable for such applications, shall be used.

Instead of the full harness and tight fitting facemask found with a compressed air breathing set the escape set will normally be in a carrying bag that can be slung over the shoulder and include a high visibility hood which incorporates a face mask and a neck seal.

> EEBD's must not be used for fighting fires or entering oxygen deficient voids or tanks.

EEBDs are stowed in the engine room near the escape ladders/ ECR and also in the accommodation. Training and Spare EEBDS should be properly marked.

As with use of any personal safety equipment, it is important that those who might have to use the items are comfortable wearing the sets and familiar with their use. During training sessions, the training EEBD must be physically used for demonstration.

Typical donning instructions (of one make):

- ➢ The line of the EEBD bag is passed around the head.
- ➢ The top of the bag is pulled by the handgrip.

- The hood is worn.
- Breathing normally, the area should be evacuated immediately.

From the moment the top of the EEBD bag is pulled, the air supply begins and lasts for at least 10 minutes (see photo).

4) Difference between EEBD and SCBA

- EEBD used for escape from an area filled with smoke while SCBA used for fire fighting
- EEBD required working duration is 10 minutes while for SCBA it is about 30 mins
- EEBD has a hood while SCBA has a tight fitting mask
- EEBD is not required to have a warning whistle
- EEBD air valve once open cannot generally be shut while SCBA cylinder valve can be shut any time.

Apply Your Knowledge

1. What type and number of CABA's do you have on board? Where are they located? List all the equipment including the fireman's outfit which is kept along with them. Find out the capacity of their air cylinders and accordingly calculate their nominal working duration.
2. Check the location of EEBD located on board your ship. Discuss the purpose of EEBD with your Shipboard Training Officer.

Function: Controlling the operation of the ship and care for persons on board

Competence: Prevent, Control and fight fires on board

Task Reference No.: C3.1

Sub task Reference Nos.: C3.1.5

Topic: Operation and Maintenance of FFA

Task Heading

- Under supervision, operate main and emergency fire pump.

Objectives

- Introduction
- Locate controls for starting the main and emergency fire pump
- Demonstrate starting of main fire pump/s
- Demonstrate starting of emergency fire pump
- Understand use of emergency fire pump

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6) Introduction
7) Main fire pump/s
8) Emergency fire pump

Description

1. **Introduction**

Water is the most cheap and abundantly available medium for fighting/ controlling many types of fire. All ships are provided with fixed sea water pipeline/s and pumps to supply water in case of an emergency, and for general service.

2. **Main fire pump/s**

Main fire pumps are fitted in the engine room to supply sea water through the pipelines fitted in engine room, deck and accommodation block. These pumps can also be used for general use and often called "General Service" pumps. All officers and petty officers on board should be familiar with remote starting procedure of the fire pump. Additionally, all officers must also be familiar with the local starting procedure. Before starting a pump for trial purpose, it must be ensured that valve/s on deck are opened so as to avoid high pressure in the line. As far as possible, one pump must always be lined up and kept ready to supply water to deck line.

Testing/ trying the fire pump

i. Starting should be carried out alternatively by remote and local locations.
ii. The pump should be tested for at least 10 minutes of operation every week.
iii. Rig up two fire hoses, one on the forecastle and one on the bridge wing and start the emergency fire pump. The minimum pressure at the nozzle should be 2.6 bar (2.8 bar for ships above 6000 GRT) with the nozzles in 'jet' mode.
iv. Confirm all pressure gauges on deck are OK. Engineer officer must check the gauges in the ER.
v. At this time, check hydrants for leakages and also try out isolation valves

3. **Emergency fire pump**

The main fire pumps fitted in the ER are likely to be put out of commission in case of ER fire. To tackle this exigency, an emergency fire pump, much smaller in size to the "General Service" pump is provided. This pump is meant to provide water through two hoses for firefighting whenever the main pumps are not available. This pump has an alternative source of power – which could be a diesel engine (with battery starting) or through emergency generator.

Testing/ trying the emergency fire pump

i. Pump should always be kept in state of readiness with inlet valve open and selector switch for starting on remote location. Remote starting controls are fitted in the fire control room (if provided), and additionally may also be fitted on the bridge, CCR, ECR and other centralized locations. In an emergency, it should be possible to start the pump directly from local or remote operation without any checks.

ii. For routine trial

- Check lub-oil level (for diesel driven engine)
- Start pump
- Check all pressure gauges
- Rig up two fire hoses, one on the forecastle and one on the bridge wing and start the emergency fire pump. The minimum pressure at the nozzle should be 2.1 bar or a throw of 12 metres
- Isolation valve on deck must be tried out and ensured that water is reaching engine room. Primary duty of this pump is to supply water for firefighting to engine room.

The pump should be tested for at least 10 minutes of operation every week.

Apply Your Knowledge

1. Check the various locations from where you can start main and emergency fire pump on your ship. Discuss the procedure of starting an emergency fire pump and testing its efficiency.

Function: Controlling the operation of the ship and care for persons on board

Competence: Prevent, Control and fight fires on board

Task Reference No.: C3.2

Sub task Reference Nos.:C3.2.1, C3.2.2

Topic: Fire Fighting

Task Heading

- Identify the classes of fire and components of the fire triangle.
- Identify and minimize fire hazards. Demonstrate understanding of the actions to be taken in the event of fire, including fires involving oil systems.

Objectives

- To familiarize with various classes of fire, components of fire and the actions to be taken in case of fire.

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Description

1. Introduction

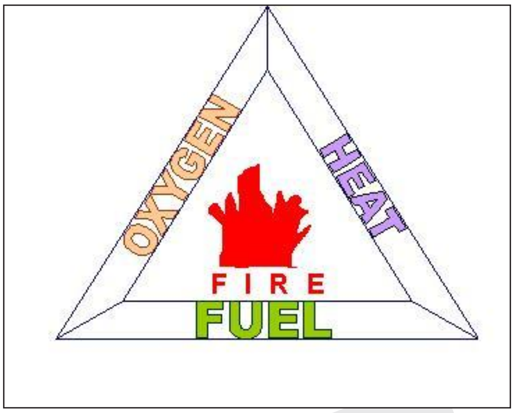
The main fire safety objective of every person on a ship must be to:

- Prevent the occurrence of fire and explosion.
- Reduce the risk to life caused by fire.
- Reduce the risk of damage caused by fire to the ship, its cargo and the environment.
- Contain, control and suppress fire and explosion in the compartment of origin.
- Provide adequate and readily accessible means of escape for passengers and crew.

> Fire is the single largest cause of serious casualties on ships and loss of life at sea.

The majority of recorded incidents of fire at sea would not have occurred had proper precautions been taken. It is the responsibility of every person on board to exercise due care, take all precautions and comply with fire safety regulations. It is important for all to understand, how a fire is caused, its elements and the action to be taken in an unfortunate event of fire on board.

2. Fire triangle



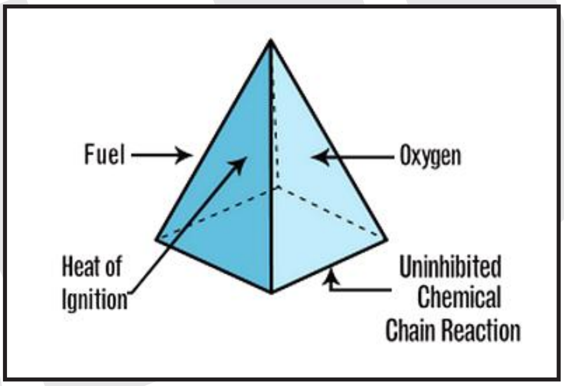
Fire is a chemical reaction known as combustion giving off heat and light. For combustion to occur three elements are required and they are:

FUEL: This can be a solid, liquid or gas, which when heated gives off flammable vapors. Examples include paper, wood, cardboard, paint, oils, acetylene, etc.

OXYGEN: This is normally present in the air in sufficient quantity to sustain a fire.

HEAT (source of ignition): A critical temperature must be reached for ignition to occur. Heat may be applied deliberately, or it may be accidental e.g. heaters being placed too close to furniture, curtains or paper; power points being overloaded, etc.

For combustion to occur there has to be a particular ratio of combustible substance to oxygen, to which a source of ignition is applied. The three elements combined, form the fire triangle.



If any one of the three sides of the triangle is removed, the triangle will collapse and hence there will not be any combustion. The principle of fighting fire is to remove one side of the fire triangle and you can avoid a fire if we can ensure that all three elements are never together in required proportion to cause a fire.

Further to above, the fire triangle shown above involves another component that is the chain reaction that results in intensifying the fire further. From chemical reactions, among fuel, oxygen and heat, the burning vapour releases heat and ignites more vapour. The additional vapour burns and produces more heat and in so doing produces more vapour, and so the process continues with increasing flame. This turns the fire triangle into a fire tetrahedron.

3. Classification of fires

International organization for standardization (ISO standard 3941)		National fire protection association (NFPA 10)	
Class A:	Fires involving solid materials, usually of an organic nature in which, combustion normally takes place with the formation of glowing embers.	Class A:	Fires in ordinary combustible materials such as wood, cloth, paper, rubber and many plastics.
Class B:	Fires involving liquids or liquefiable solids.	Class B:	Fires in flammable liquids, oils, greases, tars, oil base paints, lacquers and flammable gases.
Class C:	Fires involving gases.	Class C:	Fires, which involve energized electrical equipment where the electrical non-conductivity of the extinguishing medium is of importance. (when electrical equipment is de-energized, extinguishers for class a or b fires may

			be used safely.)
Class D:	Fires involving metals.	Class D:	Fires in combustible metals such as magnesium, titanium, zirconium, sodium, lithium and potassium.
Class F:	Fires involving cooking oils.	Class K:	Fires involving cooking grease, fats and oils.

ELECTRICAL FIRE: Electricity itself does not burn. Any fire which is referred to as an electrical fire would actually be a Class A, B C or D fire as described above, but with the additional hazard of live electrical circuits. Once the appropriate electrical circuits have been isolated the fire is treated as normal for its class

4. Basic fire prevention

I. General guidelines

- All officers and crew must be thoroughly conversant with the contents of the fire training manual and emergency contingency manual which contains instructions on fire prevention, protection and fire fighting.
- All officers and ratings must understand the origins and dangers of fire and that Constant vigilance must be maintained.
- Risk assessment carried out prior to undertaking any job must consider fire hazard present due to nature of particular job.
- Fixed fire detection system must always be operational and monitored.
- Efficient fire patrols are to be maintained on board as required. Particular care is to be exercised at times of high risk, e.g. during loading / discharging, repairs and lay-up periods.
- All fire appliances and alarms, including those in the engine room and machinery spaces, should be regularly examined and maintained.
- The operation, uses and location of the emergency fire pump and other emergency machinery and gear must be thoroughly understood by all officers.
- Care is to be exercised in the handling of portable electrical appliances and lights to ensure that they are of the required standard and that it is safe to use them. All portable appliances powered by ship's supply are not to be left switched on when unattended.
- All sources of ignition should be identified and action taken avoided

II. Common fire sources/ hazards

Following are few common fire sources/ hazards with suggested action to avoid same:

a. Smoking

Smoking has been a major cause of fire on board and ashore.

> Temperature in a cigarette could be near 700°C.

- Smoking in bed must be prohibited at all times.
- Smoking material must not be discarded anywhere in a careless manner. It must be extinguished in a suitable container (ashtray).
- Under no circumstances should smoking be permitted anywhere on the open decks, or in store rooms or paint rooms. Smoking is permitted at the discretion of the master and will be restricted to areas designated by the master.
- The master must also have all stevedores, service engineers for repair work and visitors onboard the ship observe the smoking restrictions stipulated.

b. Hot work

Hot work is any work which involves welding or burning and other work including drilling and grinding operations, electrical work and the use of non-intrinsically safe electrical equipment, which might produce heat or sparks capable of igniting combustible gases, vapors, liquids or material in or adjacent to the work area.

- Hot work can be carried out safely provided that potential hazards are clearly defined, specific instructions issued, and the operation is controlled and monitored by a responsible person on board.
- Any hot work carried out on board must be in accordance with the 'Hot Work Procedures' laid down in the company's manual.

c. Spontaneous combustion

> Major fires have occurred due to oily rags spontaneously igniting

It is outbreak of fire without application of heat from an external source. Spontaneous combustion may occur when combustible matter, such as hay or coal, is stored in bulk. It begins with a slow oxidation process under conditions not permitting ready dissipation of heat—*e.g.* a pile of oily rags. Oxidation gradually raises the temperature inside the mass to the point at which a fire starts

- Damp or oil - impregnated material such as rags, cotton waste or sawdust may oxidize and produce heat, resulting in spontaneous combustion.
- Waste and soiled material must never be allowed to accumulate especially in machinery spaces. It should be disposed of daily.
- Such materials must be kept dry and stored away from oil and greases.

d. Careless housekeeping

Careless housekeeping can often be a source of fire

- General tidiness and good housekeeping are essential aspects of fire prevention.
- Accumulation of rubbish such as packing material, full waste paper baskets and ash trays containing paper are common examples of potential fire hazards.
- Electric irons and soldering irons must be switched off when not in use. They must be allowed to cool before being stowed away.
- Strainer (lint) for the laundry drier must be regularly cleaned as it is a fire hazard.
- Clothes and other flammables must be kept clear of electrical heaters or hot equipment.
- Personal electrical equipment must not be installed in cabins without master's permission. Such equipment should be checked by a responsible officer before installation.
- When not in use, TV sets, radios, record players, electric fans and other similar appliances should be switched off and disconnected from power source.
- Use of cooking heaters / stoves of any kind in cabins is strictly prohibited.

e. Galley activity

The most common types of galley fires are caused by the heating of oils and fats to their self (auto)-ignition temperatures. Serious fires have occurred as a result of ignition of cooking oil in deep fryers and these must never be left unattended.

- Water should never be used to extinguish such fires as a violent boil-over can result. Use of fire blanket or the application of dry powder / CO_2 extinguisher is preferred.
- Accumulations of grease and oil on the surfaces of stoves, on ventilator grills and in uptake trunking not only present a risk of self (auto) ignition but can cause a fire to spread rapidly. These surfaces must be cleaned frequently.
- Electrical power for the hot plates or gas inlet valve for the burners must always be off/ shut before closing the galley at the end of the day.

f. Paint stores

Most paints contain high levels of flammable solvents and other volatile materials. If paint drums are left unsealed or become damaged, flammable vapors can readily accumulate.

- Particular attention must be paid to the condition of the flame proof electrical fittings in the room.
- Smoking, naked lights or the carriage of smoking materials into paint stores is prohibited.

- Open cans of paints and painting material must be returned to the paint locker when stopping work for the day.

g. Oxygen and acetylene cylinders

- Oxygen and acetylene cylinders must be stowed in either the special lockers provided or at a secure safe location on deck.
- Care must be taken to ensure that the cylinders and fittings in these lockers are kept free of oil and grease at all times.
- Cylinders when not in use must be capped and valves shut. Flash back arrestors must be fitted.

h. Funnel sparks

At times, ship course may have to be altered to avoid sparks falling on deck

Sparks or hot soot from the funnel or from the funnel of a nearby ship may act as a source of ignition if combustible material is found to be lying around. Poop deck area is very vulnerable

- Mooring ropes on drums may catch fire with funnel sparks.
- The risk can be reduced by blowing boiler tubes shortly before arrival at a port, however, engineers must always request permission from the bridge watch keeping officer before commencing this operation
- Extra precautions may be required when wind conditions cause funnel sparks to land on fore deck.

i. Flammable goods

- Flammable substances pose a serious fire hazard if they are improperly stored or handled.
- They can be easily ignited, with a spark for example, and can cause fire to spread quickly especially if the liquid is spilled or exposed to heat.
- When handling flammable substances, the pertinent fire fighting and emergency handling instructions contained in the Material Safety Data Sheet (MSDS) should be referred and complied with.

5. Fire precautions in port

- In port, a contact list of all important telephone numbers including that of the port fire brigade and other emergency services must be posted in conspicuous positions. On ships provided with a cargo control room, it must be also posted there.
- In the event of fire in port, close liaison between the ship and shore authorities must be maintained.
- Shore authorities and others may be unaware of the danger due to loss of stability, particularly in dry-dock, due to use of large quantities of water and must be cautioned about it.
- When welding or other "hot work" operations are to be undertaken, all flammable material in the vicinity and adjacent compartments must first be removed and the workmen made aware of possible fire risks.
- When welding in places where a risk of fire exists, a fire watchman must be in attendance with portable fire extinguisher.
- On completion of "hot work", the senior deck or engineer officer concerned must inspect the work and adjacent compartments to satisfy that no risk of fire exists.
- Ensure ‘NO SMOKING’ rules are observed.
- All electrical boxes should be kept closed to prevent the possibility of contact with combustible materials.
- Overloading of electrical circuits must not be allowed. All circuits should be protected by a proper rated fuse or circuit breaker. The use of multiple plugs drawing power from one socket must not be allowed.
- Electrical equipment should not be improperly wired or with wiring that have become frayed or loose. All electrical appliances must be of an approved type, correctly

positioned and have well maintained flexible cords. Connections between wires and plugs must not be loose.
- All cargo clusters (if used) must be removed from all spaces on completion of work for the day and disconnected from their respective power points. Cargo clusters must not be left on or near flammable materials.
- The master must ensure that sufficient personnel remain on board in port to form an emergency party.
- Following up to date documents must be available in the fire wallet/ box outside the accommodation block:
  - One up to date copy of the ship's fire control plan.
  - Cargo and stability information.

  The cargo information must be cargo data sheets, which show the physical and chemical properties of the cargo and the hazards they present, also of the action to be taken in the event of emergency.
  - Updated crew List.
- One copy of above documents should also be kept on the bridge.

6. Precautions when loading, discharging or carrying dangerous goods and flammable bulk cargoes

When loading, discharging or carrying dangerous goods or flammable bulk cargoes, the pertinent fire fighting and emergency cargo handling instructions contained in the IMSBC code, the International Bulk Chemical Code, the International Gas Carrier Code and the International Maritime Dangerous Goods Code, as appropriate, should be referred.

a. Additional precautions on dry cargo vessels

- Prior loading any dangerous cargo or flammable substance, the IMDG code or IMSBC code, as applicable, should be referred for stowage and handling instructions. The MSDS for the cargoes carried, should be kept with the stowage plan, in an accessible place.
- When loading, confirm segregation of dangerous goods has been carried out as per plan and hazard labels of dangerous goods are in place.
- When loading or discharging dry cargo or bulk cargoes, officers must inspect the holds before the hatches are closed.
- Dust created by certain cargoes may constitute an explosion hazard, especially when loading, discharging and cleaning. The risk can be minimized at such times by ensuring that ventilation is sufficient to prevent the formation of a dust laden atmosphere and by hosing down rather than sweeping.
- Some cargoes may emit flammable gases in sufficient quantities to constitute a fire or explosion hazard. Where this is indicated in the IMSBC code, the cargo spaces and adjacent enclosed spaces should be effectively ventilated at all times. It may be necessary to monitor the atmosphere in such spaces by means of combustible gas indicators.

b. Additional precautions on RO-RO vessels

- When underway
  - Confirm that all gas tight doors and access hatches are closed before sailing, and make sure that they are kept closed throughout the voyage.
  - Inspect the cargo hold periodically and check the condition of lashing and confirm there are no sources of fire.
  - Ventilate the hold continuously, if weather condition permits, whenever cars are on board in order to prevent accumulation of inflammable gases.
- Before and during cargo work
  - Ensure sufficient ventilation before lighting the cargo hold and during the cargo work.
  - After loading cars, put on brake, remove ignition key and store it in the place according to manual or instructions. Ensure that headlights and interior lights are turned off and doors and windows are closed completely.
  - Check for leakage of fuel or engine oil, or any other abnormalities of the cars.

- Close the gas-tight doors and access hatches of the cargo holds.
-

c. Additional precautions on petroleum tankers / gas / chemical carriers

Prior loading any flammable substance, the IBC code or IGC code, MSDS and relevant safety guides, as applicable, should be referred for any special requirements, action to be taken in the event of spills or leaks, fire-fighting procedures and fire-fighting media, etc.

Below are only some basic suggestions, it is very important that all recommendations as given in safety guides (e.g. ISGOTT) and procedures given in respective operating manuals must be complied with.

At all terminals, ship/shore safety checklist must strictly be complied with.

Designation of smoking areas: The master must designate the smoking areas at sea and in port (terminal). All openings in the smoking areas must be securely closed, and smoking, other than in designated areas, must be prohibited. Lighters must never be used. Safety matches must not be used outside of designated areas. Also, they must not be carried on deck where flammable gases may exist.

Flame arrestors and screens: They should be maintained in good condition and replaced if they become defective.

Restriction on use of transceivers: Transceivers, other than the explosion proof type, UHF / VHF, with battery, must not be used.

Restrictions on the use of electric appliances: Non-explosion proof electric appliances must not be used in areas where there is a likelihood of flammable gases being present. Electric appliances means electric equipment including electric appliances with power cables, flash lights, televisions, radios, tape recorders, camera with flashlights, portable telephones, transceivers and other similar appliances. Explosion proof transceivers, gas detection meters, flashlights etc., are not intrinsically safe when the battery compartment is opened.

During cargo operations

Fire fighting appliances: Prior to cargo transfer, the ship's fire fighting system should be made ready. Two fire hoses should be kept forward and aft of the manifold ready for immediate use. The water spray system should be set to protect the manifold and should be tested. A portable DCP extinguisher should be placed conveniently for use near the manifold. On gas carriers, fixed DCP monitors should be made ready and, if remotely activated, should be adjusted to protect the manifold before operations commence and hoses from fixed dry powder stations should be uncoiled and kept ready for immediate use.

