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DISTANCE LEARNING MATERIAL FOR SEMESTER 4

INDIAN MARITIME UNIVERSITY

(A Central University under the Ministry of Shipping)

DISTANCE LEARNING MATERIAL for SEMESTER 4

DNS Leading to B.Sc (Applied Nautical Science)

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DISTANCE LEARNING MATERIAL
for
(SEMESTER 4)

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

First Edition, 2013

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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 4 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

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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
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- Anglo Eastern Maritime Training Centre

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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 4 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.

IMU

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**

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

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

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

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

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

First Edition, 2013

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

This manual contains Distance Learning Material for Semester 4

- 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 4

Function 1: Navigation

Sr. No.	Topic	Task No.	Task Description	Page No.
	equipment		❖ NAVTEX, including selecting and deselecting message types and transmitting stations ❖ Weather fax, where fitted ❖ Distance/speed logs ❖ Bridge controls during maneuvering; e.g. telegraph, whistle / horn, intercom	
		A2.2.3	Assist in renewal of recording paper of various equipment; i.e. course and rudder position indicator recorder, echo sounder, telegraph order printer, NAVTEX, weather fax, GMDSS printers, etc.	
11.	Navigational equipment	A2.2.4	Locate and identify all the navigational and emergency equipment being supplied by the emergency switchboard for safe navigation.	69 – 71
12.	Ship reporting systems	A2.3.2	Assist watchkeeping officer in making various reports pertaining to ship reporting systems, as per their prescribed formats given in the publications and assist in sending such reports.	72 – 77
13.	Radar/ ARPA checks, set up procedures and operational use	A3.1.7	Demonstrate understanding of the limitations of the radar and ARPA and be aware of the possibility of misinterpretation of information, false echoes, sea returns, reliance on scanty data/information, etc.	78 – 83
		A3.1.8	Use radar performance monitors and analyze results by comparing them with the original readings	
14.	Using radar/ ARPA for collision avoidance	A3.2.2	Demonstrate ability to identify and track small boats.	84 – 86
		A3.2.3	Practice parallel indexing techniques.	
		A3.2.4	Demonstrate understanding of correct setting of CPA/TCPA alarms with respect to area of navigation.	
		A3.2.5	Carry out long range scanning by changing radar scales at regular intervals.	
15.	Use of ECDIS	A4.1.4	Assist watch-keeper in correcting/ updating electronic charts – manual, semi-automatic and automatic methods.	87 – 90
		A4.1.5	Demonstrate understanding of the limitations of ECDIS and dangers of over reliance.	
		A4.1.6	Plan and monitor a route using ECDIS.	
		A4.1.7	Demonstrate understanding of the optimum ECDIS settings and use of various alarms and indicators; e.g. watch vector, safety contour, cross track, arrival WPT, anchor watch settings.	
16.	Emergencies at sea	A5.1.2	Understudy team leaders during emergency response exercises; e.g.: ❖ Heavy weather damage ❖ Collision ❖ Grounding ❖ Flooding ❖ Rescue of survivors / assisting a ship in distress ❖ Shipboard oil pollution incident at sea ❖ Gyro failure ❖ Steering failure, ❖ Main engine/ power failure ❖ Security incident/ drill at sea.	91 – 100

Sr. No.	Topic	Task No.	Task Description	Page No.
			❖ Weighing of anchor, inspecting for damage and fouling.	
		A9.2.10	Accompany an officer on deck for anchoring operation. Recognize the significance and method of reporting to bridge the lead of the anchor chain.	
		A9.2.11	Use bow stopper and anchor brakes as directed by officer in charge during anchor stations.	
		A9.2.12	Assist with securing of anchors for sea. Recognize the importance of three point contact at the securing position.	
		A9.2.13	Demonstrate understanding of the procedure for releasing the bitter end of anchor chains.	

I M U

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task number: A1.1

Sub task Reference number: A1.1.4, A1.1.5, A1.1.6, A1.1.7, A1.1.8

Topic: Celestial navigation

Task Heading

- Obtain accurate readings of sextant altitudes of celestial bodies.
- Calculate the time of meridian altitude of the sun.
- Calculate latitude by Polaris or by meridian altitude of the sun.
- Practice celestial observations (sights) using the sextant and obtain position lines and positions.
- Plot three position lines and obtain ship's position.

Objectives

- Understand the use of sextant
- To be able to obtain ship's position using celestial bodies through staggered observations of celestial bodies.
- To be able to obtain ship's position using celestial bodies through simultaneous observations of celestial bodies.

Index

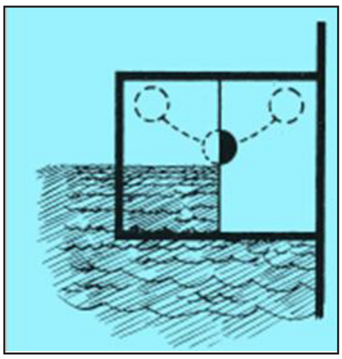
1. Finding altitude of the sun using sextant
2. Correction of altitudes
3. Position lines
4. Longitude by chronometer method
5. The marc st. Hilaire (intercept) method
6. Finding time of meridian passage of various heavenly bodies
7. Latitude by meridian altitude- SUN
8. Method of staggered observations
9. Simultaneous observations using sight reduction tables for air navigation

Description

1) Finding altitude of the sun using sextant

Before looking at the sun through your sextant, be sure to position a sufficient number of index shades (the large set of four shades) between the two mirrors to protect your eyes from the direct rays of the sun. Choose whatever combination of shades gives you a clear image of the sun without glare.

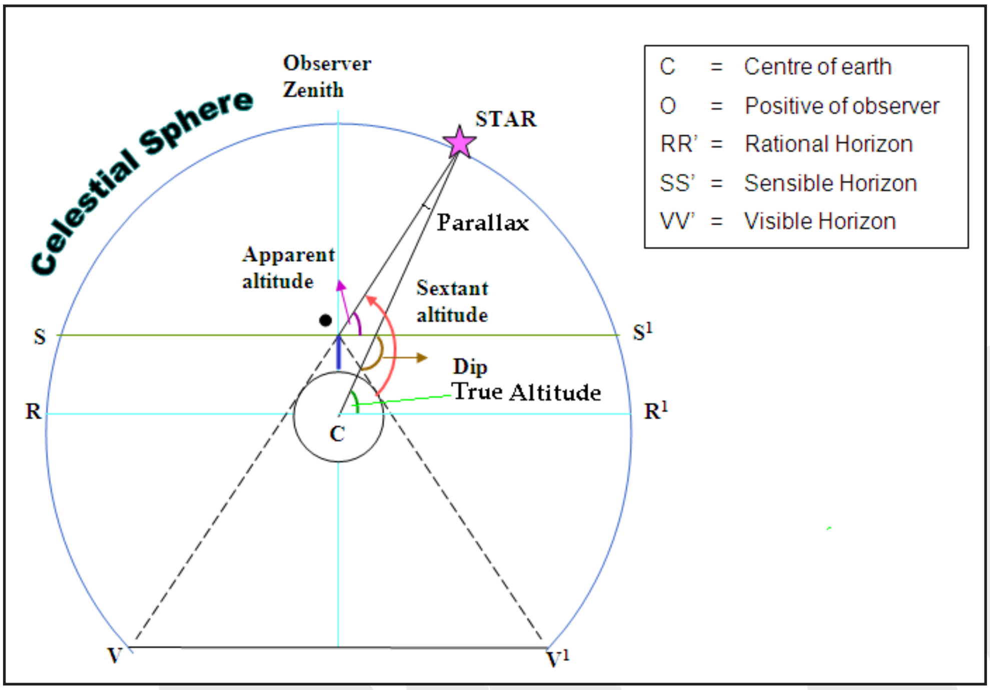
- **To measure the sun's altitude**



a) Use index shades to protect your eyes, as discussed above.
b) Use the horizon shades to darken the clear section of the horizon mirror so that it acts as a semi-mirror. The horizon will still be visible through it, but the sun's image will be reflected.
c) Stand facing the sun with the sextant in your right hand.
d) With your left hand on the quick release levers of the index arm, look through the eyepiece at the horizon and move the index arm until the sun is visible through the two mirrors and index shades.
e) Release the levers and, while slowly rocking the entire sextant from side to side, use the fine adjustment drum to bring the sun's image down to just touch the horizon with its lower edge (lower limb). The sun's image should travel a short arc that is made to touch the horizon

f) Read the sun's altitude from the scales on the sextant, being careful not to disturb the setting.

2) Correction of altitudes



- **Definitions**

- **The observer's zenith**
  It is the point at which an imaginary straight line from the centre of the earth, through the observer would meet the celestial sphere. You as an observer look up at the sky. The point in the sky directly above you is your ZENITH.

- **Rational horizon**
  This is a great circle on the celestial sphere, the plane which passes through the centre of the earth, every point on which is at 90° from the observer's zenith.

- **Sensible horizon**
  It is a small circle on the celestial sphere, the plane of which passes through the observer's eye, and is parallel to the observer's rational horizon.

- **Visible horizon**
  It is the small circle on the earth's surface, where the earth and the sky appear to meet. It is the circle bonding the observer's field of vision at sea in clear visibility.

- **Sextant altitude**
  It is the altitude of the body above the visible horizon as read off from the sextant without applying any index or instrument error.

- **Observed altitude**
  It is the altitude of the body, above the visible horizon, as read off from the sextant corrected for any index error.

- **Apparent altitude**
  It is the angle subtended at the observer between the celestial body and the sensible horizon. This will be the observed altitude corrected for index error and dip (height of eye correction).

❖ **True altitude**
True altitude of a celestial body is the angle subtended at the centre of the earth contained between the rational horizon and the centre of the body. The altitude required for navigational computation is the TRUE ALTITUDE.

To arrive at the true altitude various corrections have to be applied to its altitude measured by the sextant. These corrections in the order they are to be applied are index error, dip, refraction, semi-diameter and parallax. Semi-diameter is only applicable to sun and moon and not to stars and planets.

➢ **Application of corrections to sextant altitude**

❖ **Index error**
As mentioned is the instrumental error of the sextant. It is <u>added</u> if it is **off the arc** and <u>subtracted</u> if it is **on the arc**.

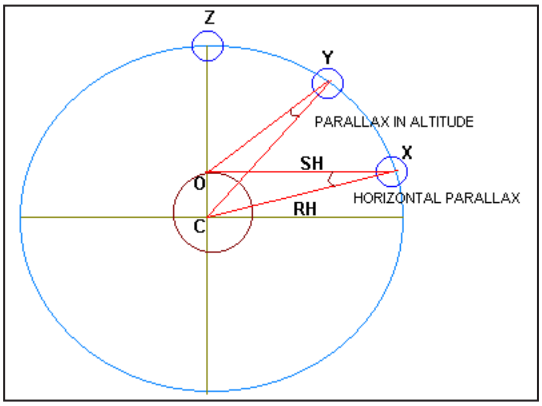
❖ **Dip (or correction for the height of eye)**
Dip occurs because the observer is not situated at sea level. The value of Dip increases as the observer's height of eye increases. The correction for Dip is always negative and is tabulated in the nautical almanac and nautical tables. It can also be found out by the formula:
Dip = 0.98 √(H.E. in feet) where H.E is the height of eye of the observer.

❖ **Refraction**
As the ray of light travels from a rarer medium to a denser medium, the ray refracts or bends towards the normal. The atmosphere of earth is most dense at the earth's surface and become rarer as the height above the surface increases. Refraction is greatest at low altitudes and is zero when the body is on the observer's zenith, as no refraction can take place when the ray is coincident with the normal. Refraction has a maximum value of about 34.5 minutes when the body is on the horizon and it decreases as the altitude increases.

❖ **Semi-diameter**

✓ The parameters used in working a sight refer to the centre of the body. It is therefore necessary that the body's zenith distance and the true altitude should also refer to the centre of the body. The sun and moon presents a visible disc to the observer. The altitude of either the upper limb or the lower limb is measured to which we apply half the apparent diameter of the body to obtain the altitude of their centres. The semi-diameter should be added to an altitude of the lower limb and subtracted from the altitude of the upper limb to obtain the altitude of the centre of the body.

✓ The semi-diameter of the sun is tabulated, once for every 3 days, in the daily pages of the nautical almanac. For the moon, it is tabulated for each day. The apparent semi-diameter of these bodies depends on their distances from the earth. The diameter is observed to be maximum when closest to the earth and minimum when they are farthest. For the sun, the SD varies from 15.8' to 16.3' and that for the Moon from 14.8' to 16.7'. Moon being closer to earth, the semi-diameter needs to be corrected further by a correction called augmentation of moon's semi-diameter. Augmentation corrections are available in the various nautical tables. It is tabulated as a function of the altitude.



❖ **Parallax**
After applying the above correction the resultant will be the altitude of the centre of the body above the observer's sensible horizon. To obtain the altitude of the body above the rational horizon a correction known as "Parallax in altitude" or simply

"Parallax" has to be applied. "Parallax" is the angle subtended at the centre of the celestial body between the observer's eye and the centre of the earth.
When the body is on the observer's sensible horizon this is known as horizontal parallax. Parallax correction is maximum when the body is on the observer's sensible horizon and zero when the body is at the observer's zenith.

When the body is at X i.e. the observer's sensible horizon the correction for parallax is maximum which is equivalent to the horizontal parallax. When the body is at Z i.e. at the observer's zenith, the correction for parallax is zero. For any other in between altitudes

$$\text{Parallax in Altitude} = \text{Horizontal Parallax x Cosine Apparent Altitude}$$

From the above diagram it is evident that as the distance of the body from the earth increases, the parallax reduces as the angle subtended at the centre of the body reduces. *Hence parallax is largest is case of Moon, lesser in case of Planets, still lesser in case of the Sun and nil in case of the stars.*

- ✓ Parallax correction for sun is available in the nautical tables.
- ✓ For planets this correction combined with a correction for phase is given as an additional correction at the start of the nautical almanac under the heading "Star and Planets".
- ✓ For moon the horizontal parallax is tabulated every hour in the nautical almanac. The parallax in altitude can be fond by the formula.