Radio equipment and radar: The operation of radio equipment and radar during cargo work must be in accordance with the following:

- The transmission of radio waves from radio equipment (excluding VHF 1 kw or less output) and the starting up of radar is prohibited. The main transmission antenna must be grounded.
- AIS is required to be operating while a ship is underway and while at anchor. Some port authorities may request that the AIS is kept on when a ship is alongside. The AIS operates on a VHF frequency and transmits and receives information automatically, and the output power ranges between 2 watts and 12.5 watts. Automatic polling by another station (e.g. by port authority equipment or another ship) could cause equipment to transmit at the higher (12.5 watt) level, even when it is set to low power (2 watts). When alongside terminal or port areas where no hydrocarbon gases are likely to be present, and if the unit has the facility, the AIS should be switched to low power. If the AIS is switched off or isolated whilst alongside, it must be reactivated upon leaving the berth.
- When it is necessary to transmit radio waves from radio equipment or start operating the radar for repair purposes, terminal permission must be asked for and repair work to be carried out after the completion of cargo handling operations.

Static electricity and ship shore bonding: On board it is possible for a static charge to build up in the cargo system on materials with low resistance, e.g. pipe work that is electrically insulated from each other. A sufficiently large potential difference between the piping system and the hull may result in a discharge of static electricity, which may cause a spark which could result in the ignition of a flammable gas / air mixture. To minimise the risks of static discharges the cargo system must be properly bonded through to the hull. This will normally be done by the fitting of bonding straps at each flange in the cargo pipe work and on the mounting of pumps and valves.

Ventilation of air conditioning units: On ships with central air conditioning units, it is essential that the accommodation is kept under positive pressure to prevent the entry of hydrocarbon vapors. Intakes for air conditioning units are usually positioned in a safe area and under normal conditions, vapors will not be drawn into the accommodation. A positive pressure will be maintained only if the air conditioning system is operating with its air intakes partially open and if all access doors are kept shut, except for momentary access or egress. The system should not be operated with the intakes fully closed, that is, in 100% recirculation mode, because the operation of extraction fans in galley and sanitary spaces will reduce the atmospheric pressure in the accommodation to less than that of the ambient pressure outside.

Windows and doors: The master must designate just one entrance to access the outside, which should be made known to all and signs posted accordingly. All other windows and doors leading out of the accommodation must be closed.

During gas-free operations: The transmission of radio waves from radio equipment must be prohibited without the permission of the master. When the radio equipment and / or radar are to be operated during gas-free operations, a safety check must be made taking into consideration the existence of an outflow of explosive gas, and if so, the quantity and the apparent wind direction and force.

Procedures for cargo tank gas purging / gas freeing: When gas freeing of any cargo tank is required, it is to be carried out after the completion of water washing of the tank and after all portable equipment has been removed from the tank.

On a vessel which is fitted with an inert gas system the gas freeing operations are to be carried out in accordance with the procedures detailed in the vessel's inert gas system operation and maintenance manual and SMS procedures.

On a vessel which is not fitted with an inert gas system the gas freeing operations are to be carried out in accordance with the appropriate recommendations of ISGOTT. If portable fans are used for gas freeing, injector nozzles and/or flexible ducting are not to be used until the hydrocarbon gas concentration is less than 100% of the lower flammable limit.

7. Basic fire fighting

There are four basic ways to fight fire:

1. Starving: by which the fire triangle is starved of the fuel or inflammable material. Remove the inflammable material and the fire will burn itself out.
2. Smothering: oxygen is very important and if that element is removed or reduced to below 15% then the fire will be put off. Examples of smothering agents are CO_2, inert gas and foam.
3. Cooling: If the substance is cooled until it does not give off sufficient vapours to support combustion, then the fire will be extinguished. Water is a good example of cooling agent.
4. Inhibition: is the process of interfering with and stopping the chemical reaction in the fire.

Fire types	Extinguishing media
Type A	Water, Water/CO_2 and Water/Soda-acid extinguishers. Foam is not recommended to be used except in special circumstances.
Type B	Water spray, Foam, Dry Chemical powder (DCP), Sand, Volatile liquids like

	Carbon tetra chloride, Methyl bromide etc, CO_2 etc.
Type C	Water spray, Inert gas, CO_2 to a certain extent and Foam.
Type D	CO_2 and DCP are normally used.

Having seen the four basic ways of fighting fire, it must be noted that the method of extinguishing a fire depends on the class of fire. For e.g. in case of an oil fire – water will not at all be useful though it is the best cooling agent. We must understand the types of fire and the method by which to extinguish.

8. General instructions on fire-fighting activities and fire-fighting procedures

FIRE ON BOARD IS A SERIOUS EMERGENCY. Fire alarms, smoke, burning smells, must always be investigated fully. Never assume it is a false alarm. Speed with which the fire is tackled is of utmost importance. In general, if a SERIOUS fire, especially in the engine room or cargo space cannot be brought under control within about 10 minutes the CO_2 (Carbon Dioxide) or other fixed firefighting system should be considered for use. Never hesitate to use the fixed firefighting systems. It is better to be cautious, because if the action is not taken in time, it may not be effective.

Person seeing the fire or smelling smoke must:

a) Raise the alarm - Use nearest manual fire alarm in alleyways.
b) Shout “Fire, Fire”.
c) Inform bridge / duty officer / duty engineer giving location of fire and his name.
d) If the fire is small, attempt to extinguish it with a fire extinguisher.
e) If fire is large, close compartment door, all other accesses and wait for assistance. Do not enter any place where smoke is present, without proper equipment.

Duty officer / engineer should sound the general emergency signal giving the location on the public address system if available. All personnel must immediately proceed to their emergency stations. Emergency check lists relating to fire must be referred to.

Apply Your Knowledge

1. List the action that would be taken in case of:

   - Paint store fire
   - Galley fire
   - Electrical fire in accommodation
   - Major fire in engine room

Function: Controlling the operation of the ship and care for persons on board

Competence: Operate life saving appliances

Task Reference No.: C4.1

Sub task Reference Nos.: C4.1.1

Topic: Life Saving Appliances (LSA)

Task Heading

- Under supervision, start the lifeboat and rescue boat engines.

Objectives

- Be able to start life boat and rescue boat engines

Index

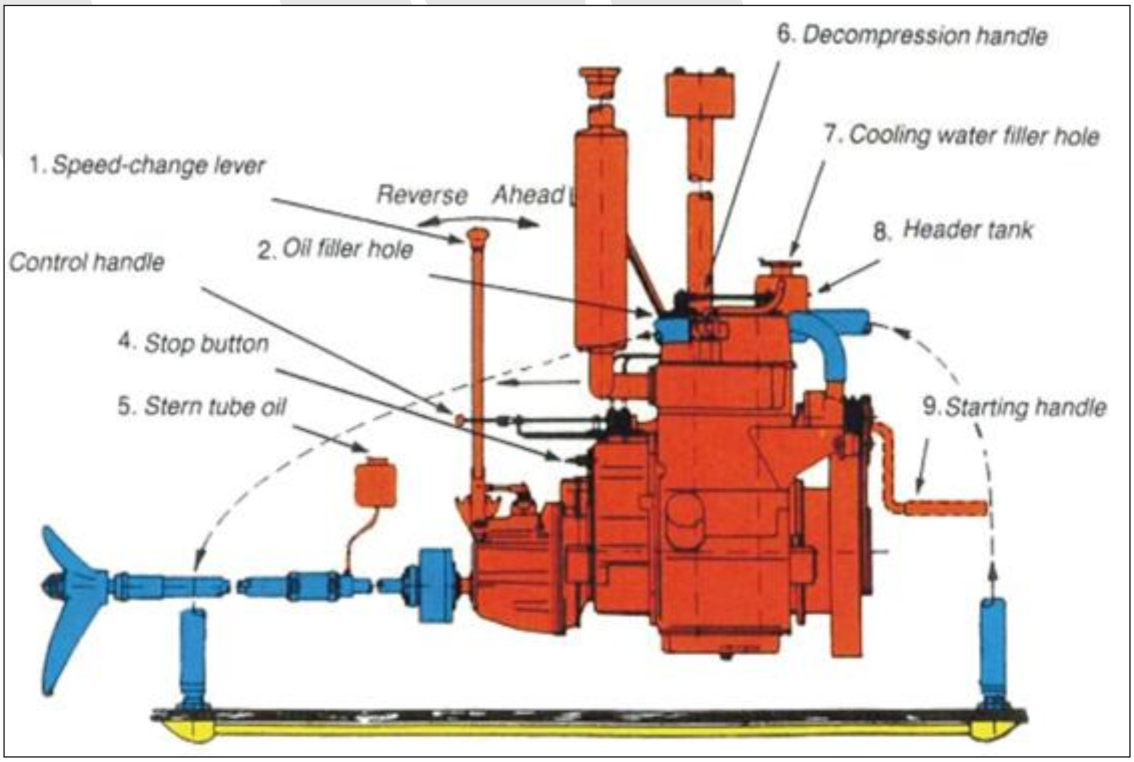
1) Introduction
2) Starting the engine manually
3) Starting the engine by battery

Description

1) Introduction

Engines must always be kept ready for starting.

Every person on board must be familiar with the starting of lifeboat and rescue boat engines. Engines on some boats are started manually and on some are started using electric (battery) or hydraulic power. For power starting, we must have two sources and independent source of recharging should be available. For batteries, this is done by charging through ship's mains while in stowed position and by alternator when lifeboat engines are being used. Hydraulic power pack is manually pressurized. Always, ensure that you have an officer with you prior attempting to start a lifeboat engine.



2) Starting the engine manually

Typical instructions for starting/ stopping a lifeboat engine manually, is given below:

Before start:

In an emergency, engines should be able to be started immediately without the “Before Start” checks. Engines must always be kept ready for starting.

- Check with the dipstick that the lube oil level is between the marks on the dipstick on engine and gear.
- Check that there is cooling water about half-way up in the header tank.
- If cold weather is expected add antifreeze mixture to the cooling water or drain all cooling water. Some ships are provided with a quick start spray for starting the engines during cold weather. This spray is normally used prior to starting the engines.
- Check that the propeller and rudder turns freely.

To start the engines:

- Place the speed-change lever in neutral position.
- Place the fuel control handle at idling.
- Turn the decompression lever to “ON” position (activate the decompression lever).
- Turn the engine rapidly at about 20 RPM using the manual handle.
- When speed is picked up, release the decompression lever and the Engine should start.
- If the engine does not start, the process may be repeated a couple of times keeping in mind that the decompression lever should only be released once the engine gains sufficient momentum.
- To control the speed of the engine, a lever is provided (which is basically a fuel lever) which can be controlled as required.
- Ahead and astern movements are controlled by a gear lever which has also a centre position which is neutral where the engines keep running but the shaft does not turn.

To stop the engines:

- On some engines, a stop button is provided, which when depressed stops the fuel and hence the engines.
- Engines can also be stopped by turning the decompression lever to ‘on’ position or by slowly reducing the fuel lever to minimum.

3) Starting the engine by battery

Typical instructions for starting/stopping lifeboat engines using battery are given below. The batteries must be kept charged at all times.

Before start:

In an emergency, engines should be able to be started immediately without the “Before Start” checks. Engines must always be kept ready for starting

- Check with the dipstick that the lube oil level is between the marks on the dipstick on engine and gear.
- Check and confirm sufficient fuel
- Check that there is cooling water about half-way up in the header tank.
- If cold weather is expected add antifreeze mixture to the cooling water or drain all cooling water. Some ships are provided with a quick start spray for starting the engines during cold weather. This spray is normally used prior to starting the engines.
- Check that propeller and rudder are clear.

Starting Engine:

- Place the speed-change/ fuel control lever in neutral position

- Select Battery to be used – both batteries in parallel can also be selected
- Put ignition switch ‘on’
- Lube oil and charging light will be ‘on’ and buzzer will sound
- Turn the starting switch on – the starting motor will turn the engine
- Release switch, once engine is started. Warning light and buzzer will go off.

Stopping Engine:

- Bring speed change/ fuel control lever to neutral position
- Turn ignition/starting switch off.

Apply Your Knowledge

1. Detail the procedure for starting a lifeboat engine in freezing conditions.

Function: Controlling the operation of the ship and care for persons on board

Competence: Operate life saving appliances

Task Reference No.: C4.1

Sub task Reference Nos.: C4.1.2

Topic: Life Saving Appliances (LSA)

Task Heading

- Demonstrate the procedures for testing the operation of:
  - Search and rescue transponder
  - Hand held VHF transceivers
  - Emergency position indicating radio beacon.

Objectives

- Understand operation of above equipment
- Be able to effectively use all above equipment

Index

1) Introduction
2) Search and rescue transponders (SART)
3) Hand held VHF transceivers
4) Emergency position indicating radio beacons

Description

1) Introduction

Every officer on board must be able to effectively use the portable GMDSS equipment provided on board for use in an emergency. They must also understand the basic working of the equipment as described below.

2) Search and rescue transponders (SART)

SART is the short form for search and rescue radar transponder, which is carried on all ocean going ships. Normally one SART is carried on each side of the ship for survival craft on each side and is stowed on the navigating bridge. This is to be carried to the survival craft when abandoning the vessel. SART is used on the survival craft for the purpose of indicating the position on radar, when any ship is passing close to the craft.

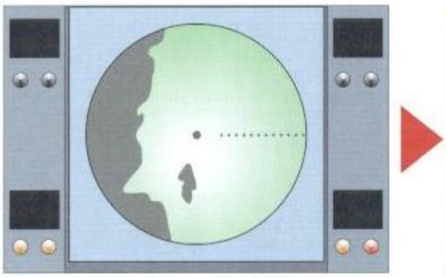
When the SART is switched 'ON' it goes on a standby mode. It does not send out any signal on its own but is triggered off by a signal of 3 cm (x-band) radar. Once triggered it gives out a signal of 12 blips on the rescue ship's radar (x band) indicating its position. The range of the SART is normally 5 – 7 miles. Once the rescue ship comes closer say upto 1 mile, the blips turn into concentric arcs on the radar and if the survival craft is less than 1 nm of the rescue ship, the blips becomes concentric circles. The range of the SART also depends on the height at which the transponder is placed and the freeboard of the vessel.

When the SART is triggered off by rescue ship radar an audible and visual alarm is given by the transponder indicating to the survivors that a rescue ship is around and they can look out for the same.

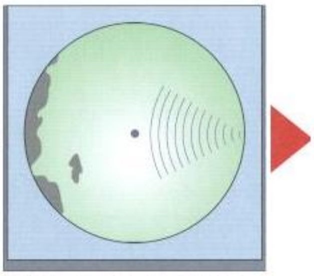
It is powered by a battery that has a life of about 3-4 years and needs replacement after the expiry date. There is a test switch on the SART which when depressed gives a light, indicating that the equipment is functional. It comes complete with a mounting bracket for the wheel house and for the survival craft.

> SART gives a signal of 12 blips on X Band radar indicating its position. No signal is received on S Band radar.

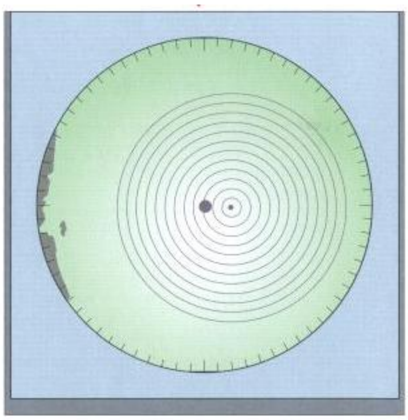
The SART can be tried out in open sea when there is no traffic – by switching on own SART and observing the signal on an X Band Radar.



Radar Display showing the SART 12 dot blip code (bearing approximately 90°)



As the search craft approaches to within about 1n mile of the SART the 12 dots will change to wide arcs.



The wide arcs change into complete circles as the SART is closed

Operating Procedure of SART is as follows:

- *Move the toggle switch to the 'ON' position.*
- *Confirm that the green light lights up. This indicates that the SART is in standby mode (able to receive radio signals)*
- *The red lamp will light intermittently when a rescue radar signal is received. As the rescue radar approaches, the lamp will change from intermittent to a steady light.*

AIS SART

AIS SART transmits target survivor information including structured alert messages, GPS position information and serialized identity number. Once activated AIS SART transmits continually for a minimum of 96 hours. An inbuilt GPS provides high speed position information to assist in quick recovery of survivors.

The transmitter sends out a specified pattern. Every minute, a sequence of 8 messages is transmitted; each message is transmitted in a 26 ms time slot. 4 messages are transmitted on channel A and 4 on channel B. All 8 messages are transmitted within a total time frame of 14 seconds. This time frame is defined to maximize the probability that one of the transmissions hit a wave top.

It is only necessary to receive one of the 8 messages from time to time to accurately locate the AIS-SART.

The transmission signal from an AIS-SART consists of an MMSI like ID code, where the first three digits will be "970". The ID code consists of a total of 9 digits and the AIS-SART uses the remaining 6 digits to indicate a manufacturer code (2 digits) in addition to the unit's unique serial number (4 digits).

In addition to the ID code that appears on the AIS and connected equipment (radar), an AIS-SART will also be visualized on an electronic chart, connected to the AIS transponder onboard. An AIS-SART will be shown as a circle with a built in cross.

3) Hand held VHF transceivers

Each ship is provided with 3 VHF transceivers to be used in survival craft. They are used in an emergency between survival craft, ship and survival craft and ship and rescue boat.

Along with the sets, primary sealed batteries are provided – these are to be used only in an emergency. In addition secondary type batteries are provided which can be charged. These batteries are used for trying out the sets. These sets must be tried out at least once a week.

Operating Instructions:

1. Switch on the set and increase the volume to maximum.
2. Reduce the squelch control to minimum and then Increase till the noise just disappears.
3. Switch to channel 16 using the channel selector knob. The set is now ready to receive transmissions on channel 16.
4. Press the PTT switch and talk keeping the handset about 6 inches from the mouth. Release the PTT switch to receive.

4) Emergency position indicating radio beacons

All SOLAS vessels are required to carry an EPIRB which shall be capable of transmitting a distress alert either through the polar orbiting satellite service operating in the 406 MHz band or, if the ship is engaged only on voyages within the INMARSAT coverage, through the INMARSAT geostationary satellite service operating in the 1.6 GHz band.

The EPIRB is a buoy shaped transmitter which can be activated either manually or automatically.

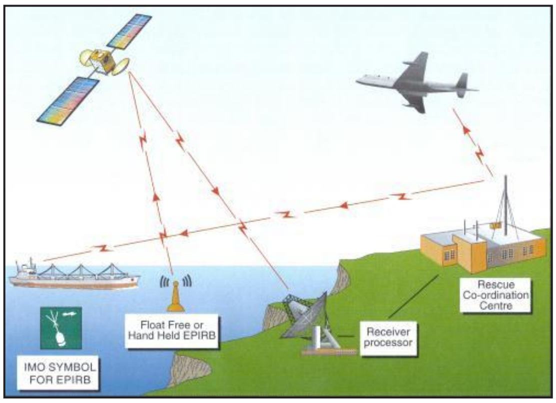
When activated, an EPIRB transmits a distress call which is picked up or relayed by satellites and transmitted via land earth stations to rescue services. From the signals transmitted by the EPIRB, the source can be located from land, ship, airplane or satellite, dependent on the type of EPIRB. It is fitted on board with a "float free" arrangement and is the only equipment on board which will transmit a distress alert in case of vessel sinking without any manual intervention.

406 MHZ EPIRB

406 MHz EPIRBs uses COSPAS / SARSAT satellites. These satellites are low earth orbiting satellites on polar paths. The position determination of the user is performed by measuring the frequency Doppler shift of the transmission signal. 406 MHz EPIRBs include a file with all user data like ship's name, call sign, etc. EPIRBs need to be programmed with the user data, and provide user identification in case of an alert. With COSPAS/SARSAT the false alert rate has been reduced dramatically but is still high with approximately a dozen false alerts per incident. Another disadvantage of low earth orbiting satellites is that the user will have to wait until a satellite passes to be assured that distress signal is received ashore. Depending on the latitude this may take hours. Due to the usage of low earth orbiting satellites, the user must expect a delay between 15 minutes and 4 hours for the signal to be received and forwarded to SAR.

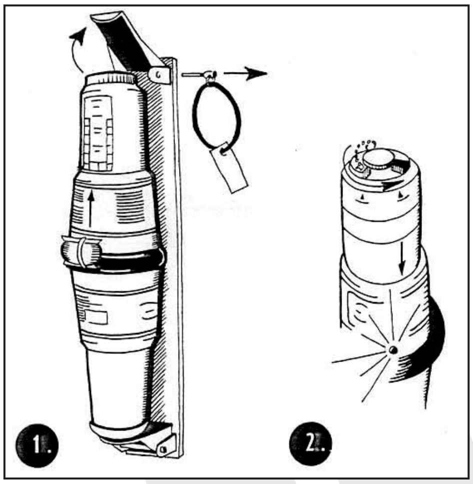
INMARSAT EPIRBs

INMARSAT EPIRBs are equipped with a built-in GPS receiver because, due to the missing satellite movement, no Doppler estimation can be performed. INMARSAT EPIRBs transmit the position in case of an emergency as part of the message. INMARSAT EPIRBs do not need programming because they transmit a unique system code. If the ships sinks and the beacon is released from the float free cradle "sinking" will be transmitted. If the beacon is activated manually then "unspecified distress" will be transmitted as the type of emergency.



The instructions of mounting and operation of the EPIRB is given along with the equipment and usually pasted on the equipment itself. The EPIRB is powered by a battery which has an expiry date usually 3 – 4 years and the battery should be replaced on expiry. EPIRBS are tried out by using the 'test' switch provided. It shows a combination of neon/LED lights indicating its functionality. EPIRB is stowed in "stand by" position and in this position it will automatically transmit alert if immersed in water. It can also be manually operated to send alert signal. It is attached with a lanyard to allow it to be attached to the survival craft, if kept immersed in the water.

EMERGENCY POSITION INDICATING RADIO BEACON TEST:



Example: ***TRON 30S***
EPIRB SELF TEST

1) *Pull out the locking pin on top of the bracket*
2) *Lift the upper arm of the bracket and remove the EPIRB*
3) *Keep the beacon in an upright condition*
4) *Press the spring loaded switch on top of the beacon to the "test" position*
5) *A successful test will be indicated by a series of blinks on the led test indicator and internal strobe light, followed by a continuous light after approximately 15 seconds.*
6) *Replace the beacon and release the switch*
7) *Replace locking pin on top of the bracket*

Apply Your Knowledge

1. Discuss the procedures for testing of:
   - SART
   - Hand Held VHF Transceivers
   - EPIRB

Function: Controlling the operation of the ship and care for persons on board

Competence: Operate life saving appliances

Task Reference No.: C4.1

Sub task Reference Nos.: C4.1.3, C4.1.4, C4.1.5

Topic: Life Saving Appliances (LSA)

Task Heading

- Locate the life saving signals table displayed and familiarize with its use.
- Prepare an emergency muster list.
- Locate the SOLAS training manual on board.

Objectives

- Familiarize with SOLAS LSA Training Manual
- Locate the life saving tables and understand the significance of the signals.
- Understand why muster List is required.
- Be able to prepare a muster List.

Index

1) Introduction
2) SOLAS LSA training manual
3) Contents of a training manual
4) Life saving signals
5) Muster list

Description

1) Introduction

Remember, safety is everybody's responsibility.

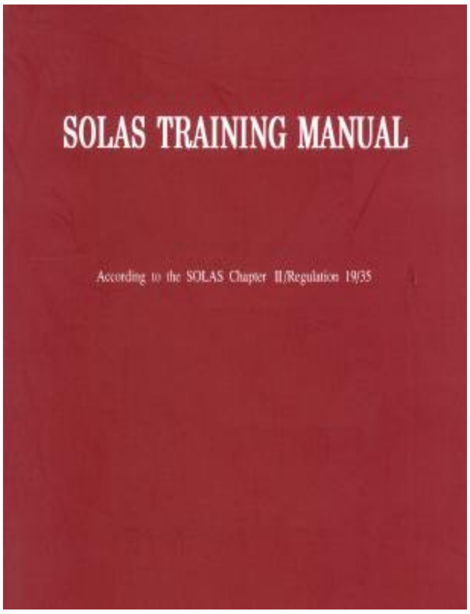
Always ensure that the training manuals are ship specific and updated.

Every person on board must be familiar with all the safety equipment provided on board. He must not only know the location but also be aware of how to use it in an emergency. Imagine, a man overboard and we do not know how to launch the rescue boat. It is also very important that every person is aware of his emergency duty and knows what to do in case of an emergency. Duties of each person on board are detailed in the muster list displayed at various places on board.

2) SOLAS LSA training manual

SOLAS LSA training manual/s is provided on each ship to enable crew to familiarize with, at least:

- The purpose of the manual is to provide all members of the crew with instructions and information on the life-saving appliances provided in the ship and on the best methods for survival.
- Illustrations may be provided to explain better.
- A manual, in the working language of the ship, must be available in the crew recreation room and mess room or in each crew cabin.



Following must be explained in detail:

- donning of lifejackets, immersion suits and anti-exposure suits, as appropriate;
- muster at the assigned stations;
- boarding, launching, and clearing the survival craft and rescue boats, including, where applicable, use of marine evacuation systems;

- method of launching from within the survival craft;
- release from launching appliances;
- methods and use of devices for protection in launching areas, where appropriate;
- illumination in launching areas;
- use of all survival equipment;
- use of all detection equipment;
- with the assistance of illustrations, the use of radio life-saving appliances;
- use of drogues;
- use of engine and accessories;
- recovery of survival craft and rescue boats including stowage and securing;
- hazards of exposure and the need for warm clothing;
- best use of the survival craft facilities in order to survive;
- methods of retrieval, including the use of helicopter rescue gear (slings, baskets, stretchers), breeches-buoy and shore life-saving apparatus and ship's line-throwing apparatus;
- all other functions contained in the muster list and emergency instructions; and
- instructions for emergency repair of the life-saving appliances.
- Every ship fitted with a marine evacuation system must be provided with on-board training aids in the use of the system.

3) Contents of a training manual

A SOLAS LSA training manual is a controlled document and typical contents of this manual of a ship is given below:

Section	Contents
	Foreword
ROC	Ship Specific Record of Changes
01	Mustering and Emergency Instructions
02	Life-Jackets
03	Immersion Suits
04	Thermal Protective Aids
05	Illumination in the Launching Area
06	Protection in the Launching Area
07	Lifeboats and rescue boats
08	Liferafts
09	Radio Equipment
10	Pyrotechnics
11	Life-Buoys
12	Abandoning the Ship
13	Exposure, Hazards and Protection
14	Rescue and Retrieval

Explanation regarding use of all life saving equipment in the manual must be simple and for easy understanding, illustrations could be used. Video aids could be used in lieu of or in addition to a hardcopy training manual.

4. Life saving signals

Life saving signals is used by search and rescue facilities engaged in search and rescue operations when communicating with ships or persons in distress.

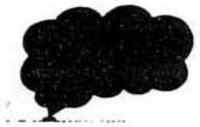
> Be aware, where the Life Saving Signal card is on the Bridge

An illustrated table describing the life-saving signals must be readily available to the officer of the watch of every ship. These signals (as given below) are posted on the bridge and additionally available in the lifeboats. They are also given in IAMSAR Vol III and the International Code of Signals.

The signals are used by ships or persons in distress when communicating with life-saving stations, maritime rescue units and aircraft engaged in search and rescue operations.

	MANUAL SIGNALS	LIGHT SIGNALS	OTHER SIGNALS	MEANING
Day signals	 **Vertical** motion of a white flag or of the arms	 or firing of a **green** star signal		**In general:** **affirmative** **Specifically:** **rocket line is held – tail block is made fast – hawser is made fast – man is in the breeches buoy – haul away**
Night signals	 **Vertical** motion of a white light or flare	 or firing of a **green** star signal		
Day signals	 **Horizontal** motion of a white flag or of the arms extended horizontally	 or firing of a **red** star signal		**In general:** **negative** **Specifically:** **slack away – avast hauling**
Night signals	 **Horizontal** motion of a white light or flare	 or firing of a **red** star signal		

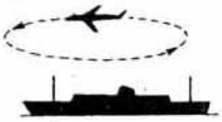
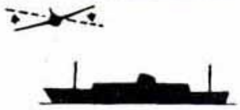
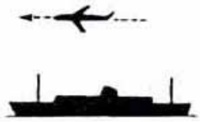
Signals to be employed in connection with the use of shore life-saving apparatus

Day signals		 Orange smoke signal	 or combined *light and sound* signal (thunder-light) consisting of 3 single signals which are fired at intervals of approximately one minute	
Night signals		 **White** star rocket consisting of 3 single signals which are fired at intervals of approximately one minute		

If necessary, the day signals may be given at night or the night signals by day.

Replies from life-saving stations or maritime rescue units to distress signals made by a ship or person

Signals used by aircraft engaged in search and rescue operations to direct ships towards an aircraft, ship or person in distress

PROCEDURES PERFORMED IN SEQUENCE BY AN AIRCRAFT			MEANING
 1 CIRCLE the vessel at least once.	 2 CROSS the vessel's projected course close AHEAD at a low altitude while ROCKING the wings. (See Note).	 3 HEAD in the direction in which the vessel is to be directed.	The aircraft is directing a vessel towards an aircraft or vessel in distress. (Repetition of such signals shall have the same meaning)
4 CROSS the vessel's wake close ASTERN at low altitude while ROCKING the wings. (See Note)  NOTE Opening and closing the throttle or changing the propeller pitch may also be practiced as an alternative means of attracting attention to that of rocking the wings. However, this form of sound signal may be less effective than the visual signal of rocking the wings owing to high noise level on board the vessel.			The assistance of the vessel is no longer required. (Repetition of such signals shall have the same meaning)

Air-to-surface visual signals

Signals used by a vessel in response to an aircraft engaged in search and rescue operations

			MEANING
Hoist "Code and Answering" pendant Close up; or	Change the heading to the required direction; or	Flash Morse Code signal "T" by signal lamp.	Acknowledges receipt of aircraft's signal
Hoist international flag "N" (NOVEMBER); or		Flash Morse Code signal "N" by signal lamp.	Indicates inability to comply

Use the following surface-to-air visual signals by displaying the appropriate signal on the deck or on the ground.

Message	ICAO–IMO visual signals
Require assistance	V
Require medical assistance	X
No or negative	N
Yes or affirmative	Y
Proceeding in this direction	↑

Surface-to-air visual signals

Reply from an aircraft observing the above signals from surface craft or survivors.

					MEANING
Drop a message or	Rock the wings (during daylight) or	Flash the landing lights or navigation lights on and off twice (during hours of darkness) or	Flash Morse Code signal "T" or "R" by light or	Use any other suitable signal	Message understood
Fly straight and level without rocking wings or	Flash Morse Code signal "RPT" by light or	Use any other suitable signal			Message not understood (repeat)

Air-to-surface visual signals

Procedures performed by an aircraft.

			MEANING
Drop a message or	Drop communication equipment suitable for establishing direct contact		The aircraft wishes to inform or instruct survivors

Signals by survivors in response to a message dropped by an aircraft

			MEANING
Flash Morse Code signal "T" or "R" by light or	use any other suitable signal		Dropped message is understood by the survivors
Flash Morse Code signal "RPT" by light			Dropped message is not understood by the survivors

* High visibility coloured streamer

Signals by survivors

5. Muster list

> Muster List must be upto date and posted before proceeding to sea.

The muster list must be prepared before the ship proceeds to sea. After the muster list has been prepared, if any change takes place in the crew which necessitates an alteration in the muster list, the list must either be revised or a new list must be prepared. The muster list must specify details of the general emergency alarm and public address system and also action to be taken by crew and passengers when this alarm is sounded. The muster list must also specify how the order to abandon ship will be given. Muster lists and emergency instructions must be exhibited in conspicuous places throughout the ship including the navigation bridge, engine-room and crew accommodation spaces.

Each passenger ship must have procedures in place for locating and rescuing passengers trapped in their staterooms. The muster list must show the duties assigned to the different members of the crew including:

- closing of the watertight doors, fire doors, valves, scuppers, side scuttles, skylights, portholes and other similar openings in the ship;
- equipping of the survival craft and other life-saving appliances
- preparation and launching of survival craft
- general preparations of other life-saving appliances
- muster of passengers
- use of communication equipment
- manning of fire parties assigned to deal with fires
- special duties assigned in respect to the use of fire-fighting equipment and installations.

The muster list must specify which officers are assigned to ensure that life-saving and fire appliances are maintained in good condition and are ready for immediate use.

The muster list must specify substitutes for key persons who may become disabled, taking into account that different emergencies may call for different actions.

The muster list must show the duties assigned to members of the crew in relation to passengers in case of emergency. These duties must include:

- warning the passengers
- seeing that they are suitably clad and have donned their lifejackets correctly
- assembling passengers at muster stations
- keeping order in the passageways and on the stairways
- generally controlling the movements of the passengers
- ensuring that a supply of blankets is taken to the survival craft.

The format of the muster list used on passenger ships must be approved by flag state.

Apply Your Knowledge

1. Check the location of SOLAS training manual on board and discuss the contents with shipboard training officer.

Function: Controlling the operation of the ship and care for persons on board

Competence: Operate life saving appliances

Task Reference No.: C4.1

Sub task Reference Nos.: C4.1.6, C4.1.7

Topic: Life Saving Appliances (LSA)

Task Heading

- Locate the lifeboat launching instructions posted at the lifeboat deck and demonstrate understanding of launching procedures and procedures of abandoning a ship.
- Demonstrate understanding of the procedure for launching (including liferaft stowed away from accommodation area) and inflating liferafts.

Objectives

- Understand and familiarize with lifeboat launching procedure
- Understand the "on load release" arrangement
- Understand and familiarize with liferaft launching procedure
- Understand procedure of abandoning ship

Index

1) Introduction
2) Lifeboat launching
  a. Davit launching procedure for open boats
  b. Davit launching procedure for enclosed boats
  c. Free-fall lifeboat launching procedure
3) Life rafts
  a. Liferaft launching (manually)
  b. Liferaft launching by davits
  c. Automatic release of life raft
4) Abandoning ship
  a. Actions to be taken when called to survival stations
  b. Actions to be taken when ordered to abandon ship
  c. Actions to be taken when in water.

Description

1) Introduction

> In an emergency, time is critical. Please be familiar with the instructions for launching lifeboats and liferafts on board your ship.

In the unlikely event of ever having to abandon ship all must know their emergency duties and must carry out same as safely and rapidly. Launching of lifeboats is an operation which could easily go wrong causing accidents and delay. Everybody on board must be familiar with launching instructions of lifeboats and liferafts. Instructions for launching of lifeboats and liferafts are given near the boat and raft and placed such that they can be read under emergency lighting.

2) Lifeboat launching

Lifeboats may be of open, semi enclosed or fully enclosed type. The fully enclosed type boat may be launched by davits or 'free fall'. The other boats are davit launched.

i. Davit launching procedure for open boats

Launching of lifeboats must be carried out in accordance with the launching procedure given in the manuals and practiced during drills. A typical launching procedure for an open boat is described below:

i. Check harbour pins removed.
ii. Insert drain plugs.
iii. Pass out toggle painter and make fast forward on the ship.
iv. Lower embarkation ladder.
v. Ensure winch handle is not engaged.
vi. Check tricing pendants secured and bowsing tackles ready.
vii. Release gripes, ensure lashing wires are clear.
viii. With great care lower life-boats to embarkation deck by manually lifting the brake operating lever. Do not let the falls over-run. Tricing pendants are not strong enough to carry the weight of the boat.
ix. Rig bowsing tackles; ensure fee ends are secured inside the boat.
x. Release tricing pendants together.
xi. Inform the bridge that life-boat ready.
xii. Passengers and crew to embark. Ensure everyone is sitting down. Hands and arms must be kept inboard.
xiii. Ease the life boat out from the ship's side with the bowsing gear, and then release bowsing gear.
xiv. When ordered, lower away. Brake to be fully open.
xv. When the lifeboat is afloat, release fall blocks, take care to avoid the swinging blocks.
xvi. Embark the launching party and let go the toggle painter.
xvii. Get the lifeboat away from the ship; keep a good look out for any survivors in the water.

In motor lifeboats the engine is started on order from the boat in-charge. The following photographs show the davit launching procedure for open lifeboats.

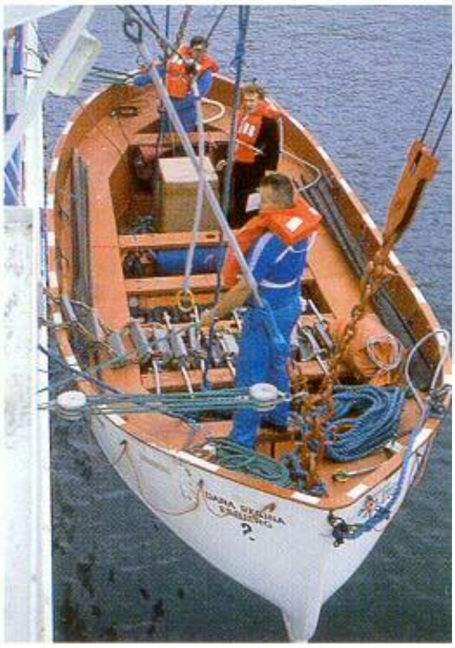

1


2

3

4

5



6

Some of the additional precautions that must to be taken when lowering/embarking on to the lifeboat:

- All crew should be wearing life-jackets.
- If available fenders should be rigged on the outboard side of the lifeboat.
- No one should stand between the falls and the boat ends.
- Persons in the boat should grasp the lifelines,
- The painter should be kept taut when lowering the boat to the water line, to prevent the boat from surging.
- The after block should be cast off first in a tideway to prevent the boat from broaching to. ‘Broaching-to’ is the term used for turning violently, heeling over and getting flooded.
- The forward block is then cast off as the boat is making a slight headway.
- When lowering the boat in heavy weather/ heavy sea – the boat should be lowered on the crest of the wave. When the boat slides to the succeeding trough, her falls are automatically slackened by the boat’s weight. On rising to the next crest they are amply slack for rapid unhooking.

- Note when performing all the three points above, the painters should always be kept taut so that the boat does not get swamped away and remains alongside directly under the boat davits.
- Boat hooks/ oars are kept ready to shear away the boat from the shipside the moment it is cast off. The boat is then maneuvered to safety away from the sinking vessel.

b) Davit launching procedure for enclosed boats

All enclosed boats are provided with an “off and on load release arrangement” for releasing the falls. This enables the falls to be released with a ship making headway of 5 Knots. Many accidents involving the on load release system have taken place with lives being lost. Operation of the release arrangement and subsequent recovery must be thoroughly understood.

i. The painter is kept ready for securing – ensure same is secured to a strong point on board
ii. Remove battery charging plug (if provided)
iii. Ensure the brake lever securing pin (if any) is out and brake ready for release.
iv. Lower ladder – it may be required for boarding
v. Release davit securing arrangement (F & A)
vi. These boats are usually boarded from stowed position – board the boat ensure plug/s in place
vii. If the gripes are to be released manually, release same
viii. Shut the boat door.
ix. Start lifeboat engines
x. Ensure everybody is seated and strapped on.
xi. Lower the boat from inside.
xii. Once waterborne, release the hooks by operating the “on load release system”
xiii. Release the painter
xiv. Move off the ship – using engines
xv. On ships where toxic gases may be present – use the compressed air provided.
xvi. On ships, where flammable cargo is carried and there is a fire, use the water sprinkler system provided.

- **On load release hooks**

Caution: The lifeboat hooks must not be released under load before being water borne. A hydrostatic interlock is provided to prevent releasing the boat before being waterborne. This must not be manually bypassed unless in an emergency, if the boat cannot be lowered due to problem with davit/winch.

> It is extremely dangerous to release the boat before it is waterborne.

The most common cause of fatal accidents involving lifeboat launching systems is the failure of on-load release hooks. A SOLAS requirement for lifeboats on ships built after 1 July 1986 stipulates that they should be fitted with a hook disengaging gear, capable of being operated both on and off-load. This requirement has resulted in a number of manufacturers worldwide developing various ingenious mechanisms for satisfying the regulation.

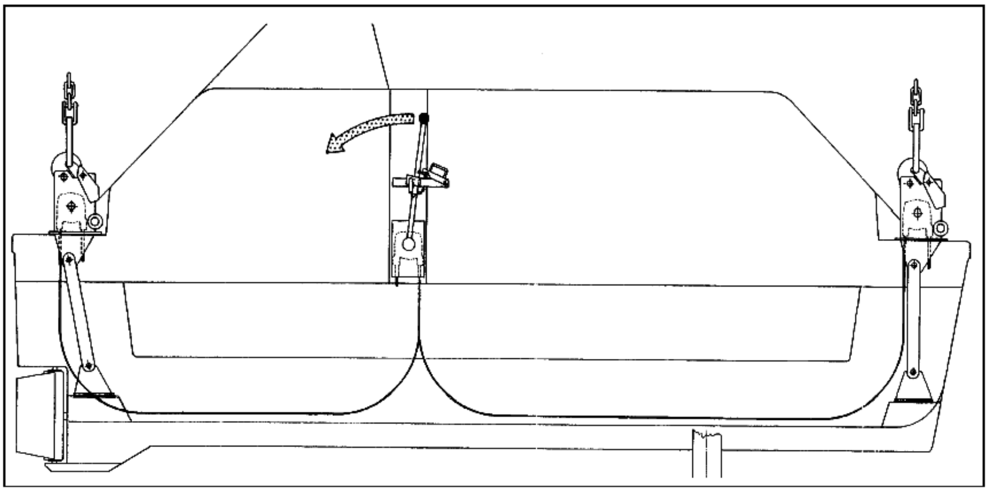
As a result, many on and off-load release hooks have become over-complicated, and a number of accidents have occurred. These accidents have generally resulted in a lifeboat being released involuntarily from one or both of its hooks. On those occasions when only one hook has been released, the attachment at the other end was often torn away, causing the lifeboat to drop into the water; sometimes inverted.

Read the Lifeboat manual to understand the correct re-setting procedure for the hooks.

Analysis of a number of accidents reveals that premature hook release has often been caused by the failure to re-set it correctly when the lifeboat was being recovered from its previous launching. This shortcoming stems from a lack of understanding of the mechanism involved, inadequate training and poor maintenance. Once the hook has been incorrectly reset, spontaneous release is possible at any time before the lifeboat is next put in the water.

Please see below, one of the release mechanisms used in the lifeboats.