Summary for altitude correction's of celestial objects

Corrections	**Sun**	**Star/Planet**	**Moon**
Index error	-ve On the arc +ve Off the arc	-ve On the arc +ve Off the arc	-ve On the arc +ve Off the arc
Dip	-ve	-ve	-ve
Refraction	-ve	-ve	-ve
Semi-Diameter	-ve Upper limb +ve Lower limb	Not applicable	-ve or +ve after augmentation
Parallax	+ve	Only for Planets Venus and Mars	+ve

- ❖ **Total correction**

In practical navigation instead of applying all the corrections as stated above the sextant altitude is corrected for index error and dip to obtain the apparent altitude. The other corrections are combined together in what is called "Total correction" and these are tabulated in the "Nautical Almanac".
We will work out few examples to familiarize the candidates with correction of sextant altitude.

Example 1 Sextant altitude of sun

On 20th May, the sextant altitude of sun's lower limb was 35º 21.6'. If the index error was 3.8' on the arc and the height of eye was 18m find the true altitude.

Using all corrections		**Using total corrections**	
Sext Alt	35^0 21.6'	Sext Alt	$35^0$21.6'
I.E (on the arc)	- 3.8'	I.E (on the arc)	- 3.8'
Obs Alt	35^0 17.8'	Obs alt	35^0 17.8'
Dip (18m)	- 7.5'	Dip (18m)	- 7.5'
App. Altitude	35^0 10.3'	App alt	35^0 10.3'
Refraction	- 1.4'	Total corrn. (LL)	+ 14.6'
	35^0 08.9'	**True Altitude**	**35 24.9'**
SD (LL)	+ 15.8'		
	35^0 24.7'		
Parallax	+ 0.1'		
True Alt	**35^0 24.8'**		

Example 2 - Sextant altitude of moon

On 12th September, at 1800 UTC the sextant altitude of Moons LL was 40º 13.6’. Index error 1.5’ off the arc. HE 12 m. Find the True altitude.

Applying all corrections		Applying total correction	
Sext Alt	40º13.6’	Sext Alt (S.A)	40º13.6’
I.E (off the arc)	+ 1.5’	I.E (off the arc)	+ 1.5’
Obs Alt	40º15.1’	Obs alt (OA)	40º 15.1’
Dip (12m)HE	- 6.1’	Dip (HE 12m)	- 6.1’
	40º09.0’	App alt(AA)	40º 09.0’
Refraction	- 1.1’	Main Corrn	+ 53.6’
	40º07.9’	HP Corrn (58.7)	+ 6.1’
Ang SD	+ 16.1’	**T. altitude**	**41º 08.7’**
	40º24.0’		
Parallax	+ 44.9’		
True Alt	**41º08.9’**		

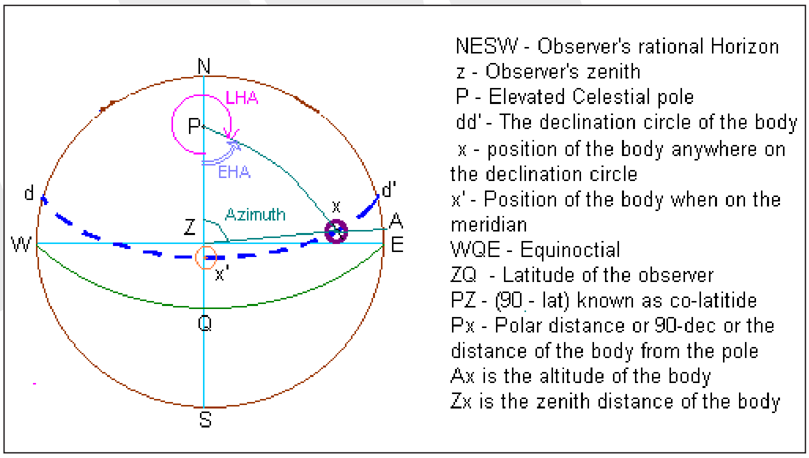
Please note when using altitude correction tables for the moon 30’ is to be subtracted from the total to get the True altitude if upper limb has been taken. Correction of altitudes for stars and planets is the same as that for the sun and hence no worked out example is shown. An additional correction mentioned in the almanac for mars and Venus needs to be applied.

3) Position lines

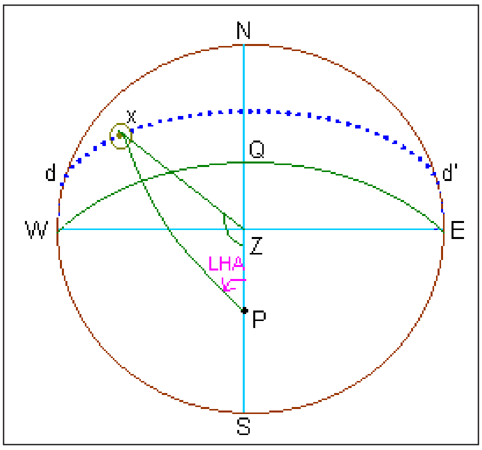
As in the case of terrestrial bodies, the celestial bodies can also be used to obtain the position line of the vessel. There are four methods of obtaining the position line.

Drawing for astronomical calculations

For the purpose of understanding astronomical calculation – figures are drawn on the plane of the observer’s rational horizon.



Most astronomical calculation involves the solution of spherical triangle PZX. The above figure has been drawn for an observer in the northern latitude with the body having a northern declination. For the observer in the southern latitude and with the body having a northern declination the parameters will as shown in the figure below.



Astronomical position lines are basically a part of the position circle drawn on the earth surface with the geographical position of the body as the centre and the zenith distance in minutes of arc as the radius in miles. Intersection of two such position lines will give the position of ship.

To obtain the observer's latitude when the celestial body is on the observer's meridian, we use "Latitude by Meridian altitude" (Lat by Mer Alt) method. When the body is not on or near the observer's meridian then there are two the methods of obtaining the position line.

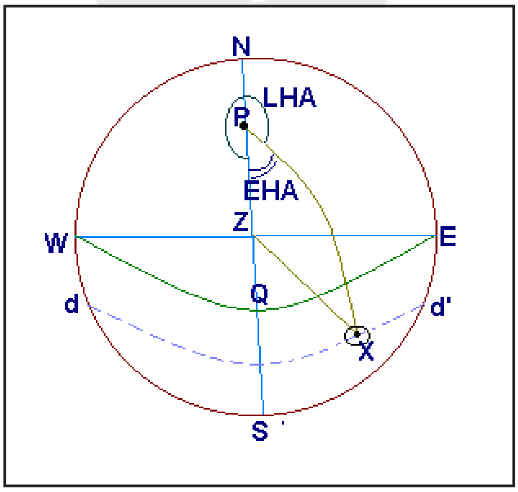
a) The Longitude by chronometer method and
b) The Marc St. Hilaire (intercept) method.

The above two methods give positions through which the position line can be drawn. We know that the direction of the position line is at right angles to the azimuth.

4) Longitude by chronometer method

In the figure given:

a) The DR latitude is used. This gives the co-lat – PZ in the spherical triangle PZX.
b) From observed altitude we get the true zenith distance i.e. ZX
c) Declination of the body is obtained from the almanac. This gives us the third side of the spherical triangle PZX i.e. PX



In the above spherical triangle PZX we know all the three sides. We have to find the LHA i.e. angle P in the above and hence can use the Haversine formula as follows:-

Hav P = [hav ZX – hav (PZ~PX)] / Sin PZ x Sin PX

i.e. Hav P = [Hav zenith distance – Hav (L~D)]. Sec lat. Sec Dec

Once we know angle P which is the LHA, longitude of the observer can be found by finding the difference between the GHA of the body & LHA of the body.

For Sun:

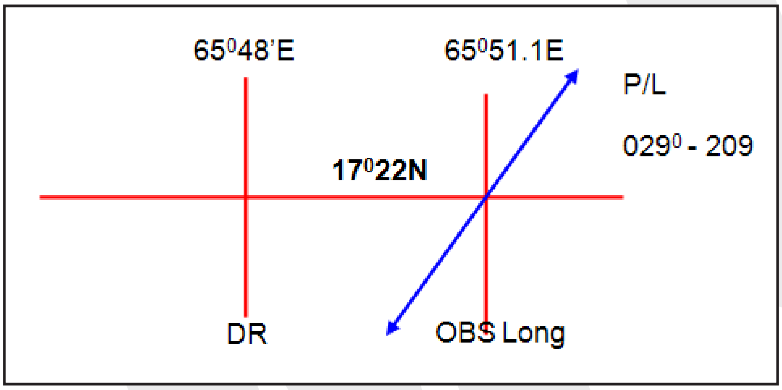
LHA ○ (Sun) = GHA ○ (Sun) + Long E (-Long W)

Example: On 12th Feb, at GMT 12d 04h 31m 40s in DR position 17º 22'N 065º 48'E, the sextant altitude of, Sun's UL East of the meridian was 32º 11.0'. If the GHA obtained after applying correction to what is given in the almanac for that day and year is 244º 21.5', Dec was S 13º 46.0', the HE was 12m and IE was 2.3 off the arc calculate the direction of the P/L and the position through which it passes.

Formula: Hav LHA = Sec lat. Sec Dec [Hav ZD – Hav (L~D)]

		Altitude corrn	
Declination:	S 13°46.0'	Sext Alt	32°11.0'
Lat:	N 17°22.0'	IE	+ 02.3'
(L~D)	31°08.0'	Obs alt	32°13.3'
		Dip (12m)	- 6.1'
Nat Hav ZD	0.23629	App alt	32°07.2'
Nat Hav L~D	0.07202	Tot corn (UL)	- 17.3'
Nat Hav diff	0.16427	T. Alt	31°49.9'
		TZD	58°10.1'
Hav LHA = 0.16427 x sec 17°22 ' x sec 13°46' = 0.17721			
LHA	= 310°12.6'	A	= 0.26 S
GHA	= 244°21.5'	B	= 0.32 S
Obs long	**65°51.1'**	C	= 0.58 S
DR Lat :	**17°22'N**	**Az S 61°E**	
		Azimuth = 119°	

Azimuth = 119^0
P/L = 029^0 ⟷ 209^0



Answer : P/L 029° – 029° drawn through DR Lat 17°22'N and obs long 65°51.1'E

Note: The LHA can also be obtained using the calculator, by using the below formula:

$$\textbf{Cos P} = \frac{\textbf{Sin T.Alt – Sin Lat . Sin Dec}}{\textbf{Cos Lat . Cos Dec}}$$

Usually at sea, the Longitude by Chronometer is used to take the AM and PM Sun sights and the Latitude by Meridian Altitude is used for obtaining the latitude when the sun is on the meridian. Running fix method is used to transfer the AM longitude obtained to the meridian latitude and to obtain the position at the meridian passage time. Simple interpolation using speed and course is done to obtain the ships position at noon (SMT).

5) *The Marc St. Hilaire (Intercept) method*

Using the Haversine formula
Hav Zenith distance = (Hav P x Cos lat x Cos dec) + Hav (Lat ~Dec)
Using scientific calculator the same can be obtained by using the formula
Cos CZD = (Cos P x Cos Lat x Cos dec) $\pm$ (Sin Lat x Sin dec.)
Note: - In the above formula if lat and dec are same names add (+). If Opposite names subtract (-) Also:-
If LHA lies between 0° and 180°, P= LHA
If LHA is between 180° and 360°, P = 360 – LHA.

Example: On 12^{th} Feb, at GMT 12d 04h 31m 40s in DR position 17° 22'N 065° 48'E, the sextant altitude of, Sun's UL East of the meridian was 32° 11.0'. If the GHA obtained after applying correction to what is given in the almanac for that day and year is 244° 21.5', Dec was S 13°

46.0’, the HE was 12m and IE was 2.3 off the arc calculate the direction of the P/L and the position through which it passes.

From the previous example we pick up the following parameters
GHA O = 244º21.5’ L~D = 31º08.0’
T. Alt = 31º 49.9’
TZD = 58º 10.1

GHA O	244º21.5’
Long (E) +	065º48.0
LHA O	310º09.5’

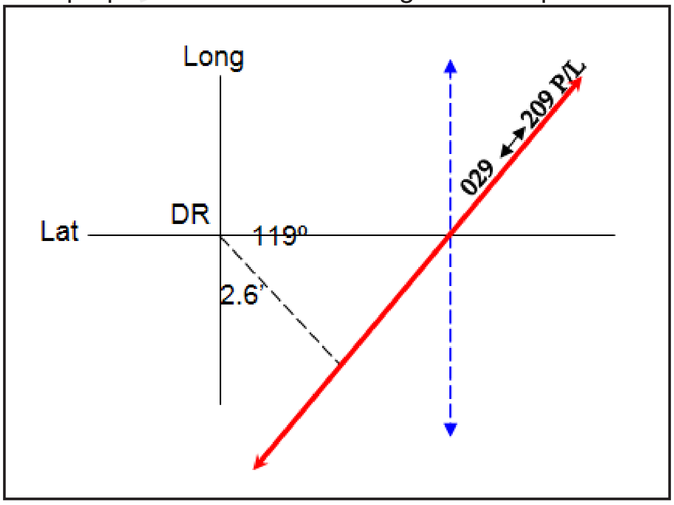
Hav CZD = (Hav LHA x Cos Lat x Cos D) + Hav (L~D)
By scientific calculator the same can be obtained by
Cos CZD = Cos P x Cos Lat x Cos dec ± Sin Lat x Sin dec.
Note: - In the above formula if lat and dec are same names add (+). If Opposite names subtract (-) Also:-
If LHA lies between 0º and 180º, P= LHA
If LHA is between 180º and 360º, P = 360 – LHA.