Release lever mechanism diagram

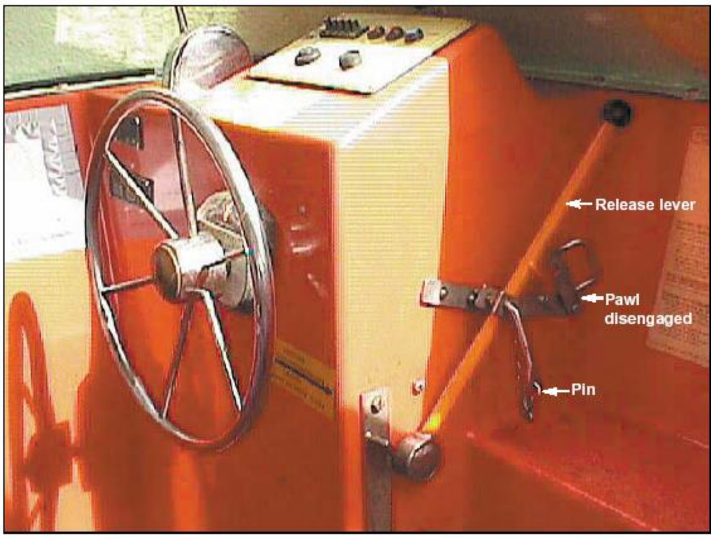


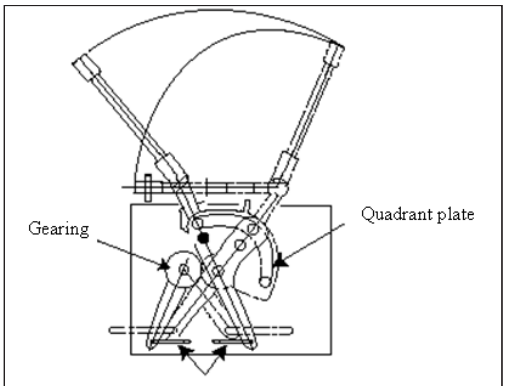
The central operating lever is placed adjacent to the coxswain's position.

The lever for the release mechanism of the boat is secured by two locking devices, a safety pin and a pawl.

The safety pin passes through a bracket that houses the release lever, preventing the lever from being moved unless the pin is first withdrawn and the pawl lifted. The pawl, which engages in a lug on the release lever, must be lifted clear of the lug to permit movement of the release lever.

Release mechanism





To release the hooks:

i. Ensure that hydrostatic interlock is in release position
ii. Turn the safety pin and pull it out.
iii. Move up the locking pawl and pull the release lever.
iv. After releasing the hooks return the release lever to the original position.

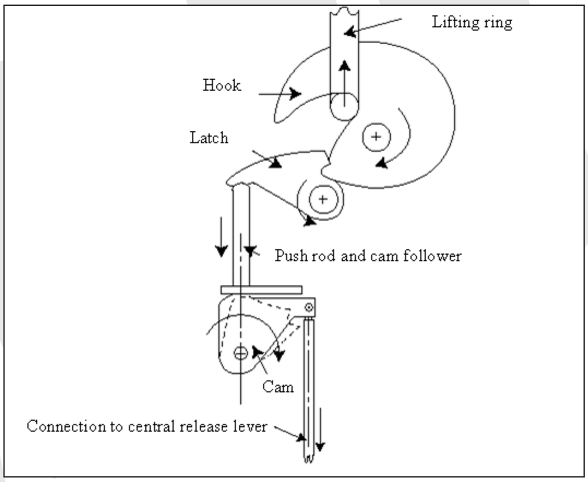
For preparing to hoist the boat:

i. Check the resting position of the hooks and release lever (safety pin in place).
ii. Push the long link into the hooks.

Hoisting the boat:

i. Hoist the boat clear of the water and stop.
ii. Recheck the hooks and ensure that the cams and hook are resting in the proper positions.
iii. Confirm hydrostatic interlock is in ‘lock’ position
iv. Continue hoisting the boat.

Checking of the position of the hooks is very important as this may cause release of the lifeboat hook when hoisting.

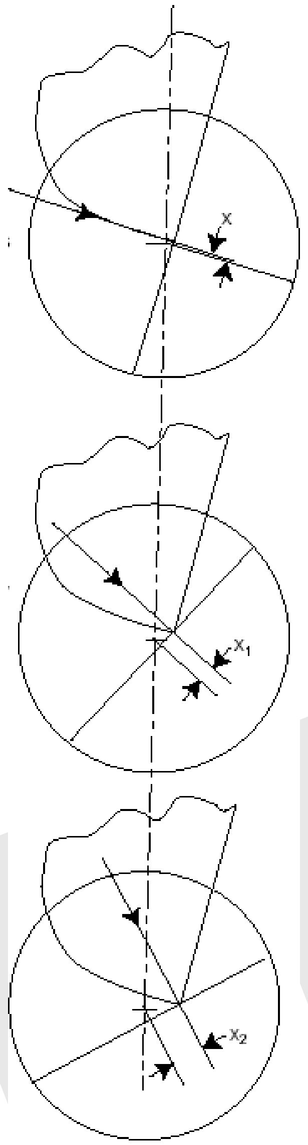


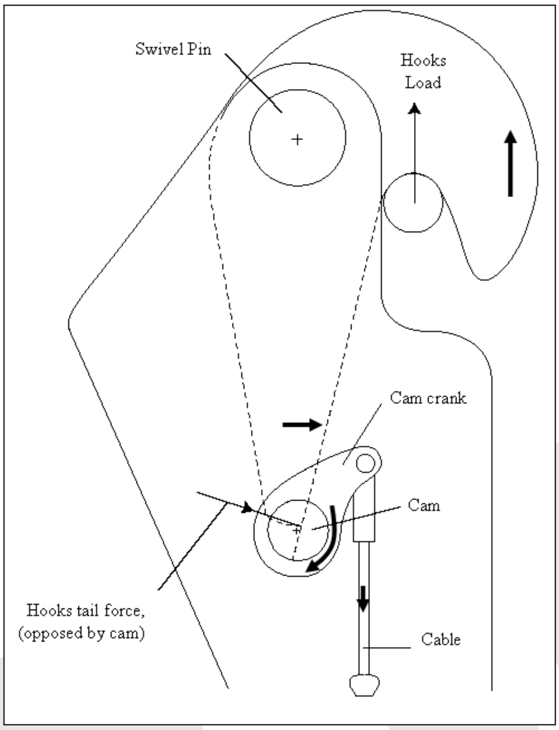
After the hooks are unlocked, under the weight of the boat, they would open, freeing the falls and releasing the boat. When the boat is released, the hooks are designed to be returned to an upright position by counterweights. When the release lever is returned to its original position, the hooks would be secured once more. The hooks then are ready, if required, for the falls to be hooked up again after the release lever is secured.

Improper resetting of the cam, as shown dotted, can induce an opening moment leading to inadvertent release.

The diagram, showing the important features of resetting the mechanism, is complicated and makes it necessary to be able to clearly see the actual mechanism to understand its working.

Diagrammatic arrangement of hook release mechanism and the direction of movement of its components during release





The diagram, showing the important features of resetting the mechanism, is complicated and makes it necessary to be able to clearly see the actual mechanism to understand its working.

Hook and cam in fully closed position. Flat face of cam and tail of hook are in contact

Partially closed condition- Improper resetting of the cam when a boat is being recovered might generate this state. This can be aggravated by sticky cables. This allows the force from the hook's tail to generate a much larger force on the cam. This can lead to rotation of the cam and spontaneous opening of the hook.

The above sequence shows the importance of properly resetting the cam when recovering a boat.

Other factors, such as wear of the hook's swivel pin and bush, will, when under load, allow the hook and its tail to rise relative to the cam. Even in the fully locked position the turning force is increased, causing the hook to release. A similar effect is achieved if the tip of the hook's tail, where it makes contact with the cam, is excessively worn.

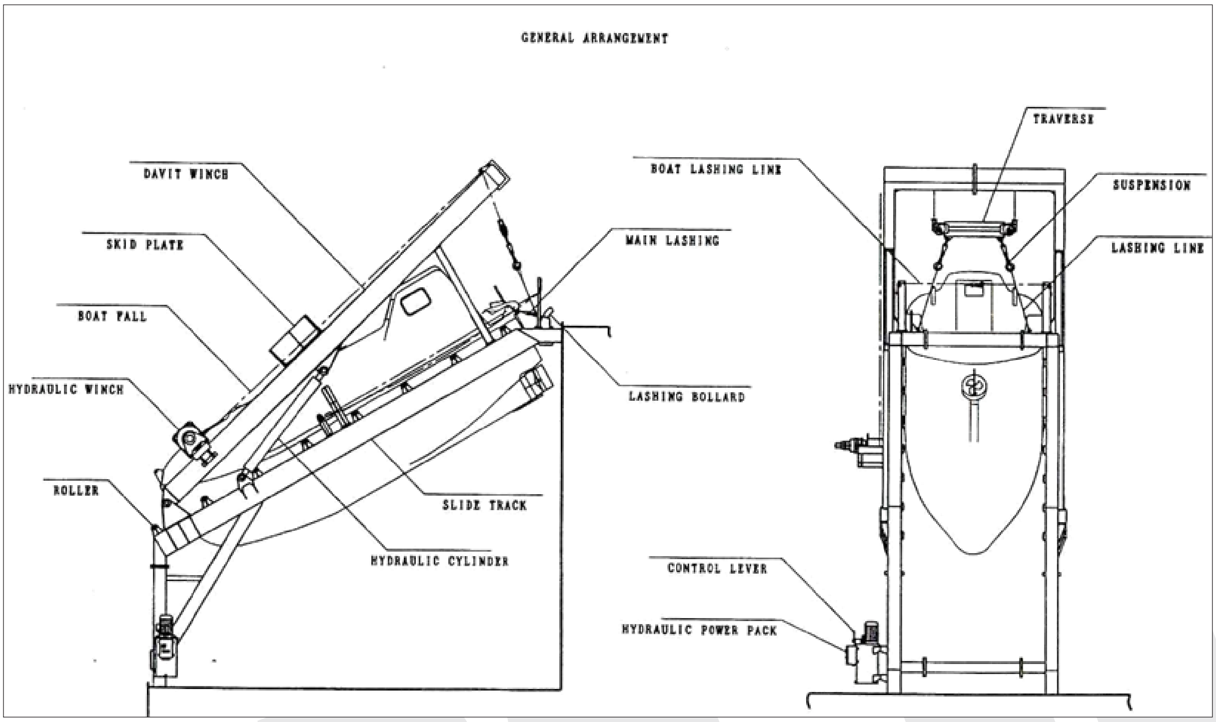
c) Free-fall lifeboat launching procedure

The davit and the winch are equipped at the stern of the ship. In the event of an emergency the crew members on the ship board from the boat stowage position and the boat can be lowered for their escape.
In addition, it is possible to launch the boat using the boat fall as an auxiliary launch device.

The davit consists of accessories included a slide track, davit arm, step, a suspension, and a lashing device.
The winch consists of reduction gears, a hydraulic brake device, and a hydraulic motor.

The boat is designed to allow a free fall by operation from inside the boat.

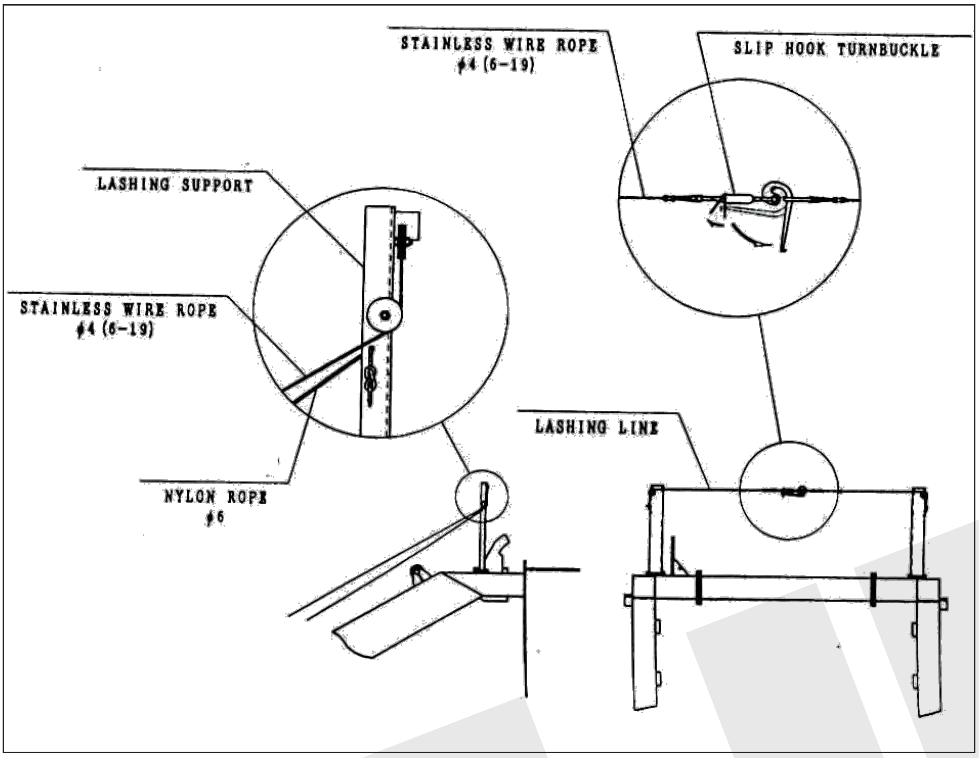
The boat is hoisted by the hydraulic winch and the boat to the specified position and the boat is stored by the hydraulic cylinders.



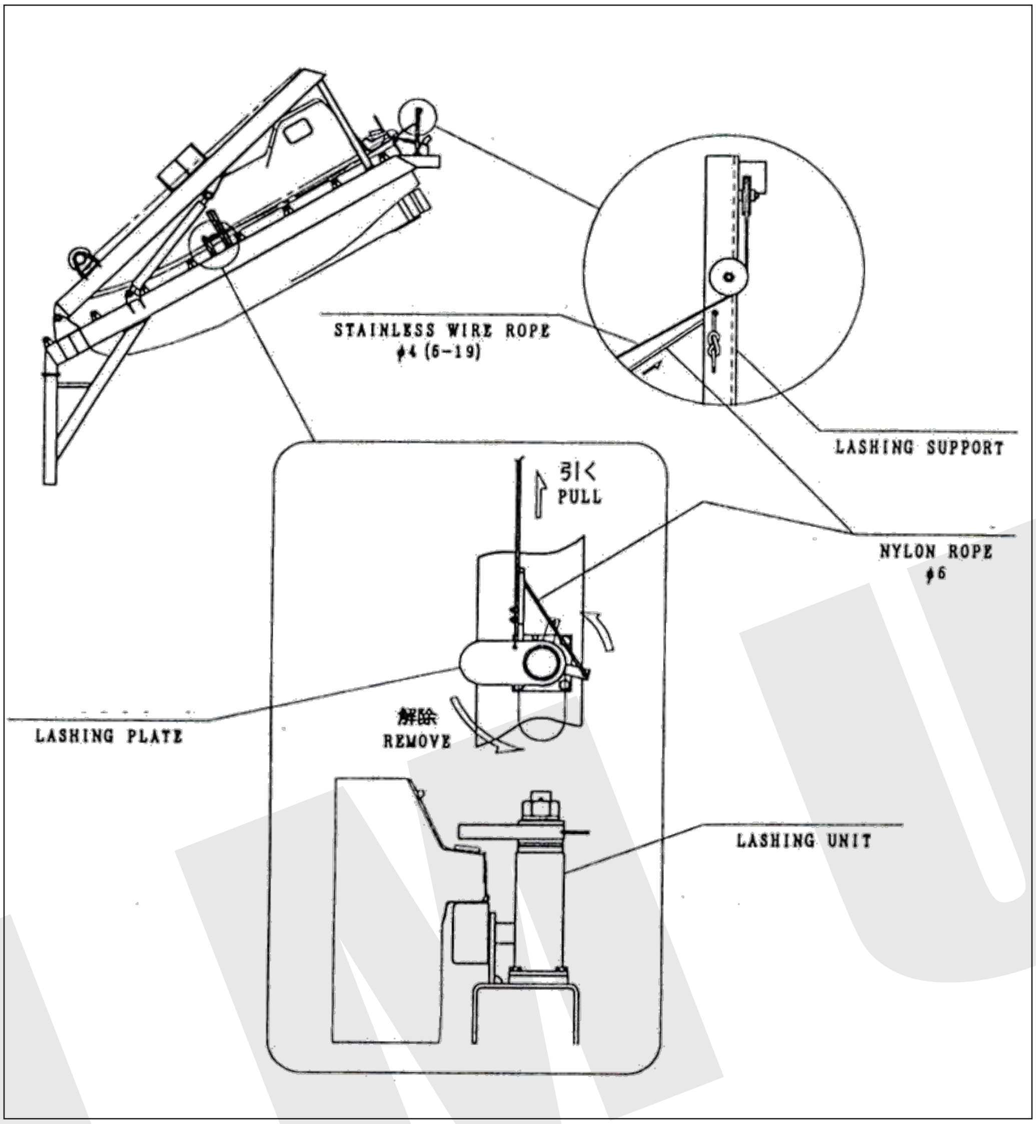
LAUNCHING OPERATION

PREPARATION BEFORE LAUNCHING

i. Check to ensure that there is no obstacle in the boat fall path.
ii. Caution: At all times maintain a condition in which there are no obstacles so as to launch the boat quickly. If any obstacle exists, it may cause an accident.
iii. Remove the lashing line



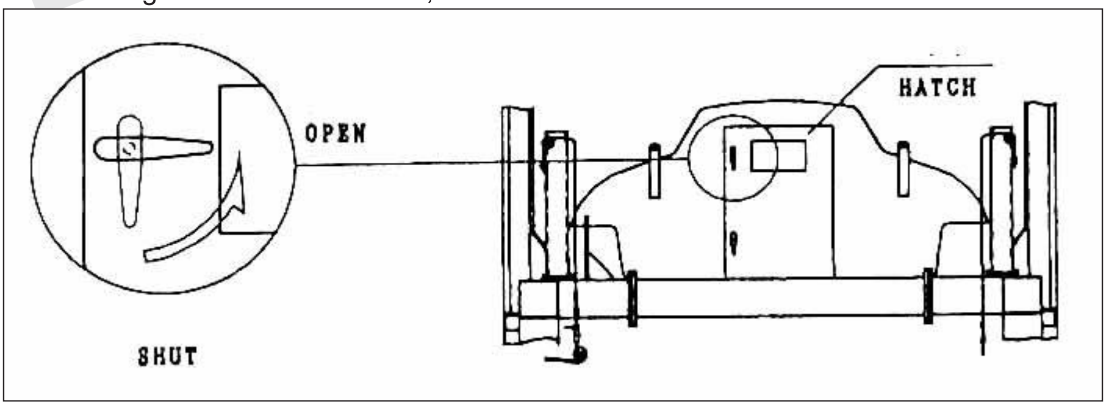
iv. Check to ensure that the lashing plate has been released. The lashing plate will automatically be released if you release the lashing lines. If the lashing plate is not released, release it manually using a nylon rope.



v. Check to ensure that the drain of the boat is closed.

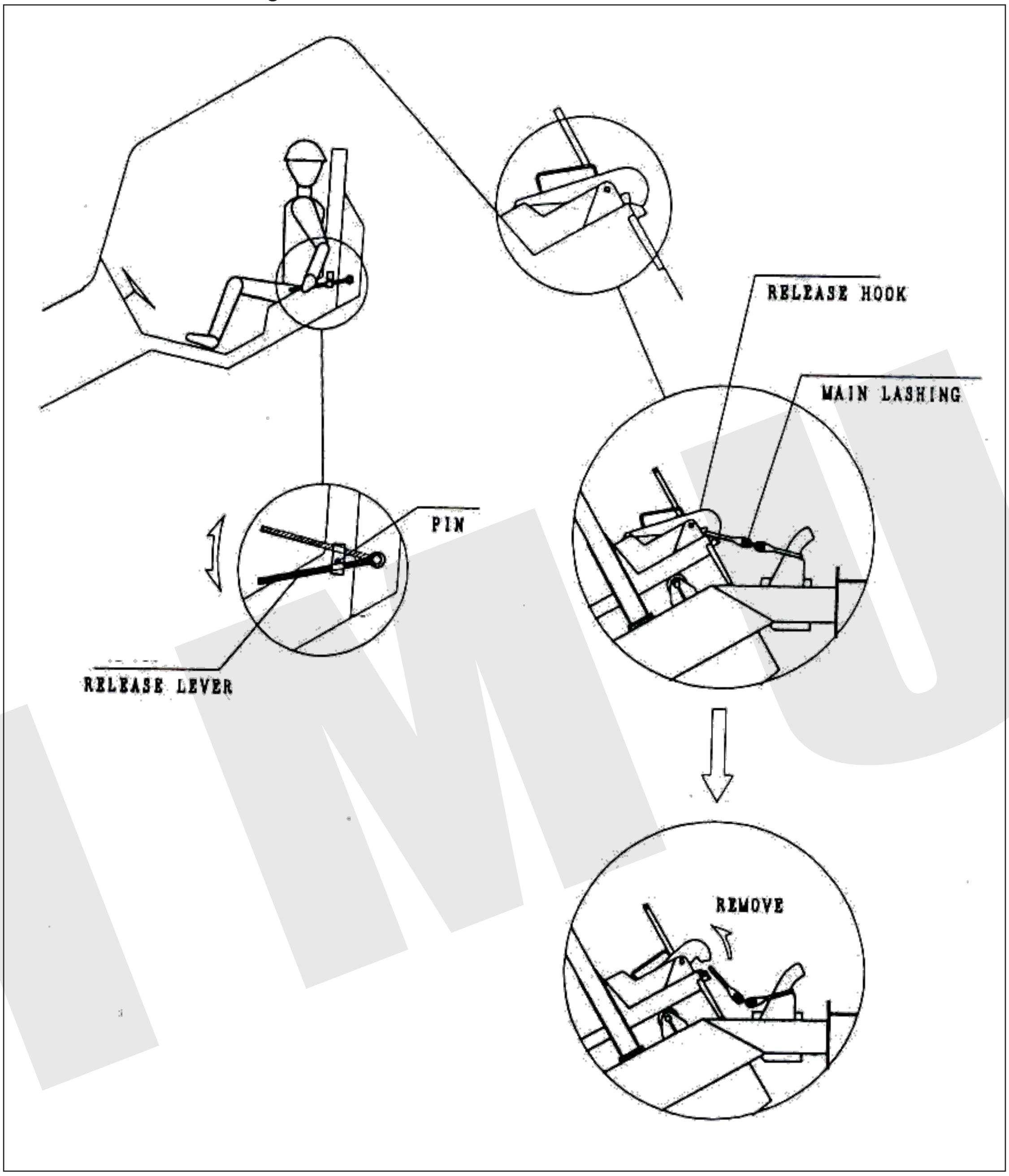
LAUNCH BY FREE FALL

i. The operator check to ensure that preparation of the boat launching has been made.
ii. The crew members aboard the boat from the rear hatch.
iii. The in-charge boards the boat last, and will close the hatch from within.



iv. The in-charge checks to ensure that crew members are wearing seat belt securely and takes a seat in the control compartment and wears a seat belt. (The crew members hold on to the rear handrail of the seat in front.)
v. Start the engine

vi. The procedures to start the engine are described on the side of the control compartment.
vii. The operator releases a pin with which the release lever has been secured.
viii. The operator operates the release lever up and down several times (about 7 times) to release the main lashings.



ix. Releasing of the main lashing allows the boat to be launched by a free fall.
x. After the boat is launched, (immediately move away from the ship.)