LHAO = 310º09.5’
P= 49º50.5’ (P= 360-LHA)
Lat = 17º22.0’N
Decln: 13º 46.0’S
Cos CZD = Cos 49º 50.5’ x Cos 17º22’ x Cos 13º46.0’ – Sin 17º22’ x Sin 13º46’
= 0.5267919
CZD = 58º12.7’(Calculated Zenith Distance)
We have already found the True Zenith Distance which is 58º10.1’ earlier in the calculation. The difference of these two will give the intercept.

Calculated Zenith distance (CZD)	=	58º12.7’
True Zenith distance (TZD)	=	58º10.1’
Intercept	**=**	**2.6’ Towards**

When CZD > TZD intercept is TOWARDS and plotted on the same line as bearing. When CZD < TZD the intercept is termed AWAY and plotted on opposite side of the bearing.

So using DR latitude and declination, we get the intercept as 2.6’ towards.
Now we have the azimuth for sun for that time as 119º, so we plot the intercept on the bearing of 119º and the P/L, which is perpendicular to the bearing from that point.



On comparing the above solution obtained by the Marc St. Hilaire method with the longitude by chronometer method, we will observe that the P/L intercepts the DR latitude in the same position as the longitude we calculated using long by chronometer method.

6) To find the time of meridian passage of various heavenly bodies

SUN:

a) From the nautical almanac for that day LMT meridian passage can be obtained. It is tabulated for every day of the year at the right hand bottom corner.
b) Find the DR position of the vessel at the time.
c) Apply longitude in time (if east longitude subtract and if west longitude add). This will give you the GMT time of Meridian passage of the sun.

Example: Find the time for meridian passage of sun by ships clocks (-0500Z), in longitude 70º E on 12th November.
On Inspection of the Almanac, for 14th Sept we get:

LMT M.P.	12d 11h 44m 00s
LIT (E) 700	- 04h 40m 00s
GMT MP	12d 07h 04m 00s
Zone time of place	+ 05 00 00
	12d 12h 04m

The sun will be on the meridian at 12h 04m by ships clock
When the heavenly body is on the meridian its LHA = 360^0

Stars
Example: To find the LMT of Meridian passage of Star Capella, in long 60ºE on 14th Sept.
Since the star is on the meridian LHA* = 360º
LHA* = GHA γ + SHA* + E Longitude
On Inspection of the Almanac, for 14th Sept we get:
SHA* CAPELLA = 280º51.2'
360 = GHA γ + 280º51.2' + 60º = GHA γ + 340º 51.2'
GHA γ = 360º – 340º51.2' = 19º08.8'

From Almanac GMT Time	= 14d 01h 45m 13s
GMT Time of MP of * Capella	= 14d 01h 45m 13s
LIT 60^0E	+ 04h 00m 00s
LMT Time of MP of * capella	= 14d 05h 45m 13s

Similarly meridian passage time can be worked out for planets and the moon.
The second method shown above can be used to calculate the MP time of sun also
When at MP LHA sun = 360^0
Working out example 1 in this method
360º = GHA (Sun) + 70ºE
GHA (Sun) = 360º –70º = 290º

Looking at almanac for 12th November GMT at which sun's GHA will be 290^0 will be 12d 07h 04m 06s which is very close to what we got by the previous method.

We will now look into the various methods of obtaining a position line using celestial objects.

7) Latitude by meridian altitude

SUN
The altitude of the body is taken when the body is on the observer's meridian. The meridian altitude of the body will be the maximum altitude attained by the body for the stationery observer. When the body is on the meridian, the bearing of the body will be exactly north or south. Hence the position line (being tangent to the circle of position) will run exactly east - west. Thus the P/L will coincide with the latitude of the place and hence this can be obtained.

Example:
On 4th April, in DR position 35º10'N 148º18'E, the sextant meridian altitude of the sun's lower limb was 60º10.3'. From almanac, calculated declination is 05º33.9' N. If IE was 2.2' off the arc, and HE was 12.0m, find the latitude and the PL.

In the above example sextant altitude is to be corrected to get the True altitude as explained earlier.

Sext Alt	60º10.3’	
I.E (off)	+ 2.2’	
Obs Alt	60º12.5’	
Dip (12m)HE	- 6.1’	
App alt	60º06.4’	
Tot.corrn LL	+ 15.4’	
Talt	60º21.8’S	Named same as Azimuth
MZD	**29º38.2’N**	Named opposite to T.Altitude.
Now we have		
MZD	29º38.2’ N	
Decln	05º33.9’ N	
Latitude	**35^{0} 12.1 N**	

The method of obtaining noon position using sextant and celestial bodies demonstrated above is as below:

The SUN is used to take the AM sight. The altitude of the sun should preferably be above 20º-25º. Longitude is calculated using longitude by chronometer method. The fix obtained by using DR latitude and observed longitude is used along with course and distance to obtain the DR position at the time of meridian passage. Using this DR position and the tabulations of the nautical almanac the time of meridian passage is calculated. At the time of meridian passage, sight of the sun is taken to obtain the latitude using the latitude by meridian altitude method. The noon position is calculated using the latitude obtained and DR longitude

8) Method of staggered observations

The way of obtaining Noon Sight is using running fix method by staggered observations obtaining PL by long by chron method or intercept method at AM and then obtaining another PL using latitude by meridian altitude (Lat by Mer Alt) method.

In this example the vessel is on route from San Francisco to Yokohama in the month of July. Vessel’s last fix was Lat. 37° 50’.0 N Long. 122°45’.0 W on 10th at 18h00m. Yokohama Pilot Station position is Lat. 35° 24’.0 N Long. 139° 36’.0 E.

The vessel is presently sailing on a Mercator track steering 268° T and making 16 knots.

The vessel is keeping strict zone time throughout the voyage.

During the 08h00m to 12h00m watch on the 11th at 08h42m ships time, when the chronometer read 4h 40m 20s, an observation of the sun gave a sextant altitude of 29° 43’.2. The chronometer error was 1m 14s slow, index error was 0.5’ on the arc and the height of eye was 14.2m.

The first thing to do is find the actual GMT of the observation

Ships Time = 11d 08h 42m
Zone = + 8h 00m (added because the vessel is in west Long.)
GMT = 11d 16h 42m
Therefore:
Chronometer = 11d 16h 40m 20s
Error = + 1m 14s (added because the error is slow)
GMT = 11d 16h 41m 34s

The next thing to do is calculate the distance sailed since the last fix
Last Fix = 10d 18h 00m
Obs Time = 11d 08h 42m
Interval = 00d 14h 42m or **14.7 hours** (This is time interval)

IMU

Using **Distance = Speed x Time** we get:

Distance	=	16.0 x 14.7
	=	**235.2 nm**

We then use **plane sailing** (because the distance is less than 600 miles) to find the DR position at the time of the observation.

From (10d 18h)	Lat.	37° 50'.0 N	Long.	122° 45'.0 W
Run 268° x 235.2'	D.Lat.	- 8'.2 S	D.Long.	+ 4° 57'.4 W
DR (11d 08h 42m)	Lat.	37° 41'.8 N	Long.	127° 42'.4 W
½ D. Lat.		+ 4'.1		
Mean Latitude Lat.		37° 45'.9 N		

D.Lat is found either from Norie's or by the formula:

D.lat	=	Distance x Cos Course
	=	235.2 x Cos 268°
	=	8.2

Departure is found either from Norie's or by using the formula:

Departure	=	Distance x Sin Course
	=	235.2 x Sin 268°
	=	235.1

D.Long is found using the formula:

$$\text{D.Long} = \frac{\text{Departure}}{\text{Cos Mean Lat.}} = \frac{235.1}{\text{Cos } 37^\circ\ 45'.9} = 297.4' = 4^\circ\ 57.4'$$

Because the course is in the SW quadrant of the compass the D.Lat. is named S and the D.Long. is named W.

We can now calculate the sight using Marc St. Hilaire (Intercept) method

Firstly find the LHA and Declination of the Sun

GHA Sun (11d 16h)	=	058° 38.4'	Dec	=	22° 03.7' N
Increment (41m 34s)	=	+ 10° 23.5'	d (0.3)	=	- 0.2' S
GHA Sun	=	069° 01.9'	Dec	=	22° 03.5' N
Longitude (W so "-")	=	127° 42.4'			
LHA Sun	=	291° 19.5'			

We can now calculate the Zenith Distance using the formula:

Cos CZD = (Cos LHA x Cos Lat x Cos Dec) + (Sin Lat x Sin Dec)

= (Cos 291° 19.5' x Cos 37° 41'.8 x Cos 22° 03.5') + (Sin 37° 41'.8 x Sin 22° 03.5')

= 0.49633

CZD = 60° 14.6'

We can now calculate the True Zenith Distance (TZD) as follows:

Sextant Altitude (SA)	=	29° 43.2'	
Index Error (I.E.)	=	- 0.5'	As this is on the arc it is subtracted
Observed Altitude (OA)	=	29° 42.7'	
Height of Eye (Dip)	=	- 6.6	From Almanac Table – always "-"ve
Apparent Altitude (AA)	=	29° 36.1'	
Total Correction (TC)	=	+ 14.3'	From Almanac Table
True Altitude (TA)	=	29° 50.4'	
True Zenith Distance	**=**	**60° 09.6'**	

We can now find the intercept by comparing the true and calculated zenith distances:

True Zenith Distance (TZD)	=	60° 09.6'
Calculated Zenith Distance (CZD)	=	60° 14.6'
Intercept (Int)	**=**	**5.0' Towards**

We now calculate the bearing of the body using either ABC Formula or ABC Tables in Norie's
Using the formula's we get:

$$A = \frac{\text{Tan Lat.}}{\text{Tan LHA}} = \frac{\text{Tan } 37° \ 41'.8}{\text{Tan } 291° \ 19.5'} = 0.302 \text{ S}$$

$$B = \frac{\text{Tan Dec.}}{\text{Sin LHA}} = \frac{\text{Tan } 22° \ 03.7'}{\text{Sin } 291° \ 19.5'} = 0.435 \text{ N}$$

$$C = A \sim B = 0.435 – 0.302 = 0.133 \text{ N}$$

$$\text{Tan Az} = \frac{1}{(\text{C x Cos Lat.})} = \frac{1}{(0.133 \text{ x Cos} 37° \ 41'.8)} = \text{N } 84.0° \text{ E}$$

Now that we have the Intercept and bearing we can calculate the **Intercept Terminal Position (ITP)** by either formula or using Norie's

From DR 08h 42m	Lat.	37° 41.8' N	Long.	127° 42'.4 W
Plot 084° x 5.0'	D.Lat.	+ 0.5' N	D.Long.	- 6.3' E
ITP	Lat.	37° 42.3' N	Long.	127° 36.1' W
½ D. Lat.		- 0.3'		
Mean Latitude	Lat.	37° 42.0 N		

D.Lat is found either from Norie's or by the formula:

D.lat = Intercept x Cos Azimuth
= 5.0' x Cos 84°
= 0.5'

Departure is found either from Norie's or by using the formula:

Departure = Intercept x Sin Azimuth
= 5.0' x Sin 84°
= 5.0'

D.Long is found using the formula:

$$\text{D.Long} = \frac{\text{Departure}}{\text{Cos Mean Lat.}} = \frac{5.0}{\text{Cos } 37° \ 42.0'} = 6.3'$$

Because the Intercept is Towards and the Azimuth is NE, the D. Lat. is named N and the D. Long is named E.

Latitude by meridian altitude of sun

Now that we have the Intercept terminal point (ITP) for the AM sight we have now to calculate when meridian passage will take place and the DR position of the ship at that time. This is done by double approximation as follows:

We first use the tabulated time on the daily page of the almanac and correct this time for longitude using our present longitude, i.e. the AM ITP longitude.

Calculating the time of meridian altitude of the sun

LMT Meridian Passage (MP)	=	12h 06m	This is the tabulated time
Longitude in Time (LIT)	=	+ 8h 30m	Added because Long. Is W
GMT Meridian Passage	=	20h 36m	
Zone	=	- 8h 00m	Subtracted because Zone is W
Ships time MP	**=**	**12h 36m**	

We now use the time of 12h 36m to run up the AM ITP to find the MP DR position

Time Run = Noon Time – AM Sight Time
= 12h 36m – 08h 42m
= 3h 54m or 3.9h

Distance Run = Speed x Time

= 16 x 3.9
= 62.4 nm

From ITP	Lat.	37° 42.3' N	Long.	127° 36.1 W
Run 268° x 62.4'	D.Lat.	+ 2.2' N	D.Long.	+ 1° 18.9' W
Noon DR	Lat.	37° 44.5' N	Long.	128° 55.0' W
½ D. Lat.		- 1.1'		
Mean Latitude Lat.	37° 43.4' N			

D.Lat is found either from Norie's or by the formula:

D.lat = Distance x Cos Course
= 62.4 x Cos 268°
= 2.2

Departure is found either from Norie's or by using the formula:

Departure = Distance x Sin Course
= 62.4 x Sin 268°
= 62.4

D.Long is found using the formula:

D.Long = $\frac{\text{Departure}}{\text{Cos Mean Lat.}}$
= $\frac{62.4}{\text{Cos } 37° 43.4'}$
= 78.9'
= 1° 18.9'

Using this first Noon DR we calculate again the time when MP will occur thus:

LMT Meridian Passage (MP)	=	12h 06m	This is the tabulated time
Longitude in Time (LIT)	=	8h 36m +	Added because Long. Is W
GMT Meridian Passage	=	20h 42m	
Zone	=	8h 00m -	Subtracted because Zone is W
Ships Time MP	=	12h 42m	

Using this new time we again calculate the DR position for meridian passage.