3. Life rafts

Liferafts are carried on a ship to provide a means of emergency evacuation in the event of a disaster aboard the ship. They are collapsible and generally stored in a heavy-duty fiberglass canister.

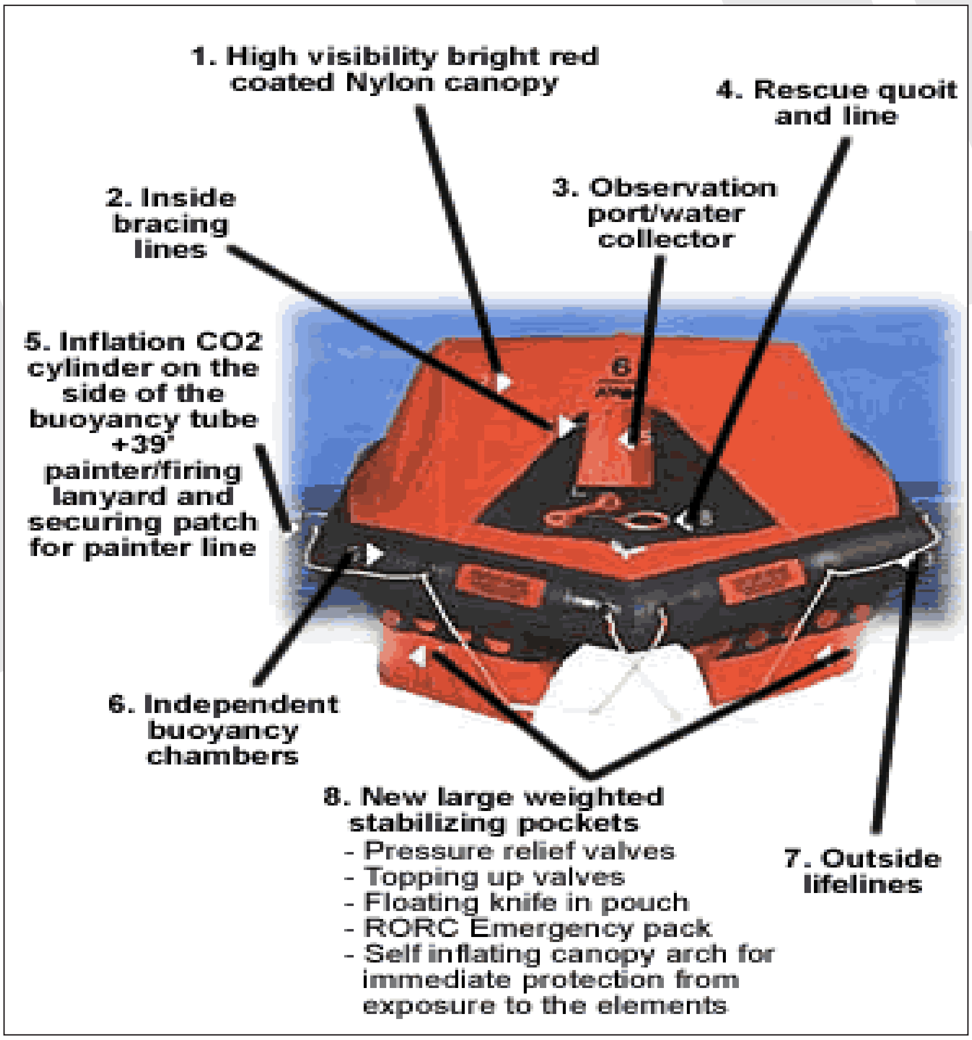
Ships are equipped with one or more inflatable or rigid liferafts on each side of the ship, of such aggregate capacity as will accommodate the total number of persons on board. In case the ship is equipped with a free fall lifeboat, the liferafts on at least one side of the ship are served by launching appliances. Additionally, Cargo ships where the horizontal distance from the extreme end of the stem or stern of the ship to the nearest end of the closest survival craft is more than 100 meters also carry a liferaft stowed as far forward or aft, as is reasonable and practicable.

The liferaft is constructed from a rubber compound and/or a synthetic material. There are two separate buoyancy chambers or tubes, either of which alone is designed to be capable of supporting the complete liferaft with all its emergency equipment and a full complement of survivors.

In SOLAS liferafts, to assist in providing protection against adverse temperatures, the floor is doubled and is capable of being inflated; the canopy is also doubled with an air gap between the inner and outer wall. The canopy is erected automatically by an arch or centre column which is inflated, with the buoyancy tubes, by a CO_2 / nitrogen charge stored in a steel pressure cylinder under the floor.

The canopy, colored orange, is fitted with rain water collection points and lights are fitted both inside and outside. Grab lines are becketed around the inside and outside of the liferaft and the entrances are provided with means of assisting survivors to board. The entrances, when closed, are capable of maintaining the interior of the liferaft in a dry condition. Look-out points are provided in the canopy.

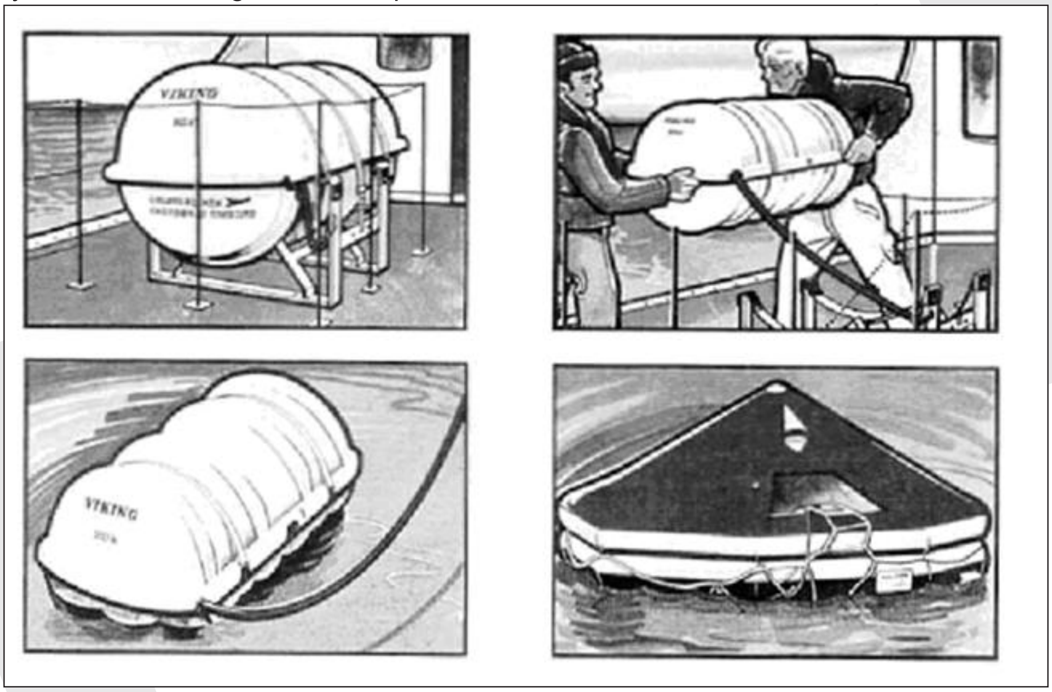
On the underside of the liferaft is a righting line or ladder for use in righting the liferaft should it inflate in the inverted position, or be capsized for any reason.



a) Liferaft launching (manually)

The procedure for launching liferafts manually is:

i. Unfasten the slip hook and all securing of the life raft. REMEMBER the painter should be made fast to a strong point on board (this may be the Hydrostatic Release Unit).
ii. Remove the detachable railings.
iii. The raft is removed from the cradle and thrown overboard.
iv. Haul in the painter to approximate length of 25 meters, and then give a sharp pull and the raft will inflate.
v. To board the raft – keep the raft to the ship's side by means of the painter. Then jump on to it or jump into the water and swim out to it. Ensure that you do not have nails in your shoes, or any sharp pointed object that could damage the raft. Ensure footwear does not have any sharp objects protruding. Do not jump into the liferaft from a height of more than 3 meters and into the water from a height greater than 6 meters. It is best to climb down into the liferaft from a ladder.
vi. To help survivors in the water to board the raft – use the rescue quoits provided in the raft.
vii. When all persons are on board, haul in as much painter as possible inboard and cut the painter. A knife is specifically provided outside the raft, near the entrance for this purpose.
viii. Drift away from the danger area and then throw out the sea anchor.
ix. If the raft inflates upside down, the raft can be turned around by standing on the gas cylinder and hauling at the cord provided at the base of the raft.



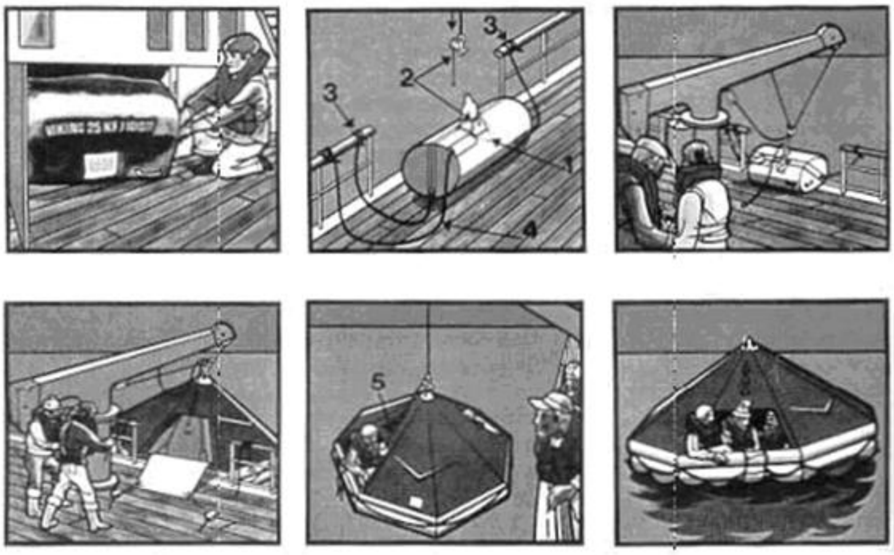
b) Liferaft launching by davits

The procedure to launch liferafts by davit is as follows:

i. Take the liferaft packed in valise out of the storage, place it close to davit. Remove portable rails adjacent to the davit on the shipside.
   - Open flap on valise
   - Close slip-hook into ring/shackle.
   - Fasten the steering lines both forward and aft of the liferaft.
   - Haul out and fasten about 10 meters of painter to a strong point on the ship.
ii. Haul valise aloft and swing it outboard. Release/inflate raft by hauling out remaining painter.
iii. Ease the raft off to deck-height. Haul taut the steering lines and fastens the boarding flap. DON'T FORGET to remove the lines when launching
iv. Launch raft. Slip-hook to be released manually when raft is on surface of the sea.
v. The raft is now free.
vi. If there are any survivors floating in the water – rescue them by means of the rescue quoits provided.

vii. When all persons are on board, haul in as much painter as possible and cut the painter using the knife provided on board the raft.

viii. Shove away the liferaft from the danger area to safety and throw out the sea anchor.



The davit launched liferaft can also be launched manually.

c) Automatic release of life raft

An appliance called hydrostatic release unit is used to facilitate automatic release.

The unit activates at a depth of 1.5 to 4 meters below the water from a sinking ship and release the raft from its lashings. When this happens the painter becomes free from the upper part of the attachment line and remains attached to the ship only by the weak link.

The life raft floats to the surface and the stretched painter activates the inflation of the life raft. The weak link breaks thus setting the painter free and the life raft becomes free from the sinking ship.

The life raft release procedure when using Hammar type of HRU is described in detail as follows:

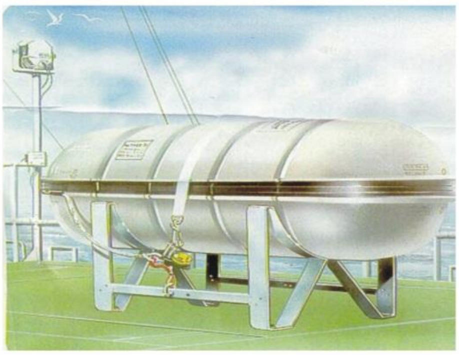


Fig 1

Fig 2

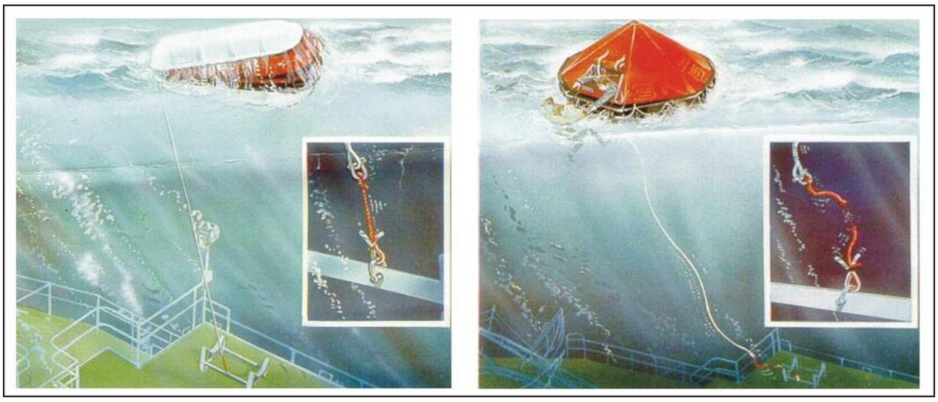


Fig 3 Fig 4

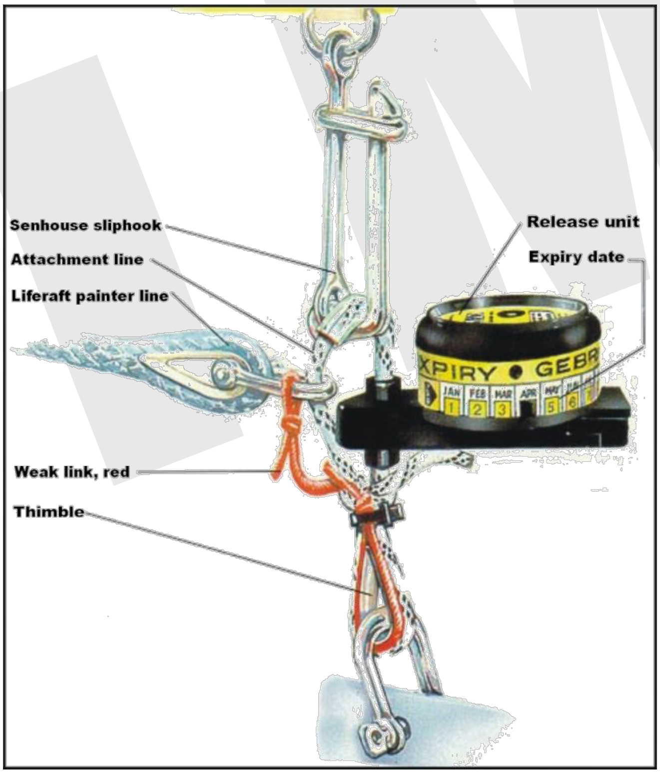
Fig. 1 – White strong rope of HAMMAAR H20 secured to deck or liferaft-cradle and attached to life raft lashing with a slip hook. Life raft painter line shackled to weak-link and around strong white rope.

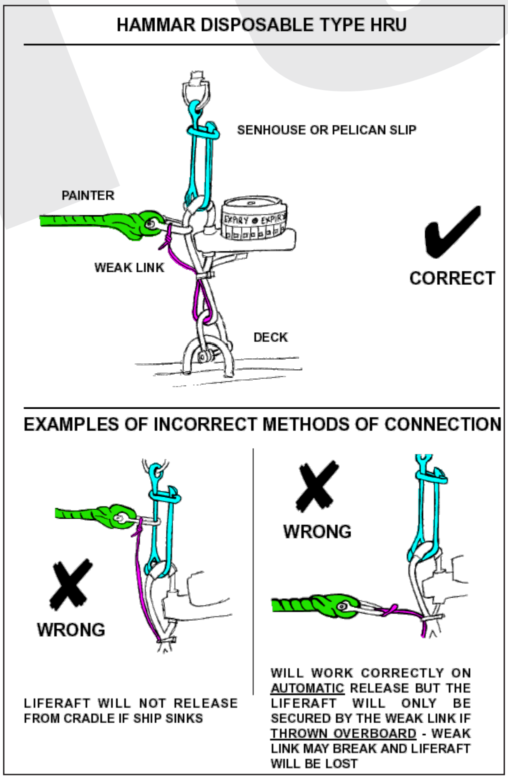
Fig. 2 – If the ship sinks, the water pressure will activate the sharp knife which cuts the strong rope and the life raft will float free.

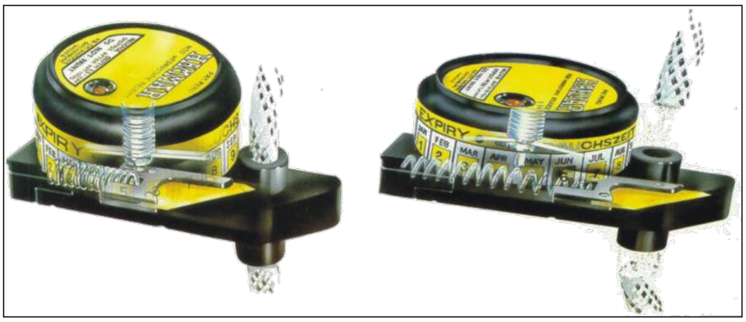
Fig. 3 – As the ship sinks, the life raft painter will be stretched and the life raft starts to inflate.

Fig. 4 –Weak link breaks and survivors can board the inflated life raft.

Hammar Type of HRU does not need servicing and must be replaced after every two years. The HRU must be connected properly.







4. Abandoning ship

a) Actions to be taken when called to survival stations

On hearing any alarm signal all personnel on board muster as instructed in the ships muster list. In the event of an emergency, whether general, fire, man overboard or other, various duties may have to be carried out. It is therefore necessary that all personnel are familiar with the location and operation of all the vessels safety equipment and procedures.

In any emergency, time is critical.

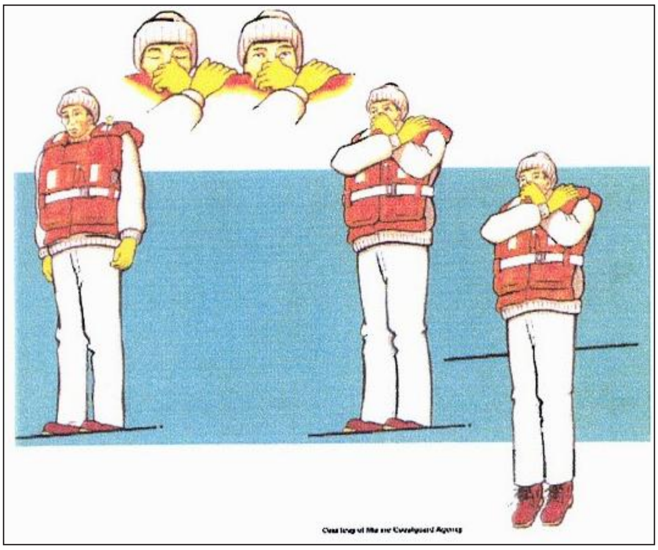
When mustering for lifeboat stations, wear safety shoes, helmet, boiler suit / clothing covering full body, take lifejacket and immersion suit and proceed as quickly as possible to the muster point. Collect additional protection items such as blankets. Take orders from your team leader. Please note that only the master or officer in-charge can give the abandon ship order, which is always given verbally.

b) Actions to be taken when ordered to abandon ship

Records show that many ships sink in less than 15 minutes. This affords little time to formulate a plan of action, so careful preplanning is essential to be ready in an emergency. Here are some sound pointers for you to remember when abandoning ship:

> Only the Master can give the abandon ship order, which is always given verbally.