Time Run = Noon Time – AM Sight Time
= 12h 42m – 08h 42m
= 4h 00m

Distance Run = Speed x Time
= 16 x 4
= 64 nm

From ITP	Lat.	37° 42.3' N	Long.	127° 36.1 W
Run 268° x 64' D.Lat.		- 2.2' S	D.Long.	+ 1° 20.9' W
Noon DR	Lat.	37° 40.1' N	Long.	128° 57.0' W
½ D. Lat.		+ 1.1'		
Mean Latitude Lat.	37° 41.2' N			

D.Lat is found either from Norie's or by the formula:

D.lat = Distance x Cos Course
= 64 x Cos 268°
= 2.2

Departure is found either from Norie's or by using the formula:

Departure = Distance x Sin Course
= 64 x Sin 268°
= 64

D.Long is found using the formula:

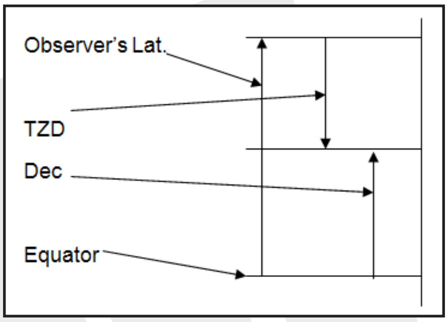
D.Long = $\frac{\text{Departure}}{\text{Cos Mean Lat.}}$
= $\frac{64.0}{\text{Cos } 37° 41.2'}$
= 80.9'
= 1° 20.9'

We now have an accurate time and DR for the observation of the sun on the meridian (meridian passage) and shortly before this time we will be on the bridge wing observing the altitude with the sextant. As soon as the altitude starts decreasing we note the time and the sextant angle. We can then calculate the Latitude at that instant and by running up the AM sight position line we can find a fix for the time of the noon observation.
The first thing to do is find the declination, True altitude and then TZD for the time of observation.

Sextant altitude observed 74° 16.6’ at 20h 42m 05s

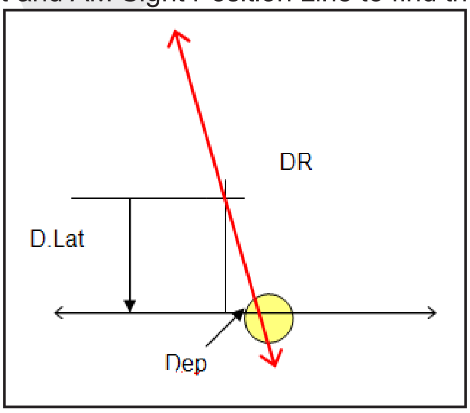
Dec	=	22° 02.4’ N
d (0.3)	=	- 0.2’ S
Dec	=	22° 02.2’ N
SA	=	74° 16.6’
IE	=	- 0.5’
OA	=	74° 16.1’
Dip	=	- 6.6’
AA	=	74° 09.5’
TC	=	+ 15.7’
TA	=	74° 25.2’
90°	=	90° 00.0’
TZD	=	15° 34.8’

Using the TZD and Declination we can calculate the Latitude. We know the DR Latitude is 37° 40.1’ N, therefore the Sun is to the South of the observer. Therefore using a simple diagram we can see that TZD + Dec = Lat as follows:



TZD	=	15° 34.8’
Dec	=	22° 02.2’
Lat.	**=**	**37° 37.0’ N**

We can now plot the Noon Lat and AM Sight Position Line to find the Noon Fix:



Comparing the DR and Observed Lat we get the D.Lat

DR Lat	=	37° 40.1’ N
Obs Lat	=	37° 37.0’ N
D.Lat	=	3.1’ S

We can then use the D.Lat to calculate the Departure (Dep) with the formula:

Departure = $\dfrac{\text{D.lat.}}{\text{Tan Az}}$ (**This is the AM sight Azimuth**)

	=	$\dfrac{3.1}{\text{Tan } 84.0°}$		
	=	0.3’		
D.Long	=	$\dfrac{\text{Dep.}}{\text{Cos Noon Lat.}}$		
	=	$\dfrac{0.3}{\text{Cos } 37° \ 37.0’}$		
	=	0.4’		

We can then apply this D. Long to the Noon D.R. Long and we have the Noon Fix

Noon D.R.			Long.	127° 57.0 W
Plot			D. Long	+ 0.4’ E
Noon FIX	**Lat.**	**37° 37.0’ N**	**Long.**	**128° 56.6’ W**

9) Simultaneous observations using sight reduction tables for air navigation

For practical approach, we would proceed from where we had obtained the NOON fix, Lat. 37° 37.0’ N Long. 128° 56.6’ W of the same day i.e. 11th of July, mentioned on the previous page and then move towards simultaneous observations of the stars in the evening twilight.

Calculating time of evening twilight using the nautical almanac

In order to prepare for taking evening stars we must calculate the time of evening civil twilight which is done as follows.

First of all a DR position for twilight is calculated using double approximation (the same as for meridian passage)

We first use the tabulated time on the daily page of the almanac and correct this time for longitude using our present longitude, i.e. the Noon Fix longitude.

		10th July	11th July	12th July
Lat 40° N	=	20h 02m 00s	20h 01m 40s	20h 01m 00s
Lat 37° 37.0’ N	=		**19h 53m 32s**	
Lat 35° N	=	19h 45m 00s	19h 44m 40s	19h 44m 00s

LMT Civil Twilight	=	11d 19h 54m	This is the tabulated time
Longitude in Time (LIT)	=	+ 8h 36m	Added as Long is W
GMT Civil Twilight	=	12d 04h 30m	
Zone	=	- 8h 00m	Subtracted as Zone is W
Ships Time Civil Twilight	**=**	**11d 20h 30m**	

We now use the time of 20h 30m to run up the Noon Fix to find the PM DR position

Time Run	=	PM Twilight Time – Noon Fix Time
	=	20h 30m – 12h 42m
	=	7h 48m or 7.8h
Distance Run	=	Speed x Time
	=	16.5 x 7.8
	=	128.7 nm

From Noon	Lat.	37° 37.0’ N	Long.	128° 56.6 W
Run 294° x 128.7’	D. Lat.	+ 52.3’ N	D. Long.	+ 2° 29.3’ W
Noon DR	Lat.	38° 29.3’ N	Long.	131° 25.9’ W
½ D. Lat.		- 26.2’		
Mean Latitude Lat.		38° 03.1’ N		

D. Lat is found either from Norie’s or by the formula:

D.lat	=	Distance x Cos Course
	=	128.7 x Cos 294°
	=	52.3

Departure is found either from Norie’s or by using the formula:

Departure	=	Distance x Sin Course
	=	128.7 x Sin 294°

= 117.6

D. Long is found using the formula:

D. Long = Departure / Cos Mean Lat.

= 117.6 / Cos 38° 03.1’

= 149.3’

= 1° 18.9’

Using this first Twilight DR we calculate again the time when MP will occur thus:

		10th	11th	12th
Lat 40° N	=	20h 02m 00s	20h 01m 40s	20h 01m 00s
Lat 38° 29.3’ N	=		**19h 56m 32s**	
Lat 35° N	=	19h 45m 00s	19h 44m 40s	19h 44m 00s

LMT Civil Twilight	=	11d 19h 57m	This is the tabulated time
Longitude in Time (LIT)	=	+ 8h 46m	Added Long. Is W
GMT Civil Twilight	=	12d 04h 43m	
Zone	=	- 8h 00m	Subtracted Zone is W
Ships Time Civil Twilight	**=**	**11d 20h 43m**	

Using this new time we again calculate the DR position for meridian passage.

Time Run = PM Twilight Time – Noon Fix Time

= 20h 43m – 12h 42m

= 8h 01m or 8.0h

Distance Run = Speed x Time

= 16.5 x 8

= 132 nm

From Noon	Lat.	37° 37.0’ N	Long.	128° 56.6 W
Run 294° x 132’	D. Lat.	53.7’ N	D. Long.	2° 33.2’ W
PM Twilight DR	Lat.	38° 30.7’ N	Long.	131° 25.9’ W
½ D. Lat.		26.9’		
Mean Latitude Lat.		38° 03.8’ N		

D. Lat is found either from Norie’s or by the formula:

D.lat = Distance x Cos Course

= 132 x Cos 294°

= 53.7

Departure is found either from Norie’s or by using the formula:

Departure = Distance x Sin Course

= 132 x Sin 294°

= 120.6

D. Long is found using the formula:

D. Long = Departure / Cos Mean Lat.

= 120.6 / Cos 38° 03.8’

= 153.2’

= 2° 33.2’

Now that we have an accurate DR and time for the start of twilight we calculate the LHA of Aries and then choose the stars that we will use

HA Aries (12d 04h)	=	349° 56.4’
Increment (42m 32s)	=	10° 39.7’
GHA Aries	=	360° 36.1’
Longitude (W so “-“)	=	131° 25.9’
LHA Aries	=	229° 10.2’

IMU

Using the DR Latitude 38° 30.7’ N and LHA Aries we can inspect the Sight Reduction tables for Air Navigation and choose which stars we will use

Excerpt from Sight Reduction tables for Air Navigation

LAT 39°N

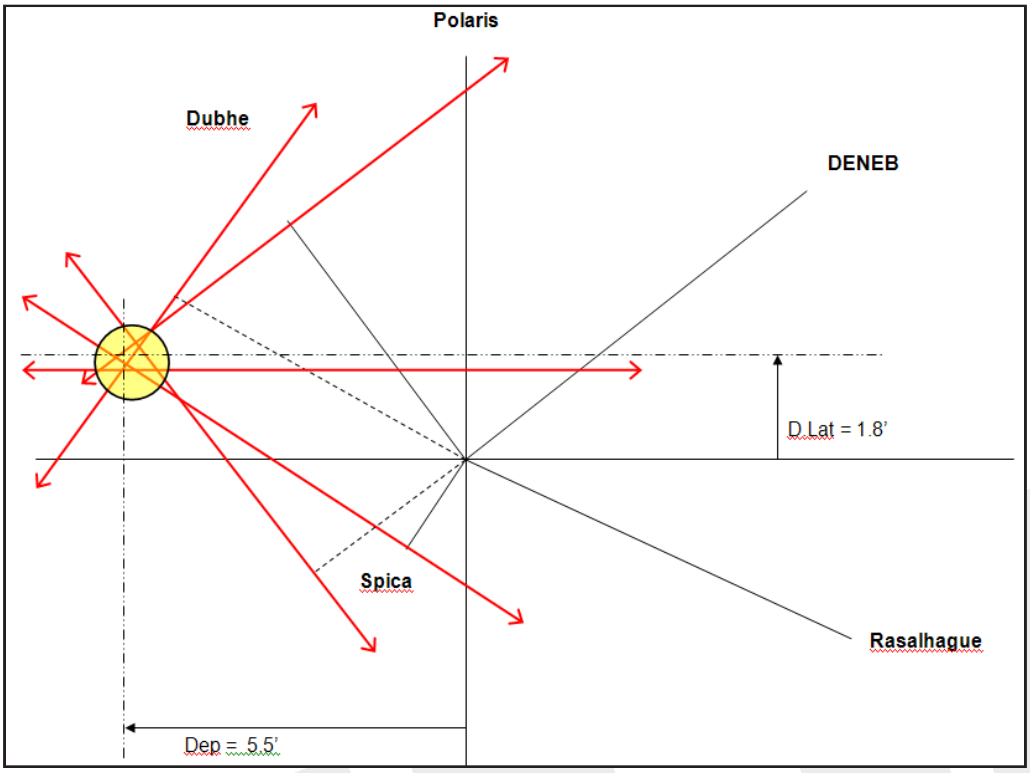
LHA ♈	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn
	◆VEGA		Alphecca		ARCTURUS		◆SPICA		REGULUS		◆POLLUX		CAPELLA	
180	17 15	054	43 55	089	54 37	114	36 00	154	53 22	230	36 55	278	20 37	313
181	17 53	054	44 41	089	55 19	115	36 21	155	52 46	231	36 09	279	20 03	314
182	18 31	055	45 28	090	56 01	116	36 40	156	52 10	233	35 23	280	19 30	314
183	19 09	055	46 15	091	56 43	118	36 58	157	51 32	234	34 37	280	18 56	314
184	19 47	056	47 01	091	57 24	119	37 16	158	50 54	235	33 51	281	18 23	315
185	20 26	056	47 48	092	58 05	120	37 33	160	50 16	236	33 05	281	17 50	315
186	21 05	057	48 34	093	58 45	121	37 49	161	49 37	237	32 20	282	17 18	316
187	21 44	057	49 21	093	59 24	123	38 03	162	48 58	238	31 34	282	16 45	316
188	22 23	057	50 07	094	60 03	124	38 17	163	48 18	239	30 49	283	16 13	317
189	23 02	058	50 54	095	60 41	125	38 30	164	47 37	240	30 03	283	15 41	317
190	23 42	058	51 40	095	61 19	127	38 42	166	46 57	242	29 18	284	15 10	318
191	24 22	059	52 27	096	61 56	128	38 53	167	46 15	243	28 33	284	14 39	318
192	25 02	059	53 13	097	62 32	130	39 04	168	45 34	244	27 48	285	14 08	319
193	25 42	060	53 59	098	63 07	132	39 13	169	44 52	245	27 03	285	13 37	319
194	26 22	060	54 46	098	63 42	133	39 21	171	44 10	245	26 18	286	13 07	320
	DENEB		◆VEGA		Alphecca		◆SPICA		REGULUS		◆POLLUX		Dubhe	
195	12 17	041	27 03	061	55 32	099	39 28	172	43 27	246	25 33	286	61 12	332
196	12 48	041	27 43	061	56 18	100	39 34	173	42 44	247	24 48	287	60 49	331
197	13 19	042	28 24	061	57 04	101	39 39	174	42 01	248	24 04	287	60 26	330
198	13 50	042	29 05	062	57 49	102	39 43	176	41 18	249	23 19	288	60 03	330
199	14 21	043	29 46	062	58 35	103	39 46	177	40 34	250	22 35	289	59 39	329
200	14 53	043	30 28	063	59 20	103	39 48	178	39 50	251	21 51	289	59 15	329
201	15 25	043	31 09	063	60 06	104	39 49	180	39 06	252	21 07	290	58 51	328
202	15 57	044	31 51	064	60 51	105	39 49	181	38 21	252	20 23	290	58 26	328
203	16 29	044	32 33	064	61 36	106	39 47	182	37 37	253	19 39	291	58 01	327
204	17 02	045	33 15	064	62 20	107	39 45	183	36 52	254	18 56	291	57 36	327
205	17 35	045	33 57	065	63 04	109	39 42	185	36 07	255	18 12	292	57 11	327
206	18 08	046	34 39	065	63 49	110	39 38	186	35 22	256	17 29	292	56 45	326
207	18 42	046	35 21	066	64 32	111	39 32	187	34 37	256	16 46	293	56 19	326
208	19 16	047	36 04	066	65 16	112	39 26	188	33 52	257	16 03	293	55 53	326
209	19 50	047	36 46	066	65 59	113	39 19	190	33 06	258	15 20	294	55 26	325
	DENEB		◆VEGA		Rasalhague		ANTARES		◆SPICA		REGULUS		◆Dubhe	
210	20 24	048	37 29	067	35 48	104	15 48	146	39 10	191	32 20	259	55 00	325
211	20 59	048	38 12	067	36 33	105	16 14	146	39 01	192	31 35	259	54 33	325
212	21 33	048	38 55	068	37 18	105	16 40	147	38 51	193	30 49	260	54 06	324
213	22 08	049	39 38	068	38 03	106	17 05	148	38 39	195	30 03	261	53 39	324
214	22 44	049	40 22	068	38 48	107	17 29	149	38 27	196	29 17	261	53 11	324
215	23 19	050	41 05	069	39 32	108	17 53	150	38 14	197	28 31	262	52 44	324
216	23 55	050	41 48	069	40 16	109	18 16	151	37 59	198	27 44	263	52 16	324
217	24 31	051	42 32	069	41 00	109	18 39	151	37 44	200	26 58	263	51 49	323
218	25 07	051	43 16	070	41 44	110	19 01	152	37 28	201	26 12	264	51 21	323
219	25 43	051	44 00	070	42 28	111	19 22	153	37 11	202	25 25	265	50 53	323
220	26 20	052	44 44	071	43 11	112	19 43	154	36 54	203	24 39	265	50 25	323
221	26 56	052	45 28	071	43 54	113	20 03	155	36 35	204	23 52	266	49 57	323
222	27 33	052	46 12	071	44 37	114	20 23	156	36 15	205	23 06	267	49 29	323
223	28 10	053	46 56	072	45 20	115	20 41	157	35 55	207	22 19	267	49 00	323
224	28 48	053	47 40	072	46 02	116	21 00	158	35 34	208	21 33	268	48 32	323
	DENEB		◆ALTAIR		Rasalhague		ANTARES		◆SPICA		Denebola		◆Dubhe	
225	29 25	054	18 57	094	46 43	117	21 17	158	35 12	209	41 39	253	48 04	323
226	30 03	054	19 44	095	47 25	118	21 34	159	34 49	210	40 54	254	47 35	323
227	30 40	054	20 30	095	48 06	119	21 50	160	34 25	211	40 09	255	47 07	322
228	31 18	055	21 16	096	48 46	120	22 05	161	34 01	212	39 24	256	46 39	322
229	31 56	055	22 03	097	49 27	121	22 20	162	33 36	213	38 39	256	46 10	322
230	32 35	055	22 49	097	50 06	122	22 34	163	33 10	214	37 54	257	45 42	322
231	33 13	056	23 35	098	50 46	123	22 47	164	32 43	215	37 08	258	45 13	322
232	33 52	056	24 22	099	51 24	124	22 59	165	32 16	216	36 22	259	44 45	322
233	34 31	056	25 08	099	52 02	126	23 11	166	31 48	217	35 37	259	44 17	322
234	35 10	057	25 54	100	52 40	127	23 22	167	31 20	218	34 51	260	43 48	323
235	35 49	057	26 39	101	53 17	128	23 32	168	30 50	219	34 05	261	43 20	323
236	36 28	057	27 25	101	53 53	129	23 41	169	30 21	220	33 19	262	42 52	323
237	37 07	058	28 11	102	54 29	131	23 50	170	29 50	221	32 32	262	42 23	323
238	37 47	058	28 56	103	55 04	132	23 58	171	29 19	222	31 46	263	41 55	323
239	38 26	058	29 42	103	55 38	134	24 05	172	28 48	223	31 00	264	41 27	323