- Put on as much warm clothing as possible, making sure to cover head, neck, hands and feet.
- Avoid entering the water if possible, e.g. board a davit-launched survival craft on the embarkation deck. If davit-launched survival crafts are not available, use over-side ladders or if necessary lower yourself by means of a rope or fire hose.
- If you have to enter the water, jump close to the survival craft so that you can board rapidly. Remember that the maximum recommended jumping height when wearing an approved lifejacket is 4.5 meters. If jumping from a greater height, hold lifejacket and don when in the water.
- Where it is possible for you to enter the water by climbing down the ladder or rope, then do so, as this will lessen the shock effect. Always enter the water feet first.
- If you have to jump into the water, use the following procedure if possible (see illustration).



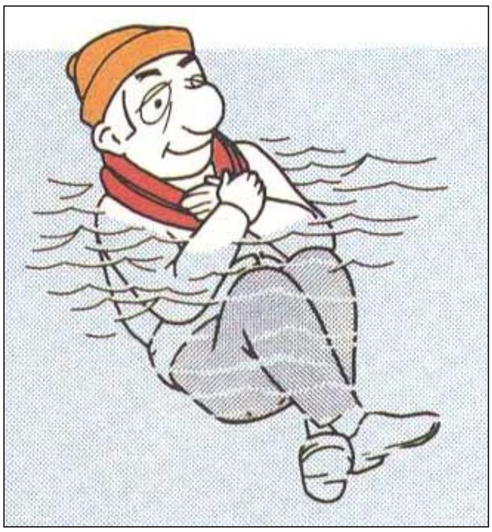
- ➢ Come right to the side of the vessel.
- ➢ Cover your nose and mouth with one hand.
- ➢ Hold your lifejacket with the other hand.
- ➢ Make sure the water below is clear.
- ➢ Step off clear of the vessel and bring your legs together.

Remember that when you enter the water in the manner described, you will go under, come up, go down again and then stabilize. You can then uncover your mouth.

- Once you reach the survival craft, cling to it or you could drift away. Putting your arm through the grab lines is better than holding on with your hands, which can quickly become numb in cold conditions.

c) Action to be taken when in water

Avoid staying in the water unless there is no alternative. While afloat in the water, do not attempt to swim unless it is to reach a nearby craft, a fellow survivor, or a floating object on which you can lean or climb. Unnecessary swimming will pump out any warm water between your body and the layers of clothing, thereby increasing the rate of body heat loss. In addition, unnecessary movements of your arms and legs send warm blood from the inner core to the outer layer of the body. This results in a very rapid heat loss. Remain as still as possible using flotation to keep you high in the water. Heat loss occurs much faster in water than in air, so the more of your body you can keep out of the water the better. Remember, pain will not kill you, but heat loss will!



The body position you assume in the water is also very important in conserving heat. If you don't have an immersion suit, use the H.E.L.P. (heat escape lessening posture) technique.

Float as still as possible with your legs together, elbows close to your side and arms folded across the front of your lifejacket. This position minimizes the exposure of the body surface to the cold water. Try to keep your head and neck out of the water.

If your exposure suit or personal floatation device has a whistle attached, use it to attract attention. You may not be visible, but using the whistle will enable you to let others know where you are. If you have taken the time to prepare a personal survival kit, you may have other signalling devices that will boost your chances of rescue. Use them wisely.

Try to board a lifeboat, raft, or other floating platform or object as soon as possible in order to shorten the immersion time. Remember, you lose body heat many times faster in water than in air. Since the effectiveness of your insulation has been seriously reduced by water soaking, you must now try to shield yourself from wind to avoid a wind-chill effect (convective cooling). If you manage to climb aboard a lifeboat, shielding can be accomplished with the aid of a canvas cover or tarpaulin, or an unused garment. Huddling close to the other occupants of the lifeboat or raft will also conserve body heat.

If possible, form a group with other survivors in the water. There is safety in numbers, and a group is more easily located and more likely to maintain morale. Huddling together will also decrease heat loss.

Apply Your Knowledge

1. Discuss the procedure for launching the liferaft and the sequence of boarding.

Function: Controlling the operation of the ship and care for persons on board.

Competence: Apply medical first aid on board ship

Task number: C5.1

Sub-task Reference number: C5.1.1, C5.1.2

Topic: Practical application of medical guides and advice by radio and Medical equipment on board

Task Heading

- Locate and read the "International Medical Guide for Ships".
- Locate all first aid boxes and check that contents are in order.

Objectives

- Familiarize yourself with International Medical Guide for Ships and First Aid Boxes.

Index

1. International Medical Guide for Ships
2. First aid boxes

Description

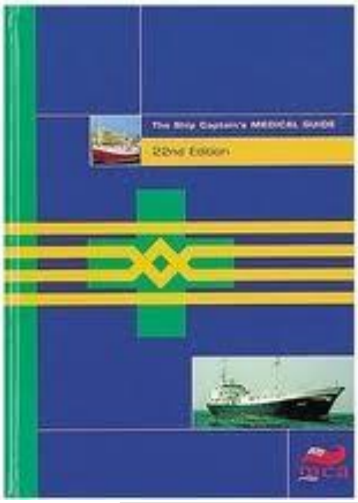
1) International Medical Guide for Ships

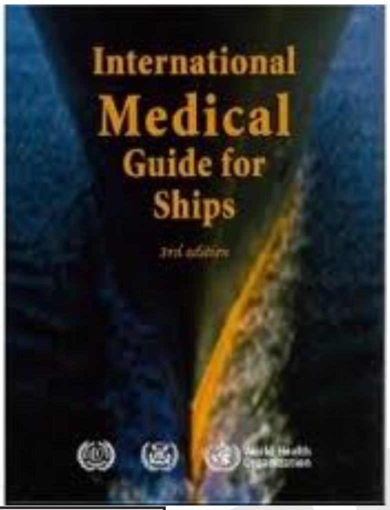
The maritime labour convention stipulates that all ships shall carry a medicine chest, medical equipment and a medical guide. The "International Medical Guide for Ships" supports a main principle of that convention: to ensure that seafarers are given health protection and medical care as comparable as possible to that which is generally available to workers ashore, including prompt access to the necessary medicines, medical equipment and facilities for diagnosis and treatment and to medical information and expertise.

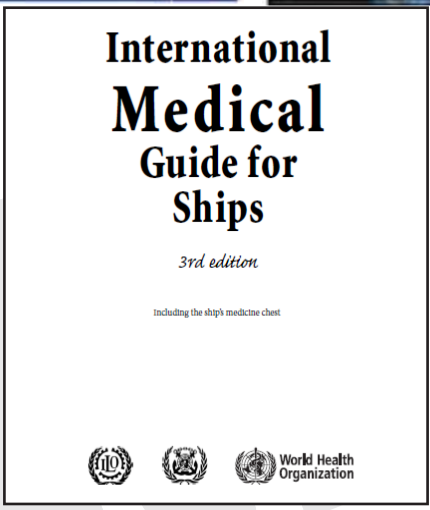
There are two medical guides available to the ship's captain for medical care and assistance, which at the time of writing this task are:

1. The Ship Captain's Medical Guide 22nd edition published by the stationary office, UK and
2. The International Medical Guide for Ships 3rd edition (published by World Health Organization (WHO)

The ship captain's medical guide was compiled by Dr Harry Leach, medical officer of health of the port of London, in the year 1868 and the international medical guide for ships was first published by WHO in the year 1967.







The **International Medical Guide for Ships** is easy to read and understand. It tells you how to diagnose, treat and prevent health problems in seafarers, with a focus on the first 48 hours after injury.

It should be kept in the ship's medicine chest, and you should familiarize yourself with the content before a medical emergency occurs. This way, when there is a case of illness or injury on board, you can immediately turn to emergency medical advice on the topic at hand.

Chapters 1–24 follow this structure:

- General description of symptom or disease
- Explanatory notes when necessary
- Signs and symptoms
- Key questions to ask
- What to do
- What not to do.

International Medical Guide for Ships gives guidance on diagnosis, treatment and prevention of heath problems.

These chapters also contain information on how to prevent specific injuries or illness, by action that can be taken on board. General prevention and health promotion is covered in Chapter 30.

Since immediate response is essential for life-threatening conditions, the first 11 chapters cover the principals of first aid, and how to respond to choking, bleeding, shock, pain, injuries, wounds, burns, and poisoning.

Chapter 12 outlines the general principles of physical examination and the necessity of obtaining consent for examination and treatment.

Chapter 25 describes how to use external assistance and seek medical advice by radio, and includes a general recommendation on the use of digital photographs to assist in obtaining diagnostic and treatment advice in this context. It includes a form for obtaining and transcribing such advice.

Chapter 32 contains the relevant articles of the revised International Health Regulations (2005).

Chapter 33 lists the necessary medicines for stocking the ship's medicine chest, including those which should only be used with radio medical advice. This list is consistent with WHO's essential drugs list, and provides indications, doses, and specific precautions for each entry.

Annex A contains medical referral and evacuation forms which should be copied and stored with the medical supplies.

2) First aid boxes

Seagoing ships with a crew of more than 10 should carry first aid kits, distributed in appropriate locations on the ship e.g. in the galley and engine room.

The first aid kit should include the following items, kept in a portable waterproof container:

i. 4 x triangular bandages
ii. 6 x medium sterile bandages with unmedicated dressings
iii. 2 x large sterile bandages with unmedicated dressings
iv. 2 x extra-large unmedicated dressings
v. 6 medium safety pins, rustless
vi. 20 assorted elastic adhesive dressings medicated
vii. 2 x sterile eye pads with attachment
viii. 2 x packages containing sterile gauze swabs
ix. 5 pairs large size disposable latex-free examination gloves
x. Sterile eye wash in eye wash bottle

Apply Your Knowledge

1. Check the various locations of the first aid boxes on board your ship.

Function: Controlling the operation of the ship and care for persons on board.

Competence: Monitor compliance with legislative requirements

Task number: C6.1

Sub-task Reference number: C6.1.1

Topic: Familiarize with various statutory regulations and requirements

Task Heading

- Read and discuss the contents of SOLAS with STO.

Objectives

- To go through the latest copies of SOLAS and familiarize yourself with these.

Index

1) Background
2) Contents of SOLAS

Description

1) Background

The SOLAS convention in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant ships. The first version was adopted in 1914, in response to the Titanic disaster, the second in 1929, the third in 1948, and the fourth in 1960.

> The first version of SOLAS was adopted in 1914 in response to the sinking of Titanic.

The 1960 convention - which was adopted on 17 June 1960 and entered into force on 26 May 1965 - was the first major task for IMO after the organization's creation and it represented a considerable step forward in modernizing regulations and in keeping pace with technical developments in the shipping industry. The intention was to keep the convention up to date by periodic amendments but in practice the amendments procedure proved to be very slow. It became clear that it would be impossible to secure the entry into force of amendments within a reasonable period of time.

As a result, a completely new convention was adopted in 1974 which included not only the amendments agreed up until that date but a new amendment procedure - the tacit acceptance procedure - designed to ensure that changes could be made within a specified (and acceptably short) period of time. Instead of requiring that an amendment shall enter into force after being accepted by, for example, two thirds of the parties, the tacit acceptance procedure provides that an amendment shall enter into force on a specified date unless, before that date, objections to the amendment are received from an agreed number of parties.

As a result the 1974 convention has been updated and amended on numerous occasions. The convention in force today is sometimes referred to as SOLAS, 1974, as amended.

2) Contents of SOLAS

The current SOLAS convention includes articles setting out general obligations, amendment procedure and so on, followed by an annex divided into 12 chapters.

Chapter I - General provisions

It includes regulations concerning the survey of the various types of ships and the issuing of documents signifying that the ship meets the requirements of the convention. The chapter also includes provisions for the control of ships in ports of other contracting governments.

Chapter II-1 - Construction - subdivision and stability, machinery and electrical installations

The subdivision of passenger ships into watertight compartments must be such that after assumed damage to the ship's hull the vessel will remain afloat and stable. Requirements for watertight integrity and bilge pumping arrangements for passenger ships are also laid down as well as stability requirements for both passenger and cargo ships.

The degree of subdivision - measured by the maximum permissible distance between two adjacent bulkheads - varies with ship's length and the service in which it is engaged. The highest degree of subdivision applies to passenger ships.

Requirements covering machinery and electrical installations are designed to ensure that services which are essential for the safety of the ship, passengers and crew are maintained under various emergency conditions. The steering gear requirements of this chapter are particularly important.

Chapter II-2 - Fire protection, fire detection and fire extinction

It includes detailed fire safety provisions for all ships and specific measures for passenger ships, cargo ships and tankers. They include the following principles: division of the ship into main and vertical zones by thermal and structural boundaries; separation of accommodation spaces from the remainder of the ship by thermal and structural boundaries; restricted use of combustible materials; detection of any fire in the zone of origin; containment and extinction of any fire in the space of origin; protection of the means of escape or of access for fire-fighting purposes; ready availability of fire-extinguishing appliances; minimization of the possibility of ignition of flammable cargo vapour.

Chapter III - Life-saving appliances and arrangements

The chapter includes requirements for life-saving appliances and arrangements, including requirements for life boats, rescue boats and life jackets according to type of ship.

The International Life-Saving Appliance (LSA) code gives specific technical requirements for LSAs and is mandatory under regulation 34, which states that all life-saving appliances and arrangements shall comply with the applicable requirements of the LSA code.

Chapter IV – Radio communications

The chapter incorporates the Global Maritime Distress and Safety System (GMDSS). All passenger ships and all cargo ships of 300 gross tonnage and upwards on international voyages are required to carry equipment designed to improve the chances of rescue following an accident, including satellite emergency position indicating radio beacons (EPIRBs) and search and rescue transponders (SARTs) for the location of the ship or survival craft. Regulations in chapter IV cover undertakings by contracting governments to provide radio communication services as well as ship requirements for carriage of radio communications equipment. The chapter is closely linked to the radio regulations of the International Telecommunication Union.

Chapter V - Safety of navigation

Chapter V identifies certain navigation safety services which should be provided by contracting governments and sets forth provisions of an operational nature applicable in general to all ships on all voyages. This is in contrast to the convention as a whole, which only applies to certain classes of ship engaged on international voyages. The subjects covered include the maintenance of meteorological services for ships; the ice patrol service; routeing of ships; and the maintenance of search and rescue services. This chapter also includes a general obligation for masters to proceed to the assistance of those in distress and for contracting governments to ensure that all ships shall be sufficiently and efficiently manned from a safety point of view. The chapter makes mandatory the carriage of voyage data recorders (VDRs) and automatic ship identification systems (AIS) for certain ships.

Chapter VI - Carriage of cargoes

The chapter covers all types of cargo (except liquids and gases in bulk) "which, owing to their particular hazards to ships or persons on board, may require special precautions". The regulations include requirements for stowage and securing of cargo or cargo units (such as containers). The chapter requires cargo ships carrying grain to comply with the International Grain Code.

Chapter VII - Carriage of dangerous goods

The regulations are contained in three parts:

Part A - Carriage of dangerous goods in packaged form - includes provisions for the classification, packing, marking, labelling and placarding, documentation and stowage of dangerous goods. Contracting governments are required to issue instructions at the national level and the Chapter makes mandatory the International Maritime Dangerous Goods (IMDG) code, developed by IMO, which is constantly updated to accommodate new dangerous goods and to supplement or revise existing provisions.

Part A-1 - Carriage of dangerous goods in solid form in bulk - covers the documentation, stowage and segregation requirements for these goods and requires reporting of incidents involving such goods.

Part B covers construction and equipment of ships carrying dangerous liquid chemicals in bulk and requires chemical tankers built after 1 July 1986 to comply with the International Bulk Chemical Code (IBC code).

Part C covers construction and equipment of ships carrying liquefied gases in bulk and gas carriers constructed after 1 July 1986 to comply with the requirements of the International Gas Carrier Code (IGC code).

Part D includes special requirements for the carriage of packaged irradiated nuclear fuel, plutonium and high-level radioactive wastes on board ships and requires ships carrying such products to comply with the International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships (INF code).

The chapter requires carriage of dangerous goods to be in compliance with the relevant provisions of the International Maritime Dangerous Goods Code (IMDG code). The IMDG code was first adopted by IMO in 1965 and has been kept up to date by regular amendments, including those needed to keep it in line with United Nations Recommendations on the Transport of Dangerous Goods which sets the basic requirements for all the transport modes

Chapter VIII - Nuclear ships

Gives basic requirements for nuclear-powered ships and is particularly concerned with radiation hazards. It refers to detailed and comprehensive Code of Safety for Nuclear Merchant Ships which was adopted by the IMO Assembly in 1981.

Chapter IX - Management for the safe operation of ships

The chapter makes mandatory the International Safety Management (ISM) code, which requires a safety management system to be established by the ship owner or any person who has assumed responsibility for the ship (the "company").

Chapter X - Safety measures for high-speed craft

The chapter makes mandatory the International Code of Safety for High-Speed Craft (HSC code).

Chapter XI-1 - Special measures to enhance maritime safety

The chapter clarifies requirements relating to authorization of recognized organizations (responsible for carrying out surveys and inspections on administrations' behalf); enhanced surveys; ship identification number scheme; and port state control on operational requirements.

Chapter XI-2 - Special measures to enhance maritime security

The chapter was adopted in December 2002 and entered into force on 1 July 2004. Regulation XI-2/3 of the new chapter enshrines the International Ship and Port Facilities Security Code (ISPS code). Part A of the code is mandatory and part B contains guidance as to how best to comply with the mandatory requirements. The regulation requires administrations to set security levels and ensure the provision of security level information to ships entitled to fly their flag. Prior to entering a port, or whilst in a port, within the territory of a contracting government, a ship shall comply with the requirements for the security level set by that contracting government, if that security level is higher than the security level set by the administration for that ship.

Chapter XII - Additional safety measures for bulk carriers

The chapter includes structural requirements for bulk carriers over 150 metres in length

Apply Your Knowledge

1. Refer to SOLAS Chapter V and check the navigational equipment that must be carried on board a ship of your size and year of build.

Function: Controlling the operation of the ship and care for persons on board.

Competence: Monitor compliance with legislative requirements

Task number: C6.1

Sub-task Reference number: C6.1.2

Topic: Familiarize with various statutory regulations and requirements

Task Heading

- Identify the Designated Person Ashore (DPA) for your vessel and demonstrate understanding of the DPA's role.

Objectives

- To familiarize yourself with the functions of Designated Person Ashore (DPA).

Index

1) Role of Designated Person Ashore (DPA)
2) Functions of DPA
3) Responsibility and authority of DPA

Description

1) Role of Designated Person Ashore (DPA)

The role of the Designated Person Ashore (DPA) is to provide a direct link between the master and ship staff with the company, especially if matters of safety and pollution prevention are not handled to the master and crew's satisfaction.

2) Functions of DPA

The DPA is responsible for:

- Monitoring the implementation and verification of safety and pollution prevention aspects of the operation of the ship, and
- Ensuring that adequate resources and shore-based support are provided.

The designated person holds a key role in the monitoring process of safety management system, which ensures that:

- Implementation is verified;
- Deficiencies are reported; and
- Corrective and preventive actions are identified and that appropriate action is taken.

> Look out for the DPA contact details in the Ship's Office and the Smoke Rooms.

The DPA has access to the highest levels of management.

The DPA monitors the implementation of quality, health, safety and environment policy of the company via internal audits, reports from the technical superintendents and managers and inspection reports from various authorities/third parties. Non-compliances with regards to ILO convention work/rest hours are reported to DPA, who has the responsibility to evaluate and take necessary actions to prevent further recurrence.

3) Responsibility and authority of DPA

The DPA has the responsibility and authority for:

- Ensuring that processes needed for the quality management system are established implemented and maintained.
- Reporting to top management on the performance of the quality management system and any need for improvement.
- Ensuring the promotion of awareness of customer requirements throughout the company.
- Liaising with external parties on matters relating to the quality management system

Apply Your Knowledge:

1. Who is the Designated Person for your ship? Describe his role and functions in bullet points.

Function: Controlling the operation of the ship and care for persons on board.

Competence: Contribute to the safety of personnel and ship

Task number: C7.1

Sub-task Reference number: C7.1.1

Topic: Safety of personnel and ship

Task Heading

- Attend tool box meetings prior to carrying out various jobs.

Objectives

- This module is an entirely practical module that is self-explanatory. The cadet will need to attend such meetings. Some notes are given for guidance purposes- the objective is to familiarize the cadet with the concept of tool box meeting.

Index

1) Purpose of tool box meeting
2) Discussions in the tool box meeting

Description

1) Purpose of tool box meeting

The purpose of toolbox meeting is to ensure that all parties involved within the planned work are fully aware of all aspects of the work scope.

2) Discussions in the tool box meeting

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.

Tool box meetings are carried out prior commencing the planned work.

Toolbox meeting is a formal meeting conducted by person in-charge of task to ensure that all team members fully understands the task. Written records for the meeting are not required. The following questions should be asked prior undertaking any job onboard and ensure that quick hazard identification is carried out:

a) Is there a risk of slipping, tripping, falling from a height or falling overboard?
b) Is there a risk of being struck by or against an object?
c) Is there a risk of being caught in, on, or between objects?
d) Is there any risk of lack of oxygen, or exposure to toxic gases or hazardous substances?
e) Is there a risk of fire?
f) Is there a risk of electric shock?
g) Is there a risk due to excessive heat, cold, radiation, noise, wind, rain, snow, rolling, pitching?