Because of their altitude, magnitude and the angle between them the best 4 stars will be DENEB, Rasalhague, SPICA, and Dubhe and this is the order that they will be taken in. The observations were made and the following times and sextant altitudes were obtained.

Star	Time (GMT)	Sextant Altitude
DENEB	12d 04h 45m 12s	32° 23.7’
Rasalhague	12d 04h 46m 36s	50° 45.7’
SPICA	12d 04h 48m 21s	33° 25.5’
Dubhe	12d 04h 49m 02s	44° 56.3’
Polaris	12d 04h 50m 42s	37° 52.9’

The table on the next page shows the results of the Marc St. Hilaire calculations and the page after that the plot of the intercepts and bearings.
Because the time between the sights was relatively small the same DR position was used for each sight

BODY	DENEB	RASALHAGUE	SPICA	DUBHE		POLARIS
TIME GMT	12d 04h 45m 12s	12d 04h 46m 36s	12d 04h 48m 21s	12d 04h 49m 02s		12d 04h 50m 42s
HA Aries	349° 56.4’	349° 56.4’	349° 56.4’	349° 56.4’		349° 56.4’
INCR	11° 19.9’	11° 40.9’	12° 07.2’	12° 17.5’		12° 42.6’
GHA	361° 16.3’	361° 37.3’	362° 03.6’	362° 13.9’		362° 39.0’
SHA	49° 49.4’	96° 31.3’	158° 59.8’	194° 25.3’		
GHA	411° 05.7’	458° 08.6’	521° 03.4’	556° 39.2’		
LONG	131° 25.9’	131° 25.9’	131° 25.9’	131° 25.9’		131° 25.9’
LHA	279° 39.8’	326° 42.7’	029° 37.5’	065° 13.3’		231° 13.1’
DEC						
d						
DEC	45° 12.1’ N	12°34.8’ N	11°02.7’ S	61° 52.5’ N		
					SA	37° 52.9’
SA	32° 23.7’	50° 45.7’	33° 25.5’	44° 56.3’	IE	-0.5’
IE	-0.5’	-0.5’	-0.5’	-0.5’	OA	37° 52.4’
OA	32° 23.2’	50° 45.2’	33° 25.0’	44° 55.8’	DIP	-6.6’
DIP	-6.6’	-6.6’	-6.6’	-6.6’	AA	37° 45.8’
AA	32° 16.6’	50° 38.6’	33° 18.4’	44° 49.2	TC	-1.4’
TC	-1.5’	-0.8’	-1.5’	-1.0’	TA	37° 44.4’
TA	32° 15.1’	50° 37.8’	33° 16.9’	44° 48.2’	-1°	36° 44.4’
90					A0	1° 46.6’
TZD	57° 44.9’	39° 22.2’	56° 43.1’	45° 11.8’	A1	0.6’
CZD	57° 41.8’	39° 17.1’	56° 45.0’	45° 16.3’	A2	0.9’
INT	**3.1 A**	**5.1 A**	**1.9 T**	**4.5 T**		38° 32.5’
A	0.14 S	1.21 S	1.40 S	0.37 S		
B	1.02 N	0.41 N	0.39 S	2.06 N		
C	0.88 N	0.80 S	1.79 S	1.69 N		
Az	N 55.5° E	S 58.0° E	S 35.5° W	N 37.0° W		
Brg	**055.5°**	**122.0°**	**215.5°**	**323.0°**		**000.4°**



We can now calculate the fix position

From DR 20h 43m	Lat.	38° 30.7' N	Long.	131° 25.9' W
Plot	D.Lat.	+ 1.8' N	D.Long.	+ 7.0' W
PM Fix 20h 48m	**Lat.**	**38° 32.5' N**	**Long.**	**131° 32.9' W**
½ D. Lat.		- 0.9'		
Mean Latitude Lat.		38° 31.6' N		

Note the time of the fix is taken as the mean time of the observations

D. Long is found using the formula:

$$\text{D. Long} = \frac{\text{Departure}}{\text{Cos Mean Lat.}}$$

$$= \frac{5.5}{\text{Cos } 38° \, 31.6'}$$

$$= 7.0'$$

It would then be normal to calculate the speed made good from the noon fix to this fix.

Before the next AM sight an azimuth will be calculated for a star or planet during each watch to calculate and check the compass error as would have been done each watch during the day that the above work was carried out. However observation of the bearing of the sun during the AM sight and one of the bodies during the evening star sight would have saved extra working.

Some important points to remember for the purpose of position fixing when observing stars.

- The sight should be taken during the civil twilight hours in the morning and evening. The reason being the bright stars are available for observation through the sextant and the horizon is also clearly visible.
- More than 3 stars are observed having an azimuth difference of about 45º-60º. The stars available can be found out using the star finder as described in the earlier task or using the sight reduction tables as described and demonstrated in this task above.
- Using the intercept method, the intercept of each star is calculated and positions line drawn through that intercept.

- The intersection of these position lines will give the position of the vessel. Normally a cocked hat is obtained and this is reduced to obtain the ships position.
- If the time interval between the celestial observations is considerably high, then the three PL so obtained will need to be walked back applying run for the duration lapsed between observations.

Apply Your Knowledge

1. Work out a sight using meridian altitude of sun.
2. Work out a sight using Polaris.
3. Practice celestial observations (sights) using Sun and obtain position lines and positions. Use “Intercept” or “Longitude by chronometer” method.
4. Practice celestial observations (sights) using stars and obtain position lines and positions. Use “Intercept” or “Longitude by chronometer” method.

I M U

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task number: A 1.1

Sub-task Reference number: A1.1.9

Topic: Celestial navigation

Task Heading

- Calculate times of sunset, sunrise and twilight using the Nautical Almanac.

Objectives

- Understand phenomenon of twilight and calculate time of sunrise/ sunset and twilight.

Index

1) Twilight
2) Twilight all night
3) Sunrise and sunset
4) Nautical almanac and time of sunset / sunrise / twilight

Description

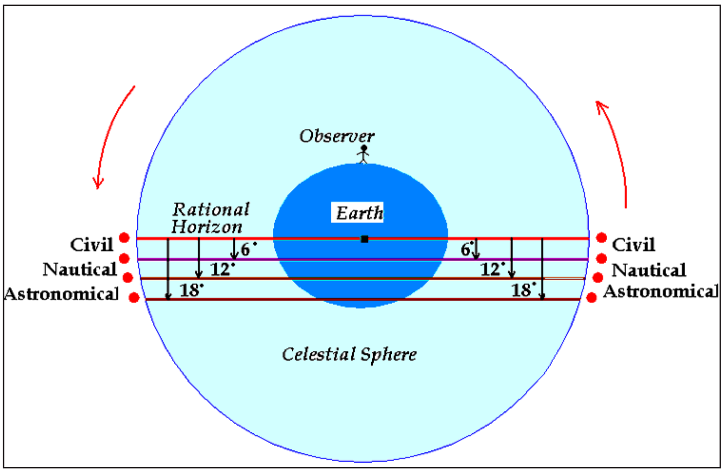
1) Twilight

Twilight period is the period before sunrise and after sunset during which light is received from the sun, the sun being below the horizon. Though the sun is below the horizon, it illuminates the upper layers of the atmosphere. A part of this light is reflected and scattered in various directions. This scattered light illuminates the earth's surface for some time before sunrise and after sunset.

Twilight continues till the sun is 18° vertically below the horizon. Following that there is total darkness. In the morning, twilight commences when the sun is 18° vertically below the horizon and ceases at sunrise. The entire period of twilight is divided into three stages, civil, nautical and astronomical.

In the mornings, astronomical twilight commences when the sun's centre is 18° below the rational horizon. Nautical twilight begins when the sun is 12° below the rational horizon and the civil twilight commences when it is 6° below the rational horizon. Each of them lasts until the visible horizon i.e. when the sun's upper limb appears over the visible horizon.

In the evening twilight commences at the visible sunset i.e. when the sun's upper limb disappears on the visible horizon. Civil twilight continues till the sun's centre is 6° below the rational horizon, nautical twilight till it is 12° below and astronomical twilight till it is 18° below the rational horizon.



Duration of twilight observed on earth, varies with the latitude of the observer. As the latitude increases the duration of twilight also increases.

2) Twilight all night

An observer on earth can experience twilight all night, provided the sun should not go more than 18° below his rational horizon.

For having civil twilight all night, Latitude + Declination $\geq$ 84°

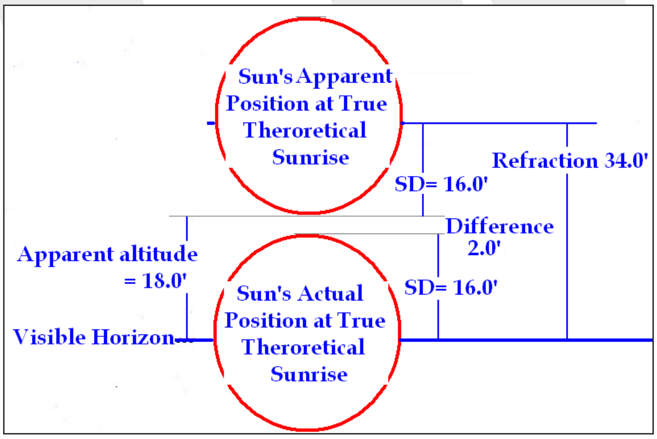
For having nautical twilight all night, Latitude + Declination $\geq$ 78°

Further, for having twilight all night, observer should be in latitude of same name as declination of the sun.

3) Sunrise and sunset

The timings shown in nautical almanac are for visible sunrise/ sunset; that is when upper limb of sun is at visible horizon during sunrise/ sunset when seen from sea level.