"One Minute Hazard Identification Guide" is meant to be a tool, used on a daily basis by each person, to identify the hazards and prevent harm to him.

h) Is there a risk due to fatigue?
i) Is there a risk of pollution of any type?
j) Is there a risk due to poor lighting?

If the answer to any question is “yes”, discuss it with the supervisor and take preventive measures before starting the job!

Apply Your Knowledge

1. Attend tool box meetings and note various discussions.

Function: Controlling the operation of the ship and care for persons on board

Competence: Contribute to the safety of personnel and ship

Task Reference No: C7.1

Sub task Reference Nos.: C7.1.2

Topic: Safety of personnel and ship

Task Heading

- Demonstrate understanding of the use of various checklists (wherever applicable) and precautions required for various critical jobs such as:
- Entry into enclosed spaces
- Working aloft
- Working over-side
- Carrying out hot work
- Using power tools
- Manual lifting and carrying

Objectives

- Understand the permit system
- Understand the importance of checklist, procedure and safety precautions, especially identified critical ones like entry in enclosed spaces, working aloft, working over-side, carrying out hot work, using power tools and manual lifting
- This task shall be read in conjunction with task C 2.4.13 and 2.4.14.

Index

1. Introduction
2. Entry into enclosed spaces
    a. Definition of enclosed space.
    b. Permit to work or permit to enter system
    c. Atmosphere tests prior entry
    d. Ventilation
    e. Entry procedures
    f. Additional precautions for working in enclosed spaces
    g. Permit for enclosed space entry
3. Working aloft and working over-side
    a. Introduction
    b. Precautions to take when using stages, cradles, bosun's chair and ropes
    c. Sample permit for working aloft
4. Hot Work
    a. Introduction
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Description

1. Introduction

On board a ship you keep hearing your seniors saying **"Be safe", "Be Careful"** or **"Follow safe practices"** and they repeat this for almost everything you do. So far you may have been lucky that you have not injured yourself or your colleague working with you or faced any grave accident. The repeated advice to follow safe practices is only to ensure that throughout your sea career you do not have an accident. Where ever you work the chances of accident occurring is minimised by following safe working practices. Read the code of safe working practices for merchant seaman thoroughly to get familiarized with various safe practices to be followed on board.

> Be Safe, Be Careful and Follow safe practices. Read the Code of Safe Working practices for merchant seaman thoroughly.

2. Entry into enclosed spaces

a) Definition of enclosed space

Enclosed spaces are compartments (spaces) on board a ship where the atmosphere may be deficient in oxygen or contain flammable or toxic fumes, gases or vapours. These compartments are not normally entered and remain closed for a period of time. Extreme precautions have to be taken when entering an enclosed space on board a ship.

> All enclosed spaces must be considered unsafe for entry until proven otherwise.

Some of the following compartments on board (**but not limited to**) can be called an enclosed space:

- Cargo holds which have been closed for a long time.
- Double bottoms and cargo tanks.
- Ballast / Fuel tanks.
- Void spaces.
- Tanker pump rooms
- Gas carrier compressor rooms
- Cofferdams
- Pressure vessels
- Battery lockers
- Chain lockers
- Inert gas plant scrubber and blower rooms.
- CO_2 bottles storage rooms
- Cable and pipe trunks
- Paint rooms
- Duct keel
- Fresh water tanks

These spaces are devoid of ventilation and hence the atmosphere in these compartments is always suspect and therefore hazardous to enter.

b) Permit to work or permit to enter system

You must note that many serious accidents have occurred, some resulting in death on board ships because safe procedures are not followed prior to entering these enclosed compartments. Any enclosed and unventilated space that can be sealed off from the outside atmosphere may be dangerous. **Remember: routine careless action of one person may endanger the lives of others on board. Entering an enclosed space requires that you follow company procedure for the issue of a "Permit to Work" or a "Permit to Enter", discuss this with your chief officer.**

Examples of such accidents are - crew member enters a cargo hold that is battened down with little or no ventilation and poor light. Especially dangerous are cargoes that absorb oxygen like pig iron. Many accidents such as explosions have occurred in battery lockers, entrance to cargo holds carrying coal cargo due to use of naked flames and cigarette lighters.

c) Atmosphere tests prior entry

The appropriate atmosphere checks are:

- Oxygen content 20.9% by volume
- Hydrocarbon vapour concentration less than 1% LFL
- No toxic or other contaminants

Note: Average oxygen content in air is about 20.9%. However, to allow for various local conditions and the sensitivity of modern equipment a reading of 20.8% or more should be considered as safe for entry.

Tests should be carried out at various depths and through as many deck openings as practicable. Ventilation should be stopped for at least 10 minutes before tests are carried out.

For tanks/holds with depths greater than 10 metres, atmosphere check should initially be done from deck level and then a second check for the lower section should be carried out from the first platform in order to make a full assessment of tank/hold atmosphere. Person doing the entry must carry an EEBD and personal gas monitor. During this entry, ventilation should be continuous.

d) Ventilation

Ventilation must be carried out before entry is permitted into any enclosed space.

- Almost all oxygen starvation accidents are caused by neglecting this principle.
- Forced ventilation is preferable. Keep as many manholes / doors open as possible.
- If forced ventilation is used at least four air changes must take place before entry is allowed. Rough estimation of four changes can be concluded by knowing the blower capacity and the time period blower has been in operation. Where only natural ventilation is possible the space must be allowed to 'breathe' for at least 24 hours.

> No entry shall be permitted into any enclosed space unless the atmosphere inside has been tested with type approved, calibrated and tested equipment.

- In certain spaces, such as double bottom tanks, the most effective way of ensuring full ventilation may be to fill the compartment with clean sea water and then pump it out allowing fresh air to be drawn in.
- Regardless of the method employed no entry shall be allowed until tests have shown that a safe, breathable atmosphere exists.
- Duct keels are provided with fixed ventilation systems which must be in operation for at least 2 hours before any entry is permitted.

e) Entry procedures

A risk assessment should be completed and potential hazards and controls identified. The master and responsible officer should ensure that:

- The space is ventilated.
- The atmosphere in the compartment is tested and found satisfactory.
- Safeguards are in place for all identified hazards.
- Piping, inert gas and ventilation systems have been isolated.
- Appropriate warning notices are placed on the relevant controls or equipment.
- Lighting is rigged, if required.
- Approved SCBA and resuscitation equipment is ready for use at the entrance to the space.
- A rescue harness, complete with lifeline, is ready for immediate use at the entrance to the space.
- Fully charged safety torch is ready for immediate use at the entrance to the space.
- Lines of communication have been clearly established and understood by all.
- A responsible crew member should be in constant attendance outside the enclosed space, in the immediate vicinity of the entrance and in direct contact with a responsible officer or bridge.
- Controls are in place so that no one shall enter an enclosed space without the completed ENCLOSED SPACE ENTRY PERMIT.
- Person entering the space should complete the permit along with responsible officer and ensure that above safeguards are put into effect prior entering the space.
- Duration of permit should be sufficient to complete the job but should never exceed one day.
- A copy of permit should be prominently displayed at the entrance to the enclosed space.
- Separate permit should be issued for each space to be entered.
- Effective ventilation shall be maintained continuously while the enclosed space is occupied.
- The permit should be rendered invalid if ventilation to the space stops or any other condition changes.
- Permit must be counter-signed by the master or chief engineer before allowing entry of Personnel.
- Following PPE should be used as appropriate:
  - Overalls, safety shoes, safety helmets, gloves, safety glasses and safety harness
  - Safety torches, approved VHF/UHF radios
  - EEBD, personal gas monitors

f) Additional precautions for working in enclosed spaces

- Loose scale, sludge or combustible material, if disturbed or heated, could give off toxic or flammable gases. As far as possible such material should be removed from work site. Effective ventilation should be maintained, and if possible, directed towards the work are.
- Any cargo pumps, pipelines, valves or heating coils which may contain flammable liquids or gases, should be thoroughly flushed with water, if possible prior opening. Tank atmosphere in the vicinity of work area should be continuously monitored.
- Canister type respirators do not provide any protection against shortage of oxygen and provides limited protection against toxic gases. These are not permitted for use in oxygen deficient atmospheres.

- Tools should be carried in a bucket or canvas bag to avoid dropping them.
- No hammering / chipping should be carried out if there is likelihood of hydrocarbon vapours.
- When removing sludge, scale or sediments from an enclosed space, continuous ventilation should be maintained and periodic gas tests carried out in the space.

g) Permit for enclosed space entry

Reference shall be made to shipboard SMS manual for the permit to enclosed space entry.

Additional notes:

- ➢ An 'enclosed space' is defined as a space that has the following characteristics:
- ❖ Limited openings for entry and exit
- ❖ Unfavourable natural ventilation
- ❖ Not designed for continuous worker occupancy
- ➢ Enclosed spaces include, but are not limited to, cargo spaces, double bottoms, fuel tanks, ballast tanks, fresh water tanks, pump-rooms, compressor rooms, cofferdams, void spaces, duct keels, inter-barrier spaces, engine crankcases, sewage tanks.
- ➢ In cases wherein chief officer or 2nd engineer form the part of the team entering the compartment, the duties of personnel supervising the entry should be taken up by the alternative person.
- ➢ Permit is to be posted at the entrance of the space to be entered, before entry is made.
- ➢ If there is more than one entrance to the space, which can be used for access, then a copy to be posted at each entrance.
- ➢ If the entrances are not within sight and control of the 'responsible person at entrance', then additional 'responsible persons' are to be designated as necessary.
- ➢ Because a space has been certified safe, it does not mean it will remain so, particularly if hot work is being carried out.
- ➢ The atmospheric condition of a space should be monitored throughout the entry, to ensure safety of the personnel and the operation. Re-check of atmospheric content must be carried out regularly at interval determined by risk assessment and especially after breaks.
- ➢ Even when the tests show a tank or compartment is safe for entry, pockets of gas should always be suspected. The use of personal detectors capable of continuously monitoring the oxygen content, hydrocarbon and toxic vapour in the atmosphere is highly recommended.

3. Working aloft and working over-side

a) Introduction

When working at a height it may not be possible for a person to pay full attention to the job and at the same time to guard himself from falling. Hence proper safety precautions are to be taken when working in such places.

> **Working aloft:** means working at a height
>
> **Working over-side:** means working outside the ship on the ship's side.

Know the hazards involved when working aloft or over-side like for example:

- ➢ Fatigue, unfit for work
- ➢ Fall, body contact with other object, injury
- ➢ Unsafe access, unsafe work area, unsecured tools
- ➢ Bad weather
- ➢ Lack of training

Adopt safety measures to control the hazards given in these points like for example**:**

- ➢ Be properly rested and physically fit
- ➢ Use safety belt, lines, hard hat
- ➢ Use a properly rigged ladder

- ➢ Work only in good weather
- ➢ Ensure experienced personnel are sent.
- ➢ When the place of work is beyond reach of the person, a ladder or a stage or a bosun's chair should be used.

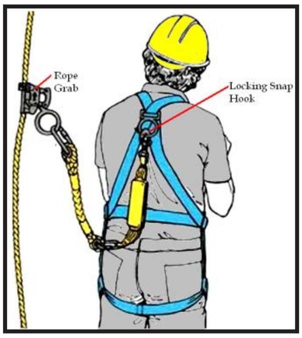
- The 'Code of Safe Working Practices for Merchant Seamen' advises that "a seamen under 18 years of age or with less than 12 months experience at sea, should not work aloft unless accompanied by an experienced seaman or otherwise adequately supervised."
- Always use a safety harness (with lifeline or other arresting device) when working aloft, outboard or over the side. A safety belt comes with a self-locking hook and this should be made fast to a strong point on the ship's structure or an eye pad if available.
- If no eye pads are available a safety line should be attached and this should be well secured to the ship's structure higher up than the stage.
- A safety line is one which has a wire heart running through. This line should not be used for any other purpose.
- Where possible and convenient use a safety net.
- All work involving stages, a bosun's chair, or working on a mast should be supervised by a responsible person. A man should always be on standby to assist persons working on the stage and help them in case of an emergency.
- When any work is to be carried out on a mast, on the superstructure or overside the duty officer to be informed. The duty officer in turn ensures that the radars are switched off, the whistle is switched off (if a person is working near the whistle) and warning notices are posted.

> Do not carry out any over-side work when the ship is moving.

- If work is to be carried out on the funnel, ensure that the engine room is informed and steps are taken to control, as far as practicable the emission of steam and harmful gases.
- Radio aerials should be isolated if work is carried out near the aerials.
- Anyone working over-side should wear buoyant clothing and as far as possible wear a life jacket. As a life jacket is very cumbersome and unwieldy to work with it is more practical to use a flotation vest specially designed to be worn while working.
- When cargo work is going on do not work over-side especially in the vicinity where cargo is being discharged.
- Tools used for working aloft should be kept lashed and secured in a container. It is a good practice to tie a short length of rope with an eye on one end so that it can be secured to the hand when working. This will avoid accidental falling of tools thereby injuring any person standing below. Tools should not be carried in pockets or loosely kept.
- When working overside a life buoy with sufficient line and a lifeline should always be kept ready in case a person falls into the water.

- A fall arrestor system shall be used while working aloft. It stops a fall within a few feet of the worker's original position. A full body harness is required with a fall-arrest system. A typical system consists of the following parts connected together:
  - full body harness
  - lanyard (with locking snap hooks or D-clips)
  - rope grab
  - lifeline

b) Precautions to take when using stages, cradles, bosun's chair and ropes



- Planks used for the construction of stages and bosun's chair cradles should be inspected to ensure adequate strength and free from defect. When not in use, they should be stowed in a dry ventilated space and not subjected to heat.
- All other equipment like blocks, lizards should be checked before use. Defective items should not be used.
- When tying the stage or a bosun's chair or when connecting a block, ensure the anchoring points are strong and well tested.
- Lines or gantlines used in stage work or for the bosun's chair should be checked for any damage and should not be used if any damage is found.
- Ropes should be kept clear of sharp edges and when using man-made fibres they should also not pass over hot surfaces.
- A ladder, of a similar construction as embarkation ladder, should be rigged adjacent to the stage. All access to the stage should be from the ladder. When the stage is to be lowered, the crew on the stage transfer themselves onto the ladder. Only once the stage rope is properly secure again the crew should climb back on to the stage.

> One of the critical operations whilst working on a stage is the lowering or hoisting of the stage. This should be done very slowly and with due diligence.

- The length of the safety line should be adjusted to ensure that just enough slack is there for the seaman to move comfortably from one end of the stage to the other. Any excessive slackness of the line is a hazard as it will increase the distance of any fall, giving a rib-crushing jerk to the seaman when it becomes taut.

- Hooks should not be used to secure a bosun's chair, unless they are of the type which, because of their special construction, cannot be accidentally dislodged.
- A bosun's chair is most often used to grease topping lifts and stays. When the chair is used for this purpose, ensure that the **bow** of the shackle and not the **pin** of the shackle ride on the wire.
- A winch should never be used to haul a person on a bosun's chair. Always haul the person by hand.
- Ropes used for stages: prior to every use, the bosun's chair should be inspected internally and externally for signs of deterioration, undue wear or damage. It should be stored away from sunlight and in a separate compartment away from containers of chemicals, detergents, rust removers, paint strippers and other substances capable of damaging it.
- Do not use ropes made of natural fibres or a mixture of natural and man-made fibres. It is preferable to use ropes made of man-made fibres especially polypropylene or polyamide.
- Before use, lifelines and gantlines, and chairs should be load-tested to four or five times the loads they will be required to carry.

c) Sample permit for working aloft

Reference shall be made to shipboard SMS manual for the permit for working aloft.

4. Hot work

a) Introduction

Hot work is any work which involves welding or burning and other work including drilling and grinding operations, electrical work and the use of non-intrinsically safe electrical equipment, which might produce heat or sparks capable of igniting combustible gases, vapours, liquids or material in or adjacent to the work area.

Hot work on ships has caused a number of major fires and explosions often resulting in loss of life or serious injury and in several instances leading to the total loss of the ship.

These procedures are meant to ensure that hot work is carried out safely and that potential hazards are clearly defined, specific instructions issued, and the operation is controlled and monitored by a responsible person on board.

Grit blasting and the use of mechanically powered tools are not normally considered as falling within the definition of Hot Work.

b) Hazards

Major hazards with hot work are:

- Fire,
- Explosion, and
- Unsafe atmosphere (created in enclosed spaces from prolonged work)

Certain potential hazards are present in all ships and will require particular precautions to be taken.
Serious fires and explosions have resulted from:-

- Hot work in the vicinity of fuel tanks
- Hydrogen emission from cathodically protected ballast tank
- Ignition of flammable materials of all types
- Ignition of flammable vapours in paint stores or during painting especially in tanks.
- Conduction of heat through steel from safe to unsafe areas.

c) Restrictions for hot work

On bulk carriers/general cargo when carrying coal cargo, smoking and the use of naked flame shall not be permitted in the cargo areas and adjacent spaces.

On container vessels when carrying specific IMDG dangerous cargoes such as Class 3 and 4 cargoes, smoking and the use of naked flame shall not be permitted in the cargo areas and adjacent spaces.

Appropriate warning notices shall be posted in conspicuous places.

Burning, cutting, chipping, welding or other sources of ignition shall not be permitted in the vicinity of cargo spaces or in the other adjacent spaces, unless the space has been properly ventilated and the methane gas measurements indicate it is safe to do so.

Certain ports do not allow hot work on board vessels. Whenever vessel is in port check if such restriction is in force prior doing hot work

d) Responsibilities

The responsibility for ensuring that hot work is conducted safely rests with the master. He shall personally ensure that the correct procedures are understood and followed by all concerned. The department heads will normally be responsible for executing the necessary tests and procedures. When work is being carried out over a period of days, the person in charge of the hot work must obtain the permit daily before commencement of work. Hot work within the machinery spaces will be subject to the approval of the chief engineer who shall personally satisfy himself that all necessary safety precautions are being observed.

> The responsibility for ensuring that hot work is conducted safely rests with the Master. Permit to work must be approved and signed by the Master.

In addition the safety officer has a duty to stop any work which he reasonably believes may cause a serious accident and immediately to inform the master or chief engineer, who will then be responsible for deciding when work may be safely resumed.

e) Special precautions

The following precautions must be observed on every occasion when hot work is intended outside the engine room workshop and in a possible hazardous location:-

- Fire fighting equipment shall be laid out ready for use. If welding or cutting on compartment boundary, equipment shall be in readiness on both sides.
- Fire watchmen shall be posted and briefed in their duties. Walkie-talkie link shall be set up between fire watchmen and bridge.
- Area shall be checked for cleanliness. All combustible material shall be cleared from the area (Both sides of the boundary where applicable).
- If hot work is to be carried out in or adjacent to any tank / hold that has contained fuel, ensure all grease or oil impregnated residues are removed.
- Check that area and adjacent compartments and fuel tanks are gas free.
- Emergency plan drawn up and discussed.

f) Gas detection

The gas free status of an area or a compartment is only confirmed at the time of testing and a zero reading obtained on a properly calibrated combustible gas indicator or explosimeter.

Hydrocarbon gas is generally heavier than air and may be in pockets even in compartments that have been ventilated for some time. It is therefore most important that tests are made throughout any compartment and at different levels.

Methane gas which may be emitted from coal cargoes is an exception to this, in that it is lighter than air, however, the same test procedures shall be observed as for petroleum hydrocarbons.

g) Precautions for welding and burning equipment

Welding (electric/gas) and other equipment used for Hot Work should be carefully inspected before each occasion of use to ensure that it is in good condition.

Where required, it must be correctly earthed. Special attention must be paid when using electric arc equipment to ensure that:

- Electrical supply connections are made in a gas free space.
- Existing supply wiring is adequate to carry the electrical current demand without overloading, causing heating.
- Insulation of flexible electric cables is in good condition.
- The cable route to the work site is the safest possible, only passing over gas free or inerted spaces.
- The earthing connection is adjacent to the work site and the earth return cable leads directly back to the welding machine. The ship's structure should not be used as an earth return.

h) Sample permit for hot work

Reference shall be made to shipboard SMS manual for the permit for hot work.

5) Using power tools

PORTABLE POWER TOOLS have, by virtue of their portability, their own special dangers and therefore must be correctly used and properly maintained. Following safety guidelines must be followed.

- Only the correct rpm rated disc or wire brush shall be used for the type of grinder to be fitted on.
- Electrical power tools must never be used if wet, otherwise electrocution may result.
- Portable tools fitted with guards must be used at all times.
- Particular attention must be given to the route the electrical supply lead will take and precautions shall be taken to ensure that doors, etc., will not chafe or damage the lead.
- Inspect the tool thoroughly before use and if any defects are found, report them to the responsible officer. Ensure electrical wires are in good condition.
- Proper personal protection shall be worn to prevent injury from flying particles, high noise levels etc.
- Always disconnect the tool from the electrical or air supply when not in use or when accessories are being fitted. This precaution will prevent accidental operation of the tool which could result in a serious injury. The equipment shall be disconnected even during the short breaks and upon completion of the job.
- Pneumatic tools shall be operated at designed operating pressure.
- Ensure that all jagged edges are taken off any tools, as they also can cause injury.

6) Manual lifting and carrying

Personnel should:

- use any mechanical aids provided;
- follow instructions; and
- take sensible precautions to ensure that they are aware of any risk of injury from the load before picking it up.