However, for the purpose of nautical calculations, sunrise/ sunset time is the time when the sun's centre is at the observer's rational horizon. Visibly this occurs when the sun's lower limb is one semi diameter above the visible horizon. The reason for this occurrence is the refraction experienced by the sun, which allows sun to be visible above horizon when it is still below the observer's rational horizon. This is the time when amplitude of the sun is obtained.



Midnight sun is a similar phenomenon as twilight all night, observed in high latitudes where the sun is continuously observed above the horizon.

UT (GMT) d	h	SUN G.H.A. ° ′	Dec. ° ′
12	00	183 22.0	S 7 24.6
	01	198 22.1	25.5
	02	213 22.3	26.4
	03	228 22.5	. . 27.4
	04	243 22.6	28.3
	05	258 22.8	29.3
	06	273 22.9	S 7 30.2
	07	288 23.1	31.1
	08	303 23.2	32.1
MONDAY	09	318 23.4	. . 33.0
	10	333 23.5	33.9
	11	348 23.7	34.9
	12	3 23.9	S 7 35.8
	13	18 24.0	36.8
	14	33 24.2	37.7
	15	48 24.3	. . 38.6
	16	63 24.5	39.6
	17	78 24.6	40.5
	18	93 24.8	S 7 41.4
	19	108 24.9	42.4
	20	123 25.1	43.3
	21	138 25.2	. . 44.2
	22	153 25.4	45.2
	23	168 25.5	46.1
13	00	183 25.7	S 7 47.0
	01	198 25.8	48.0
	02	213 26.0	48.9
	03	228 26.1	. . 49.8
	04	243 26.3	50.8
	05	258 26.4	51.7
	06	273 26.6	S 7 52.6
	07	288 26.7	53.6
TUESDAY	08	303 26.9	54.5
	09	318 27.0	. . 55.4
	10	333 27.2	56.4
	11	348 27.3	57.3
	12	3 27.5	S 7 58.2
	13	18 27.6	7 59.2
	14	33 27.8	8 00.1
	15	48 27.9	. . 01.0
	16	63 28.1	02.0
	17	78 28.2	02.9
	18	93 28.4	S 8 03.8
	19	108 28.5	04.8
	20	123 28.7	05.7
	21	138 28.8	. . 06.6
	22	153 29.0	07.5
	23	168 29.1	08.5
14	00	183 29.2	S 8 09.4
	01	198 29.4	10.3
	02	213 29.5	11.3
	03	228 29.7	. . 12.2
	04	243 29.8	13.1
	05	258 30.0	14.1
	06	273 30.1	S 8 15.0
WEDNESDAY	07	288 30.3	15.9
	08	303 30.4	16.8
	09	318 30.6	. . 17.8
	10	333 30.7	18.7
	11	348 30.8	19.6
	12	3 31.0	S 8 20.6
	13	18 31.1	21.5
	14	33 31.3	22.4
	15	48 31.4	. . 23.3
	16	63 31.5	24.3
	17	78 31.7	25.2

Lat. °	Twilight Naut. h m	Twilight Civil h m	Sunrise h m
N 72	04 47	06 06	07 15
N 70	04 52	06 03	07 05
68	04 56	06 00	06 57
66	04 59	05 58	06 50
64	05 01	05 56	06 44
62	05 03	05 54	06 39
60	05 05	05 53	06 35
N 58	05 06	05 51	06 31
56	05 07	05 50	06 27
54	05 08	05 49	06 24
52	05 08	05 48	06 22
50	05 09	05 46	06 19
45	05 10	05 44	06 13
N 40	05 10	05 41	06 08
35	05 10	05 39	06 04
30	05 09	05 37	06 01
20	05 06	05 32	05 54
N 10	05 03	05 27	05 48
0	04 58	05 22	05 43
S 10	04 51	05 16	05 37
20	04 43	05 09	05 31
30	04 31	05 00	05 24
35	04 24	04 54	05 20
40	04 15	04 47	05 15
45	04 03	04 39	05 10
S 50	03 49	04 30	05 03
52	03 42	04 25	05 00
54	03 34	04 20	04 57
56	03 25	04 14	04 53
58	03 14	04 07	04 49
S 60	03 02	03 59	04 44

Lat. °	Sunset h m	Twilight Civil h m	Twilight Naut. h m
N 72	16 15	17 25	18 42
N 70	16 25	17 28	18 38
68	16 34	17 30	18 34
66	16 41	17 33	18 32
64	16 47	17 35	18 30
62	16 52	17 37	18 28
60	16 56	17 38	18 26
N 58	17 00	17 40	18 25
56	17 04	17 41	18 24
54	17 07	17 43	18 23
52	17 10	17 44	18 23
50	17 13	17 45	18 22
45	17 18	17 48	18 22
N 40	17 23	17 50	18 22
35	17 27	17 53	18 22
30	17 31	17 55	18 23
20	17 38	18 00	18 26
N 10	17 44	18 05	18 30
0	17 49	18 10	18 35
S 10	17 55	18 16	18 41
20	18 02	18 24	18 50
30	18 09	18 33	19 02
35	18 13	18 39	19 09
40	18 18	18 46	19 19
45	18 24	18 54	19 30
S 50	18 30	19 04	19 45
52	18 34	19 09	19 52
54	18 37	19 14	20 00
56	18 41	19 20	20 10
58	18 45	19 27	20 21
S 60	18 50	19 35	20 33

4) Nautical almanac and time of sunset / sunrise / twilight

Nautical almanac lists the timing for beginning of nautical and civil twilights in the morning and those of the end of Civil and Nautical twilights in the evening. The data is listed for a group of three days corresponding to the middle day. Each of the above is given for a range of latitudes from 72° N to 60° S. All timing given are for the phenomenon over Greenwich Meridian, hence the GMT. However these times can be used as the LMT in any longitude without appreciable error. Interpolation is however necessary for latitude and for the required date.

Further these tables use three symbols. White box indicates that sun or moon will be above horizon, the black box indicates that they do not rise and the strokes indicate that twilight lasts all night.

Example: Find the SMT of Sunrise for an observer in Latitude 47°12’S Longitude 56° 30’W on 14th (Zone +03).

In latitude 45° S LMT Sunrise		14d 05h 10m
In latitude 50° S LMT Sunrise		14d05h 03m
For latitude 47° 12’S LMT Sunrise		
(By interpolation)		14d05h 07m
LIT (W)	+	03h 46m (Converting Arc to time)
GMT Sunrise		14d08h 53m
Zone (+ 03)	-	03h 00m
In 47°12’S 56° 30’W SMT Sunrise		
		14d 05h 53m

Example: For an observer in position 07°49.2’N 177°25.2’E, Calculate the time of sunset on observer’s position on 14th (Zone - 12).

In latitude 07°49.2’NLMT Sunset		14d 17h 45m05s
LIT (E)	-	11h 49m41s
GMT Sunset		14d05h 55m24s
Zone (- 12)	+	12h 00m
In 47°12’S 56°30’W SMT Sunset		14d17h 55m 24s

Apply Your Knowledge

1. Practice calculating time of Sunrise and Sunset and the time for nautical twilight for stellar observations
2. Refer to the nautical almanac for the year and mention the dates during the year when there will be no sunrise in latitude 70° N. Discuss the reasons for the same.

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task number: A 1.2

Sub-task Reference number: A1.2.6

Topic: Terrestrial and coastal navigation

Task Heading

- Practice position fixing using three simultaneous observations, with various combinations of visual bearings, radar bearings and radar ranges of conspicuous objects.

Objectives

- Understand procedures of position fixing by means of terrestrial fixes.

Please read this task in conjunction with other tasks under header A1.2

Index

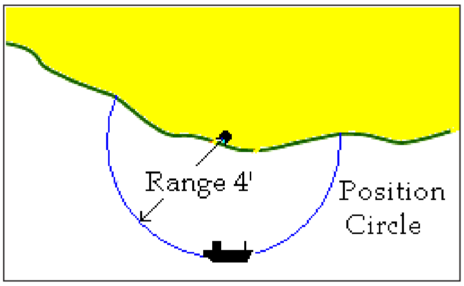
Description

1) Position fixing by terrestrial observations

Shore based objects are used for position fixing while navigating in the coastal areas.

Plotting position with reference to Floating aids to navigation shall be done with extreme caution as these are likely to set adrift.

- A position line (P/L) is the segment of a line on earth's surface on which the vessel is lying at the time of observation. This is drawn as a line in the direction with reference to an object in a known position.

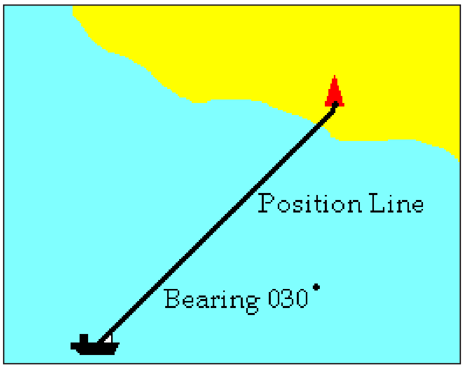


- A position circle is the periphery of a circle on earth's surface on which the vessel is lying at the time of observation. This is drawn as a circle with reference to an object in a known position, the object being at the centre of the circle and the radius of the circle equal to the distance between the vessel and the object.

a) Means to obtain a position line

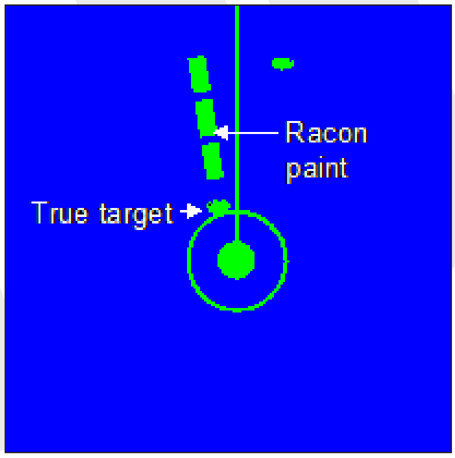
i.Position line by visual bearing of terrestrial object

Visual bearing of the terrestrial object is taken using the azimuth circle. The bearing so read is the compass bearing, which shall be corrected for the compass error for getting the true bearing. This true bearing line is drawn on the chart in the reciprocal direction starting from the shore object. The line drawn is the position line for the vessel at the time of observation. Prior drawing a position line, the object selected shall be positively identified. Coast lines or corners shall NOT be used as there visible position is likely to with the level of tides.



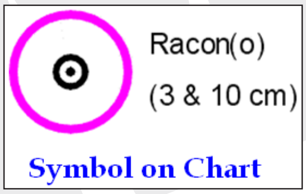
ii.Position line by transit bearing

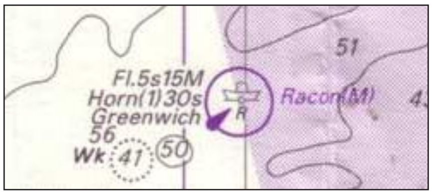
Sometimes two shore based objects are placed ashore in a line. These are meant to be observed when seen in a line. The direction of their alignment is mentioned on the chart. Seeing the two objects in a line, means the vessel is on the same position line which can be drawn from the objects leading towards sea.



iii.Position line by radar bearing

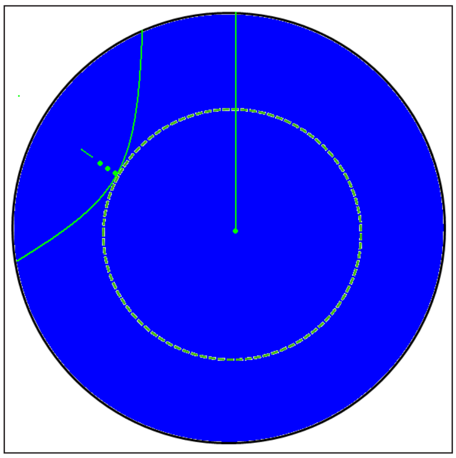
Targets observed on radar may also be used for obtaining a position line. These could be point objects such as small islands observed from a distance or radar beacons with positive identification code.





iv.Position line using a radio navigation aid

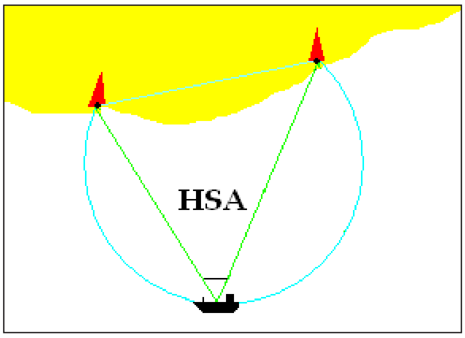
Radio navigational instruments such as LORAN, DECCA, OMEGA and Direction Finder were used to determine the position of the vessel. For LORAN, Decca and OMEGA navigational charts had special lattices drawn on them facilitating position fixing. Using a Direction Finder allows the navigator to obtain a position line from a fixed radio station marked on the chart.



b) Means to obtain a position circle

i.Position circle by radar range

Range of a shore target can be checked using radar Variable Range Marker (VRM) or range rings. The closest edge of the radar echo shall be taken as the correct range. Point

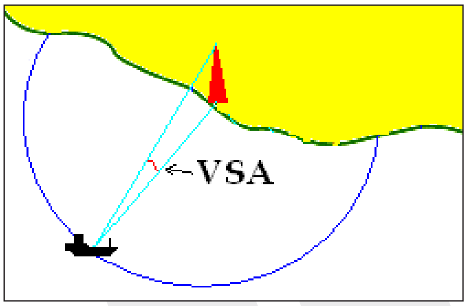


objects positively identified shall be used for taking such observations. Caution shall be exercised while using coastlines for range as the same are likely to vary with tidal levels and the echo painted is also dependent on the reflective properties surface.

ii.Position circle by horizontal sextant angle (HSA)

A position circle can be drawn using the angular separation between two prominent shore structures measured using sextant. The angle is visually observed and corrected for index error of sextant.

iii.Position circle by vertical sextant angle (VSA)



Vertical sextant angle of a terrestrial object is measured using a sextant, the range from the object is determined by calculations and a position circle is drawn.

The range can be calculated by the formula

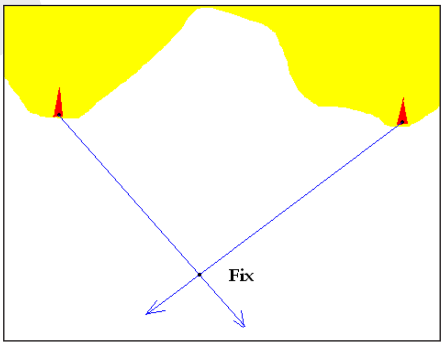
Distance = Height of Object (m) X 1.854 / Observed Alt (VSA in minutes)

iv.Position circle by raising and dipping of lights/ structures

Reference shall be made to task A 1.2.2 for determining ranges by raising and dipping of lights. The point that needs to be remembered while using raising or dipping of lights for range estimation, the ranges obtained from luminous range diagram will be approximate only, as exact assessment of visibility is not possible. Hence positions circles, and thus positions, obtained by this method are approximate only.

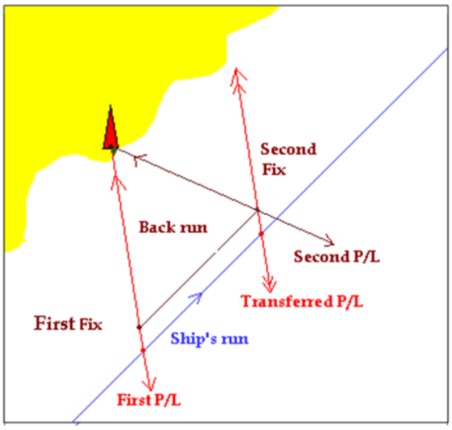
2) Position fixing

- To plot vessel's position any of the following combinations are required:
- ❖ At least two position lines
- ❖ At least two position circles
- ❖ At least one position line and one position circle

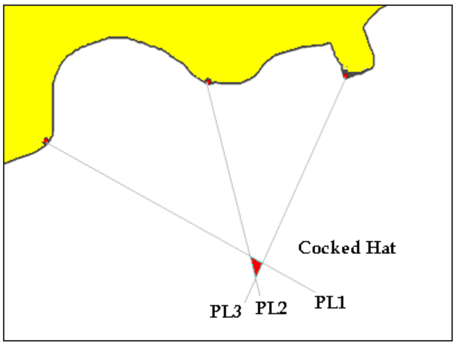


- At least two simultaneous observations are required to fix the vessel's position. The observations have to taken at the same time. Any time elapsed between two observations will lead to an error in the position.
- Using any of the above combinations vessel's position can be fixed. The accuracy of the position will depend upon the angle of cut between the two position lines; lesser the angle of cut, greater the error.

a) Two position lines

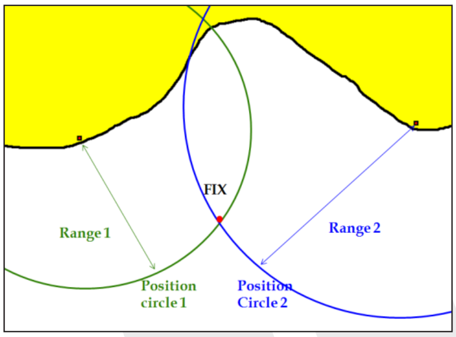


- ✓ Any tow position lines obtained by any of the methods discussed can be used to determine the position of the vessel. The point of intersection of the two position lines gives the position of the vessel. When selecting two position lines for position fixing, the lines shall intersect each other preferably at an angle of 90° or close.
- ✓ **Running fix** - When two position lines are separated by a time interval, the positions are



plotted using 'Running Fix'. The First position line is plotted on the chart for the time of observation. A second observation of the same object is taken after a known interval of time usually 6 minutes and the position line is then plotted on the chart as Second PL. The First PL is then moved on the vessel's course and speed for the time interval of between observations along with any set and drift experienced, to plot a transferred PL. The point of intersection of the transferred PL with the second PL gives the vessel's position at the time of second observation. This position can be walked back on the chart to find the position at the time of first observation.

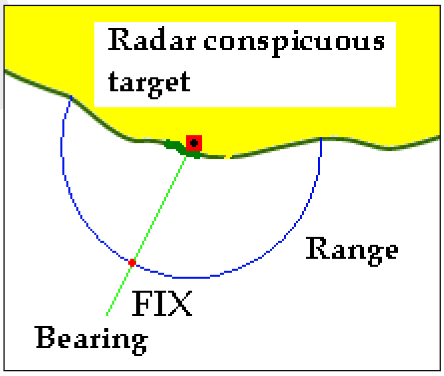
✓ **Position by more than two bearings**



The intersection of two or more position lines gives the position of the ship at any given time, provided the bearings of fixed targets are taken at the same time. When the bearings taken for the fixing ship's position are not taken at the same time OR all three bearings have an error, then these position lines will not intersect at one single point and form a triangle called the cocked hat. In case of a cocked hat, the point of intersection of the two position lines closest to hazard should be taken as the position of the ship, which will enable vessel to steer to safer water else centre of triangle as position of ship if vessel is not close to hazard.

b) Two position circles

Two position circles can be plotted in a similar manner as position lines to obtain the fix. In case of some interval between two observations the position circles can be transferred for obtaining a running fix. When transferring the position circles, the centre of the circle is transferred for the ship's run and then the circle plotted. Intersection of two position circles then gives the position.

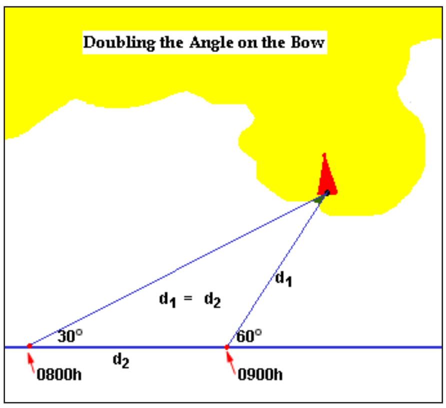


c) One position line and one position circle

A combination of any two of the above observations one PL and one position circle can be plotted to obtain a position fix.

d) Doubling the angle on bow

Relative bearing of a fixed object in a known position is observed with reference to ship's head. The angle is noted. The object is again observed after some time when the angle is observed to be doubled. In absence of any drift due to wind and current, distance made good between two observations, during which the bow angle of any terrestrial object is doubled, is equal to the distance off from the same object at the second observation. A fix can be obtained by measuring this range at the time of second observation and the bearing from the object.



e) Selected angles on the bow

Using a selected set of angles, taken as bearings of a terrestrial object, the CPA of the object can be determined. With the vessel proceeding at a uniform speed, a pair of bow angles is selected.

The time is noted when these two bow angles are observed. The distance steamed during this interval is calculated. This distance will be same as the distance when the ship will be closest to the object.

f) Bearing and a sounding line
A fix can also be obtained by using a position line in conjunction with the depth soundings. However, the accuracy with greatly depend on accuracy of depth which in turn is dependent on the date of depth survey and tidal levels. The echo-sounder trace is observed for the depth contour on the chart. The intersection of the contour with the position line is marked as the position for the vessel but it cannot be solely relied upon.

Apply Your Knowledge

1. Practice various means of position fixing while in coastal passage. Discuss the reason why is it advised to cross check the vessel’s position by alternative means when navigating in restricted waters.
2. Discuss the effect of set and drift when plotting position by running fix.

I M U

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task number: A1.3

Sub-task Reference number: A1.3.5, A1.3.6, A1.3.7, A1.3.8, A1.3.9, A1.3.10, A1.3.11, A1.3.12, A1.3.13

Topic: Charts and publications

Task Heading

- Demonstrate understanding of the procedures for correction of charts as explained in the publication "How to keep your Admiralty charts up to date" (NP 294).
- Record chart corrections using BA NP 133A or appropriate digital method
- Identify the instruments required for chart correction and chart work
- Assist correction of charts using Notices to Mariners in paper or digital format and chart tracings
- Assist checking of new charts received
- Assist correction of Admiralty Sailing Directions
- Assist correction of Admiralty List of Radio Signals
- Assist correction of Admiralty List of Lights and Fog Signals
- Assist correction of voyage charts for T & P notices and navigational warnings

Objectives

- To understand the procedure of updating nautical publications carried on board.

Please read this task in conjunction with taskA1.3.4

Index

1) Introduction
2) Upkeep of the chart system
   a) Updating paper charts
   b) Updating digital charts
5) Correction of Admiralty Sailing Directions
6) Correction of Admiralty List of Lights and Fog Signals
7) Correction of Admiralty List of Radio Signals
8) Correction of Admiralty Tide tables, Mariner's Handbook (NP100) and Ocean Passages for the world (NP136)
9) Updating of Admiralty Digital Publications

Description

1) Introduction

The admiralty charts and publications shall be kept updated to the latest edition of notices to mariners available on board. These notices are supplied on board usually within 2- 3 weeks of publishing. These are available earlier from the United Kingdom Hydrographic Office (UKHO) website. Admiralty notices to mariners provide corrections for chart published by UKHO under British Admiralty (BA) series, International Series (INT), Australian Series (AUS) and Japan (JP) Series. Local hydrographic offices publish notices to mariners for the charts locally published, which shall be used accordingly. For example, Indian Hydrographic Office publishes notices for Indian Charts which shall be consulted for correcting these charts. Details regarding contents of notices to mariners are discussed under task A1.3.4.

2) Upkeep of the chart system

The publications used for chart upkeep of chart system are

- Catalogue of Admiralty Charts and Publications (NP 131)
- Paper Chart Maintenance Record (NP 133A)

- Weekly Notices to Mariners
- Cumulative List of Admiralty Notices to Mariners (NP234 A/B)
- Annual Summary of Admiralty Notices to Mariners (NP 247 - 1 & 2)
- Symbols and Abbreviations used on Admiralty Charts (Chart BA 5011)
- How to keep your Admiralty charts up to date (NP 294)

a) Stationary used for Chart Correction
   - Pens with different sizes of nib such as 0.15mm and 0.25mm; 0.15mm nib used to insert information and a 0.25mm nib to delete
   - 2B Pencils - Used for entering T & P notices on charts and making entries in Chart Correction Log and Folio Index
   - Eraser
   - Ink - violet colour
   - Adhesive - Preferably glue sticks
   - Parallel ruler, Dividers, Compasses, Set square and Scissors
   - Template with various sizes of holes should be used for drawing radar stations, radio beacons, small circular limits, etc.

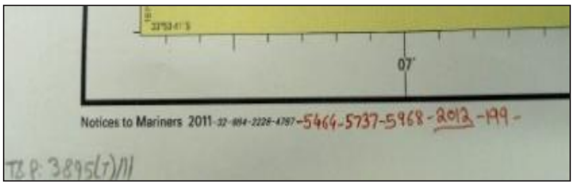
> Hacksaw blade shall not be used to draw the submarine cable as it will damage the pen tip. Rather a plastic ruler with similar teeth shall

a) Updating paper charts

- The details of charts and publications available at the start of the year are mentioned in BA publication ‘Catalogue of Admiralty Charts and Publications (NP 131)’. Publication NP 294 provides the procedure for updating admiralty charts. Symbols and abbreviations used on admiralty charts are mentioned in Chart BA 5011 which shall be consulted while correcting the chart.

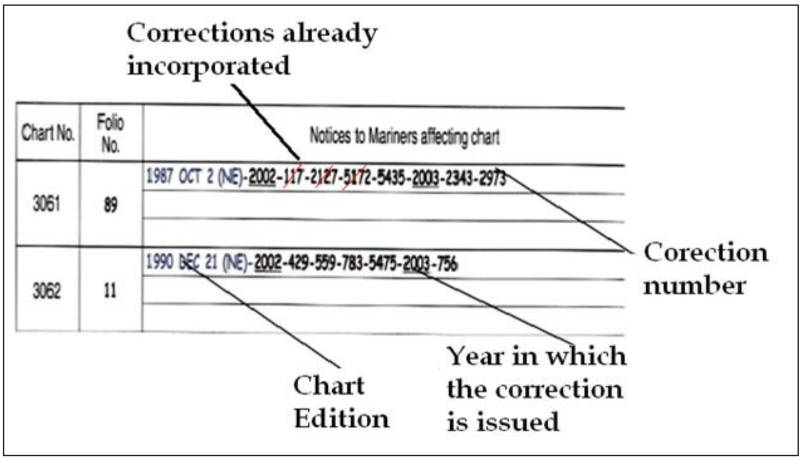
- From the time a chart is published, it is kept updated in accordance with admiralty notices to mariners. It is kept updated for all information essential to navigation by notices to mariners until it is either withdrawn or replaced by a new edition or new chart. While the chart is held with the supplier they usually undertake to keep the chart updated until supplied on board.

- Charts are maintained on board in a folio system. A folio clubs together the charts of a given geographical location. The recommended numbers for the folios are also provided in the admiralty chart catalogue. Some vessels may prefer to keep charts arranged in a numerical order.



- Upon receipt of chart it is checked for edition number against the latest edition available and the date of last correction on it. Date of last correction is usually recorded on the left hand bottom of the chart. An entry is then made on the backside of the chart showing the Folio Number for the chart, Date of receipt of chart’ and ‘Corrected up to Notice to Mariners no ….. of Year …..’ for quick reference. The details regarding the correction are made with pencil and updated regularly.

- An entry for the chart is then made in the NP 133A mentioning the chart number and edition. NP133A has sheets providing a numerical index of charts. Next to the chart number, the column indicates the folio number in which the chart is held. This is followed by space for logging numbers of Notices to Mariners affecting it. The chart edition number for the chart carried on board is mentioned in the space followed by the year of correction and correction number. The entries in NP133A are made by pencil. NP 133A also serves as an inventory of the valid charts on board.



- Upon receipt of a weekly edition of notices to mariners, the following procedures are followed. Weekly notices are dated for the Thursday appropriate to the week that the printed version is dispatched from the UKHO.