In manual lifting and carrying, the proper procedure to be followed is:

- assess the load to be lifted
- look for sharp edges, protruding nails or splinters, for surfaces which are greasy or otherwise difficult to grip and for any other features which may prove awkward or dangerous - for example sacks of ship's stores may be difficult to get off the deck;

- ensure that the deck or area over which the load is to be moved is free from obstructions and not slippery.

Some important points to note are:

- A firm and balanced stance should be taken close to the load with the feet a little apart, not too wide, so that the lift will be as straight as possible.
- A crouching position should be adopted, knees bent and maintaining the natural curve of the back to ensure that the legs do the work. It helps to tuck in the chin while gripping the load and then raise the chin as the lift begins.
- The load should be gripped with the whole of the hand - not fingers only. If there is insufficient room under a heavy load to do this a piece of wood should be put underneath first.
- The size and shape of the load are not good guides to its weight or weight distribution. If this information is not available a careful trial lift should be made, and if there is any doubt whether the load can be managed by one person help should be provided.
- The load should be lifted by straightening the legs, keeping it close to the body. The heaviest side should be kept closest to the trunk. The body should not be twisted as this will impose undue strain on the back and other parts of the body.
- If the lift is to a high level, it may be necessary to do it in two stages; first raising the load onto a bench or other support and then completing the lift to the full height, using a fresh grip.
- When two or more people are handling a load, it is preferable that they should be of similar stature. The actions of lifting, lowering and carrying should, as far as possible, be carried out in unison to prevent strain and any tendency for either person to overbalance.

> Refer Code of Safe Working Practices Chapter 19- Manual handling for lifting techniques.

- The procedure for putting a load down is the reverse of that for lifting, the legs should do the work of lowering - knees bent, back straight and the load close to the body. Care should be taken not to trap fingers. The load should not be put down in a position where it is unstable. If precise positioning is necessary, the load should be put down first, and then slid into the desired position.
- A load should always be carried in such a way that it does not obscure vision, so allowing any obstruction to be seen.
- The risk of injury may be reduced if lifting can be replaced by controlled pushing or pulling. For example, it may be possible to slide the load or roll it along. However, uncontrolled sliding or rolling, particularly of large or heavy loads, may introduce fresh risks of injury. Particular care must be taken if:
  - Stooping or stretching is likely;
  - Your hands when on the load are not between waist and shoulder height;
  - The deck area is insecure or slippery;
  - Force is applied at an angle to your body;
  - The load may make sudden or unexpected movements.
- For pulling and pushing, a secure footing should be ensured, and the hands applied to the load at a height between waist and shoulder wherever possible. Wheels on barrows and trolleys should run smoothly, consult your employer or safety representative if the equipment provided is not suitable, or is in poor condition. A further option, where other safety considerations allow, is to push with the worker's back against the load, using the strong leg muscles to exert the force.
- Even a gentle uphill slope dramatically increases the force needed to push an object, help may be necessary when moving a load up a slope or ramp. Care should be taken

with unbraked trolleys and sack trucks on a moving/rolling deck, as sudden changes in the angle of deck and direction of the slope may cause whiplash neck injuries. If a trolley becomes loose, do not try to stop it by standing in its way, but get behind it and try to act as a brake.

- Care must be taken with the laying out of heavy mooring ropes and wire ropes/hawsers. This duty requires a good technique initially in lifting the heavy eye of the rope, followed by a good pulling technique.
- Crews should make sure that there are enough people available to do the duty safely.
- When moving a load such as a barrel or a drum, rolling the load may be a safer operation than lifting it Care must, and the use of a trolley should be considered for heavy or large barrels or drums.
- Suitable shoes or boots should be worn for the job. Protective toecaps help to guard toes from crushing if the load slips; they can sometimes also be useful when putting the load down to take the weight while hands are removed from underneath.
- Clothing should be worn which does not catch in the load and which gives some body protection.
- Where the work is very strenuous, for example due to load weight, repetitive effort over a period or environmental factors, such as a confined space or an extreme of temperature, rest should be taken at suitable intervals, to allow muscles, heart and lungs to recover; fatigue makes accidents more likely on work of this type.
- Whenever possible, manual lifting and carrying should be organised in such a way that each person has some control over their own rate of work.

Apply Your Knowledge

1. Refer to the code of safe working practice and your company safety management system and list the precautions required to be taken for the following critical jobs:

   - Entry into ballast tank DB No. 2 (P)
   - Working on the radar mast.
   - Painting the loadline marks on the outboard side
   - Welding in the forepeak store
   - Using portable grinding machine
   - Manual handling of acetylene gas bottle.

Function: Controlling the operation of the ship and care for persons on board.

Competence: Contribute to the safety of personnel and ship

Task number: C7.1

Sub-task Reference number: C7.1.3

Topic: Safety of personnel and ship

Task Heading

- Identify the personal protection equipment (PPE) available on board and its use for various jobs.

Objectives

- To familiarize yourself with the functions of various PPE available on board.

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B) Health and safety guidelines
   1) Face and eye protection
   2) Head protection
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   9) Retro-reflective tapes
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   14) Training on PPE

Description

A) General

Proper and correct use of personal protective equipment (PPE) and clothing is one of the basic safety measures to be taken on the ship.

> The Master and Safety officer must ensure that each crewmember wears proper protective equipment and clothing when working.

Various personal protective equipment such as boiler suits, safety shoes, hand gloves, hard hats, ear muffs, safety harness, goggles, face masks, working vests etc are provided on board ships. Correct combinations of such equipment should be worn to protect from hazards when working.

Improper use and faulty personal protective equipment (PPE) may in itself cause a hazard. PPE, therefore, should always be maintained in good condition and it should be checked properly each time prior using it.

Proper training shall be undertaken for correct usage of PPE.

Refer to "code of safe working practices" for the duties and principles governing the guidance on safe practices which are required to be followed.

B) Health and safety guidelines

1. Face and Eye Protection

Suitable protection shall be worn to protect eyes from exposure to foreign bodies, chemicals, infra-red and ultra-violet rays or similar hazards.

Protection type	Usage
Welding Helmets /Goggles	Welding, gas cutting
Face Shields / Plain Visor	Handling chemicals, acids, Batteries etc.
Plastic box goggles	Chipping or exposure to foreign bodies from grinding, drilling, cutting, lathe machine etc.

Use of hand shields (for welding) is discouraged as both hands of the welder are occupied whilst using the same.

Use of prescription contact lens in high temperature areas (purifier rooms etc) is not recommended.

Ordinary prescriptive spectacles, unless manufactured to a safety standard, do not afford protection. Certain box-type goggles are designed so that they can be worn over ordinary spectacles.

In addition to routine jobs on board face and eye protection shall be worn when attending anchor stations, helicopter operations or working in battery charging room.

2. Head Protection

Helmets / hard hats generally provide protection from falling objects.

They can also protect against crushing or sideways blow and chemical splashes.

They may carry attachments like ear muffs or visor (protection from chemical splashes). The suspension or harness should be properly adjusted. The helmet should be adjusted to fit firmly and the chinstrap should always be used.

Bump cap is simply an ordinary cap with a hard penetration-resistant shell.

Use of bump caps is not recommended as they offer protection against only bruises / abrasion and not from falling objects / crush injuries.

Helmets must be replaced as per manufacturer's instructions (usually 5 years).

Helmets should be regularly inspected for signs of damage, cracks, excessive discoloration or heavy impact tell-tale signs.

Helmets should not be exposed to hazardous liquids, solvents and should not be painted upon. Helmet design should not be altered e.g. drilling of holes for ventilation.

3. Ear Protection

Earmuffs or plugs prevent hearing damage from excessive and prolonged repeated noise levels usually found in the machinery space and during chipping operations.

A rule of thumb to define high noise level: if you are unable to speak in a normal tone of voice standing at arm's length from your workmate.

> All personnel in high noise level areas must wear hearing protectors, including visitors and third party personnel.

Machinery spaces shall be designated as high noise level areas.
A notice stating - "Caution: Hearing Protection Required Beyond this Point" or the equivalent symbol, shall be posted on doors leading to spaces that are designated as high noise level areas.

Generally two types of hearing protection are found on board – earmuffs and ear plugs. Earmuffs are found to be more effective and better than earplugs. Earmuffs make it easier to hear voices and radios by filtering out high frequency background noise.

Dirty earplugs should not be used and one should not share them with others.

4. Hand Protection

The correct type of gloves shall be used depending on the nature of the work.

Glove Type	Usage
Leather	Handling rough and sharp objects.
Rubber	Working on electrical circuits or equipment.
Synthetic or PVC	Handling chemicals, solvents, acids or other hazardous substances that may harm skin.
Long sleeve gauntlets	Welding or gas cutting.
Cotton, woolen	Working in cold climate.
Heat resistant / Oven Mittens	Handling hot substances.

5. Foot Protection

Safety shoes shall always have hard (steel) toecap. They should preferably cover the foot up to the ankle. The soles should be anti skid and compatible on oily, chemical or wet surfaces. Crew must ensure that the shoes are worn correctly (never like a slip-on) and laces properly tied.

Synthetic or rubber safety shoes or boots should be used when working with chemicals, oils, acids or wet areas.

Footwear (sandals, flip-flops) other than safety shoes or boots shall never be worn when working.

6. Boiler Suits

Boiler suits shall be full sleeved and not too loose fitting. Boiler suits should preferably be made of cotton. Boiler suits made from synthetic materials that can easily catch fire must not be used. Boiler suits heavily soiled with paints, solvents, grease or cargo should not be used. Sleeves should be buttoned on the cuff. Sleeves should not be rolled up.

7. Safety Harness

ALWAYS

- ❖ Check and test lines and harnesses before using.
- ❖ Store lines and harnesses away from materials such as paints which are likely to contaminate them and cause damage.
- ❖ Make sure the harness is properly adjusted and that you are comfortable.
- ❖ Check the safety hook for correct operation.

Safety harness and safety helmet shall be worn by every person working aloft, over the side, below decks or any place from where a person may fall vertically 2 meters or more. Safety harness should be attached to a lifeline. The Lifeline shall be properly secured and it shall not be used for any other purpose other than fall protection. In general the lifeline length should not exceed 2 metres (6 feet). Use of safety belts is strongly discouraged.

8. Aprons

Leather apron should be used when carrying out hot-work (welding / cutting) and synthetic or PVC apron should be used for handling chemicals, acids or solvents.

9. Retro reflective tapes

Retro reflective tapes or similar material may be used on helmets or on clothing, if necessary to indicate your presence when working on deck during loading or unloading.

Personnel working in enclosed tanks and near crane operation areas such as gantry cranes should wear retro-reflective jackets for clear visibility to the crane operator.

10. Inflatable Life Jackets as Working Vests

Inflatable, SOLAS approved lifejacket shall be worn if there is any risk of falling or being washed overboard e.g. working on shipside, reading draft marks, preparing gangway etc. A lifeline should also be worn if there is a danger of falling.

They shall also be worn if using ship's raft or boat for shipside maintenance.

A lifebuoy with attached line shall also be kept ready in the close vicinity.

> Inflatable life jackets must be worn whilst preparing gangway, reading drafts or working on ship side.

11. Respirators

Facemasks and respirators should be worn to prevent inhaling dust arising from routine jobs or from cargo operations.

Respirators are of different types and designs e.g. dust respirators will protect from dusts and aerosol sprays but not from gases.

Filter, cartridge or canister type respirators provide protection against specified gases in low concentration or dusts.

Different types of respirators provide protection against specified dusts or gases and therefore it is important that the appropriate type is selected for the particular circumstances or conditions being encountered.

Manufacturer's instructions for each type of respirator shall be carefully read prior using it especially with regards to shelf life / expiry date. **Respirators do not protect against shortage of oxygen (i.e. less than 20.9 %).**

12. Chemical Suits

Chemical suits consist of jacket, pants, gloves, boots and helmet with visor. These suits are type approved as per IBC code regulations.

Material shall be chemical resistant. It should be worn when dealing with chemical or oil spills.

The container having chemical suits should be properly marked. A responsible officer should inspect the suits regularly for wear and tear.

13. Fireman Suits

Minimum of two fireman outfits are available on board. In addition, SOLAS II-2 regulation 19 / 3.6.2 requires, two sets of additional self-contained breathing apparatus be provided when carrying dangerous goods.

Fireman outfit is worn (along with self contained breathing apparatus) when fighting a fire. It is critical equipment.

> Fireman suits shall be stowed in such a manner that they are easily accessible and can be worn quickly.

Ensure every item of the fireman outfit is in place, maintained in clean and dry condition, and is not exposed to weather.

Each fireman outfit shall be stowed in a widely separated location so that fire in any one place will not make the other fireman suit redundant.

14. Training On PPE

All ship staff should be given proper training on PPE use. This is to form a part of the job specific training. The training should include the limitations and maintenance guidance of the PPE equipment being used. Special emphasis is to be laid on identification of expiry dates and defects. Defective or in-effective PPE provides no defense. It is therefore essential that the correct items of equipment are selected and that they are properly maintained at all times. The manufacturer's instructions should be kept safe with the relevant apparatus and if necessary referred to before use and when maintenance is carried out. PPE should be kept clean and should be disinfected as and when necessary for health reasons. PPE slide guide is generally issued by shipping company for guidance on minimum PPE requirement prior undertaking any job.

Apply Your Knowledge

a. List the PPE to be worn when carrying out the following tasks on your ship:

Letting Go Anchor	Chipping on deck	Pouring out chemical from drum	Welding	Securing gangway	Entering ballast tank	On deck watch while loading grain cargo

Function: Ship Security

Competence: Contribute to the enhancement of maritime security through heightened awareness

Task Reference No: D 1.1

Sub task Reference No: D 1.1.1, D 1.1.2, D 1.1.3

Topic: Ship security

Task Heading

- Recognize the three security levels.
- Understudy the Ship Security Officer with regards to his duties and responsibilities.
- Identify the Company Security Officer and his contact details. Explain his duties and responsibilities.

Objectives

- Familiarize with ISPS code, Security levels, identification and knowledge of duties and responsibilities of SSO and CSO.

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1) Introduction to ISPS code
2) Security levels
3) Requirements/ implications
4) Duties of company security officer
5) Duties of ship security officer
6) Few definitions

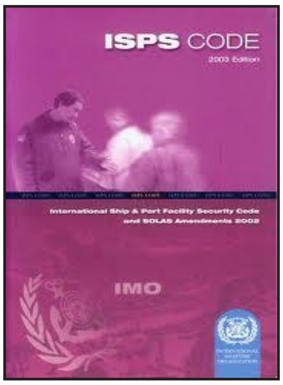
Description

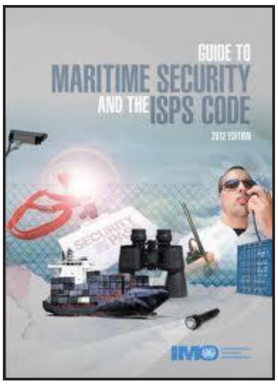
1) Introduction to ISPS code

The International Ship and Port Facility Security Code (ISPS code) is a comprehensive set of measures to enhance the security of ships and port facilities, developed in response to the perceived threats to ships and port facilities in the wake of the 9/11 attacks in the United States.

Problem of Pirates (especially around Somalia)

The ISPS code has been implemented through chapter XI-2 "Special measures to enhance maritime security" in the International Convention for the Safety of Life at Sea (SOLAS). The code has two parts, one mandatory and one recommendatory. In essence, the code takes the approach that ensuring the security of ships and port facilities is a risk management activity and that, to determine what security measures are appropriate, an assessment of the risks must





be made in each particular case to deter unwanted incidents like terrorist attacks, piracy and stowaways.

A recent publication from IMO on security is Guide to Maritime Security and ISPS Code, 2012 Edition. This user guide has been developed to consolidate existing IMO maritime security-related material into an easily read companion guide to SOLAS chapter XI-2 and the ISPS code.

2) Security levels

> Ships using port facilities may be subject to **Port State control inspections** and additional control measures. The relevant authorities may request the provision of information regarding the ship, its cargo, passengers and ship's personnel prior to the ship's entry into port. There may be circumstances in which entry into port could be denied!

The three different security levels referred to in the ISPS code are:

Security level 1: **normal**, the level at which the ship or port facility normally operates. Security level 1 means the level for which minimum appropriate protective security measures shall be maintained at all times.

Security level 2: **heightened**, the level applying for as long as there is a heightened risk of a security incident. Security level 2 means the level for which appropriate additional protective security measures shall be maintained for a period of time as a result of heightened risk of a security incident.

Security level 3: **exceptional**, the level applying for the period of time when there is the probable or imminent risk of a security incident. Security level 3 means the level for which further specific protective security measures shall be maintained for a limited period of time when a security incident is probable or imminent, although it may not be possible to identify the specific target.

3) Requirements/ implications

Ships have to carry an International Ship Security Certificate (ISSC) indicating that they comply with the requirements of SOLAS chapter XI-2 and part A of the ISPS Code. If a ship does not have a valid ISSC, the ship may be detained in port until it gets a certificate.

Shipping companies are required to designate a "**Company Security Officer"** for the company and a "**Ship Security Officer"** for each of its ships. The ship security plan should indicate the operational and physical security measures the ship itself should take to ensure it always operates at security level 1. The plan should also indicate the additional, or intensified, security measures the ship itself can take to move to and operate at security level 2 when instructed to do so. Furthermore, the plan should indicate the possible preparatory actions the ship could take to allow prompt response to instructions that may be issued to the ship at security level 3.

Similarly, each "**Contracting Government"** is required to appoint a "**Port Facility Security Officer"** and prepare a port facility security plan. This plan should indicate the operational and physical security measures the port facility should follow to operate at all three security levels.

> Masters, company security officers or ship security officers cannot set or change the security level onboard the ship.

4) Duties of company security officer (CSO)

The company security officer is designated by the ship owner. The duties and responsibilities of the CSO shall include, but are not limited to:

a) Advising the level of threats likely to be encountered by the ship, using appropriate security assessments and other relevant information;
b) Ensuring that ship security assessments are carried out;
c) Ensuring the development, the submission for approval, and thereafter the Implementation and maintenance of the ship security plan;

d) Ensuring that the ship security plan is modified, as appropriate, to correct deficiencies and satisfy the security requirements of the individual ship;
e) Arranging for internal audits and reviews of security activities;
f) Arranging for the initial and subsequent verifications of the ship by the administration or the recognized security organization;
g) Ensuring that deficiencies and non-conformities identified during internal audits, periodic reviews, security inspections and verifications of compliance are promptly addressed and dealt with;
h) Enhancing security awareness and vigilance;
i) Ensuring adequate training for personnel responsible for the security of the ship.
j) Ensuring effective communication and co-operation between the ship security officer and the relevant port facility security officers;
k) Ensuring consistency between security requirements and safety requirements;
l) Ensuring that, if sister-ship or fleet security plans are used, the plan for each ship reflects the ship-specific information accurately; and
m) Ensuring that any alternative or equivalent arrangements approved are implemented and maintained

5) Duties of ship security officer (SSO)

The duties and responsibilities of the SSO shall include, but are not limited to:

a) Undertaking regular security inspections of the ship to ensure that appropriate security measures are maintained;
b) Maintaining and supervising the implementation of the ship security plan, including any amendments to the plan;
c) Co-coordinating the security aspects of the handling of cargo and ship's stores with other shipboard personnel and with the relevant port facility security officers;
d) Proposing modifications to the ship security plan;
e) Reporting to the company security officer any deficiencies and non-conformities identified during internal audits, periodic reviews, security inspections and verifications of compliance and implementing any corrective actions;
f) Enhancing security awareness and vigilance on board;
g) Ensuring that adequate training has been provided to shipboard personnel, as appropriate;
h) Reporting all security incidents;
i) Co-coordinating implementation of the ship security plan with the company security officer and the relevant port facility security officer; and
j) Ensuring that security equipment is properly operated, tested, calibrated and maintained, if any.

6) Few definitions

a) **Contracting government** means a state which has ratified the International Convention for the Safety of Life at Sea (SOLAS) 1974, as amended.
b) **Recognized security organization** means an organization with appropriate expertise in security matters and with appropriate knowledge of ship and port operations authorized to carry out an assessment, or a verification, or an approval or a certification activity, required by this chapter or by part A of the ISPS Code.
c) **Ship security plan** means a plan developed to ensure the application of measures on board the ship designed to protect persons on board, cargo, cargo transport units, ship's stores or the ship from the risks of a security incident.
d) **Company security officer** means the person designated by the company for ensuring that a ship security assessment is carried out; that a ship security plan is developed, submitted for approval, and thereafter implemented and maintained and for liaison with port facility security officers and the ship security officer.
e) **Ship security officer** means the person on board the ship, accountable to the master, designated by the Company as responsible for the security of the ship, including implementation and maintenance of the ship security plan and for liaison with the company security officer and port facility security officers.

f) **Port facility** is a location, as determined by the contracting government or by the designated authority, where the ship / port interface takes place. This includes areas such as anchorages, waiting berths and approaches from seaward, as appropriate.
g) **Ship/port interface** means the interactions that occur when a ship is directly and immediately affected by actions involving the movement of persons, goods or the provisions of port services to or from the ship.
h) **Port facility security officer** means the person designated as responsible for the development, implementation, revision and maintenance of the port facility security plan and for liaison with the ship security officers and company security officers.
i) **Declaration of security** means an agreement reached between a ship and either a port facility or another ship with which it interfaces specifying the security measures each will implement.

Apply Your Knowledge

1. You are the OOW on port watch. A message is received from the Port authorities that the Security level in the port has been upgraded from level 1 to level 2. Discuss the actions to be taken to comply with Level 2 security.