- Section I of weekly notices to mariners contains list of admiralty charts affected. It further contains list of admiralty charts and publications newly published and available, list of new editions of admiralty charts and publications, list of admiralty charts to be published in the following weeks and list of admiralty charts and publications permanently withdrawn. Seeing these lists the inventory of charts held on board is checked. The new charts, new editions and replacements for charts withdrawn are ordered. The charts withdrawn are prominently marked 'Cancelled'. The cancelled charts are removed from the folios and stored separately with a separate inventory. The replacements for the charts withdrawn shall be ordered at the earliest. NP133A is updated accordingly.

> Charts should always be corrected using notices of the same hydrography department that published the chart.

- Section II of weekly notices contains geographical index for corrections to the charts in the format given below. This lists the geographical areas affected by the corrections mentioned in the notices.

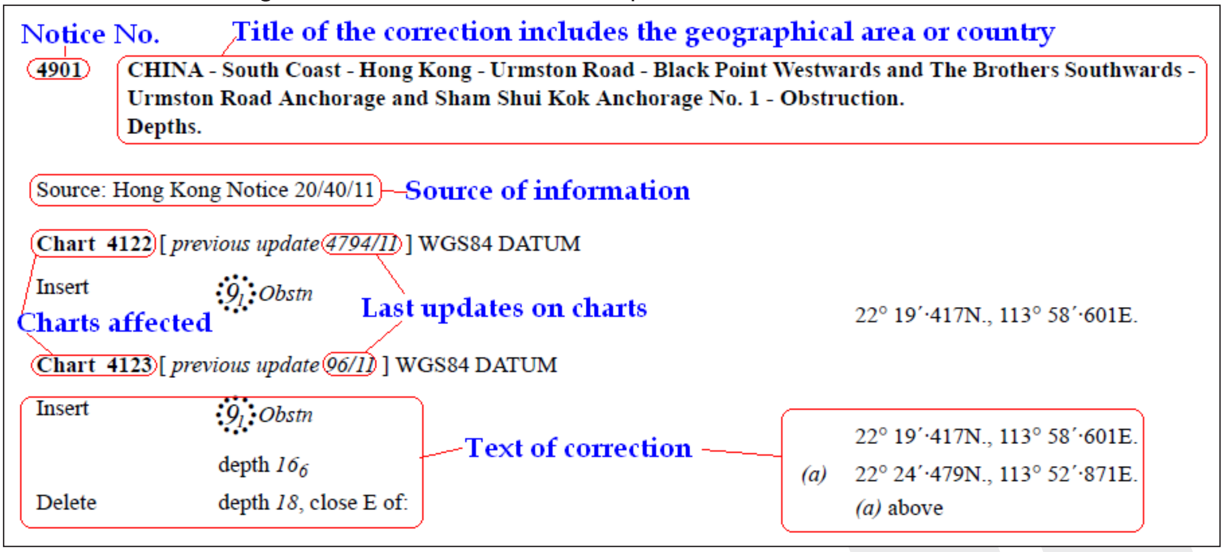
- This is followed by the index of notices and chart folios in the below format. The corrections include the corrections for BA charts and charts under INT series, AUS series and JP series.

INDEX OF CHARTS AFFECTED

Admiralty Chart No.	Notices	Admiralty Chart No.	Notices
2	5016	1994	4949
6	5014	2010	4995
66	4900	2029	4934
69	4899	2049	5006, 5007

- With reference to above lists, charts held on board are checked in NP133A. For the charts affected by any of the notices mentioned in the above lists, the numbers of the Notices affecting them are recorded against the charts number in NP133A. As and when the given chart is corrected, the correction number is struck off by pencil. The updates to charts are categorized as permanent corrections and temporary and preliminary (T&P) notices. The charts withdrawn/ cancelled are removed from the list by erasing all details from NP133A. Record for the same is updated in the inventory of cancelled charts maintained separately.

- **Correcting Charts for Permanent Corrections**
  Permanent corrections to charts are provided in the following format. Each notice carries the following information as shown in the picture below.



- For correcting the chart affected by the notice, the notice and NP 133A is taken out. The date of last correction as recorded on the left hand bottom of the chart is checked against the previous update number mentioned in the notice. If the chart is corrected for the previous notice the current correction is then done and the number then recorded on the chart. The entry for the notice number in NP 133A is struck off with pencil. In case the chart is found not corrected for last correction, the last correction notice shall be taken out. The process is continued till the last notice is tracked which is recorded on the chart. Cumulative List of Admiralty Notices to Mariners (NP234 A/B) provides a quick reference for the same. However, cumulative list is published every six months, with Part A in January and Part B in July. The publication lists the corrections for the chart since the last edition going up to last 2 years. Once the chart is corrected, it is updated on the note on the reverse side of the chart stating "Corrected up to notice no. ….. of Year …."

> Geographical positions refer to the horizontal datum of the current edition of each affected chart which is stated in the notice alongside the appropriate chart number. Hence Datum shift is NOT to be applied to positions for correcting charts.

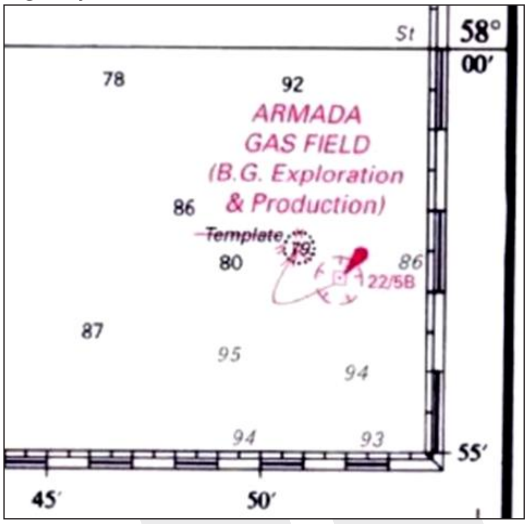
Cumulative List of Admiralty Notices to Mariners

Chart No.	Edition	Notices to Mariners
44	Feb. 2001	**2010** **(11)** 1303 **(22)** 2679 **(27)** 3329 **2011** **(7)** 663 **(12)** 1241 1341 **(31)** 3403 **(35)** 3882 **(50)** 5734 **2012** **(16)** 1762 **(23)** 2515 2517
45	Mar. 2010	**2010** **(39)** 4738
46	Oct. 2011	**2012** **(11)** 1086 **(12)** 1286 **(13)** 1414 **(19)** 2114

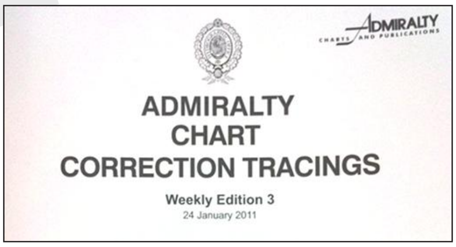
❖ Basic principles to be observed during chart correction

- When several charts are affected by one notice, the largest scale chart should be updated first to appreciate the details of the update.
- Voyage charts shall be corrected first followed by remaining charts.

- Positions are normally given in degrees, minutes and decimals of a minute, but may occasionally quote seconds for convenience when plotting from the graduation of some older-style charts.
- Information shall always be inserted before deleting any information.



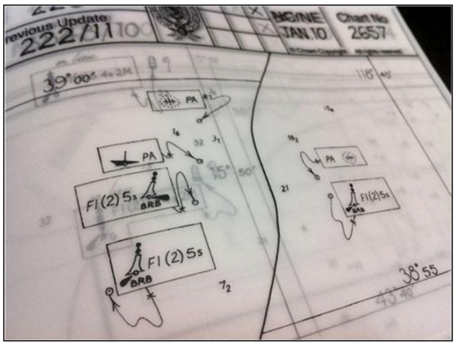
- Information updated shall not unduly obscure the printed data. The correction shall be made neatly using the fine tip pens.
- The notices shall be read and understood prior correcting.
- Symbols for the notice as prescribed in chart 5011 only shall be used.
- The correction number shall be recorded on the chart only after the correction is done.
- If the reference details mentioned in the notice are not mentioned on the chart, it means some the previous corrections are missing.
- Any deletion on the chart shall be using a single neat line.
- It is a good practice to refer to the latest cumulative summary while correcting any chart to check the record of corrections on the chart.
- Having made the correction on the chart, it shall be cross checked for correctness.
- All positions must be exact, depths and symbols must be clear, legends and descriptions must be readable.
- Small arrows may be used to indicate positions in cases where sufficient space is not available at the site of updating.
- Block corrections require the blocks to be cut and pasted on to the chart. These are printed in colour only on one side of the sheet. The glue used shall be such as will not affect the paper.



- No update, except those given in Section II – permanent correction of admiralty notices to mariners, weekly editions, is made to any chart in ink.

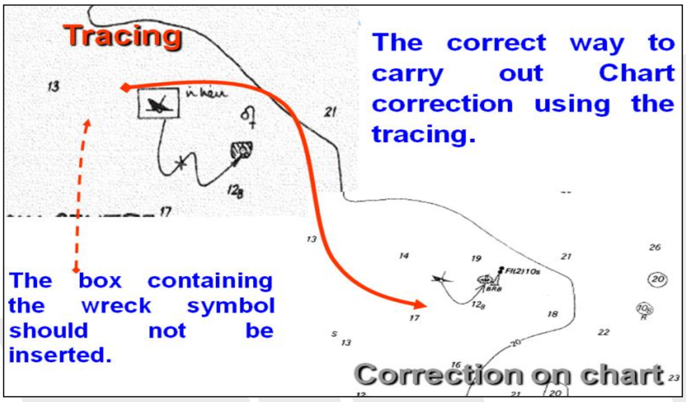
❖ **Use of tracings for chart corrections**

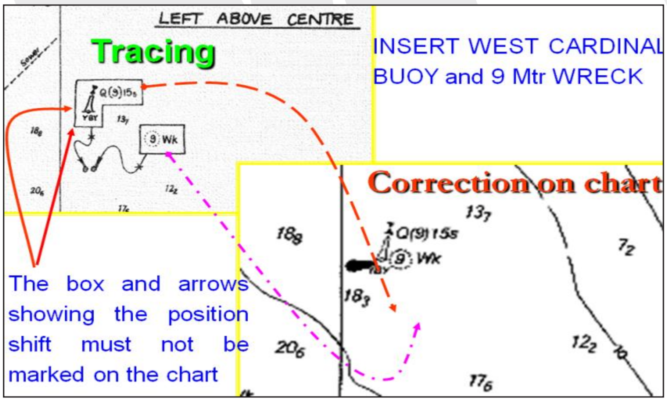
Tracings are provided in separate envelopes to facilitate quick updating of charts. Tracings are used to locate the site of correction on the chart quickly. The tracings shall be used in conjunction with the weekly notices. Each tracing applies to one chart only. The number of chart corrected is printed on the bottom right hand corner of the tracing. The number of previous correction appears on the tracing also which shall be checked on the chart. It should be noted that a tracing is only a guide to illustrate the correction and to pin-point a position. It should not be copied directly onto a chart as many of the symbols are printer's symbols used to instruct the printer or the chart plate maker. The instructions regarding use of chart correction tracings are as follows:



IMU

Corrections		Information to be inserted is usually enclosed by a firm line and arrowed to a small circle.
Insertion		When not practical to enclose with a firm line i.e. light sectors, submarine cables and pecked lines, this symbol is used to indicate insertions.
Position		Needle point surrounded by a small circle is the exact position.
Deletion		Information to be deleted is enclosed by a firm line, shaded and marked with the symbol.
In Lieu		This is how the new information is inserted in place of an existing one.
Move		This is how relocation of a buoy or a light is represented on a chart.
N.B. "Move", "In Lieu" or " ₰ " shown on the tracing is only meant to be indicative and is not to be repeated on actual corrections. The corrections should be applied to a chart without the outer firm line.		





- **Correcting charts for temporary and preliminary notices**

> Care shall be taken not to erase valid T&P notices from the chart while making a new passage plan.

✓ The temporary notices are notices informing about temporary developments in the given area affecting navigation such as offshore exploration, naval exercises etc. These are temporary in nature. Preliminary notices are regarding the operations that may have started in the area such as making of a new berth, a new dredged navigation channel etc. Such notices are printed in Section II of weekly notice to mariners after the permanent corrections. The suffix (T) or (P) indicate temporary of preliminary nature.

✓ Entries are made in NP133A for T&P notices. These corrections are made on the charts using pencil and the number recorded on the left hand bottom of the chart. Usually the affected voyage charts only are corrected for such notices. These notices are kept filed in a separate folder for quick reference. Temporary and Preliminary Notices should be rubbed out as soon as the Notice is received canceling them.

✓ The list of T&P notices in force is also published in the Annual Summary of notices to Mariners (NP247). T&P notices are printed on one side of the paper in order that they may be cut up and filed. To assist in filing, the year is indicated after the notice number and an in-force list is published monthly.

4953(T)/11 NORTH SEA - Netherlands Sector - East Friesland TSS Southwards - Buoyage. Works.

Source: Netherlands Notice 40/437(T)/11

1. The following light-buoys, *Fl(5)Y.20s*, have been established to mark the construction of the Bard 1 wind farm

Position (WGS84 Datum)	*Designation*
54° 01′·15N., 5° 14′·74E.	*Bard 1*
54° 00′·30N., 5° 32′·87E.	*Bard 2*
54° 02′·25N., 5° 57′·98E.	*Bard 8*
53° 56′·50N., 6° 05′·86E.	*Bard 12*
53° 52′·67N., 6° 08′·06E.	*Bard 13*

2. Mariners are advised to navigate with caution in the area.

Charts affected - 1423 (INT 1045) - 1633 (INT 1417)

Correcting for radio navigational warnings

These provide the mariner with early information of important incidents which may constitute a danger to navigation. Same are incorporated on the charts by pencil. The printouts of these warnings are kept filed in a separate folder. The reprints of these warning in force are printed in Section III of Weekly notices. Applicable warnings shall be cross checked plotted on voyage charts and then kept filed.

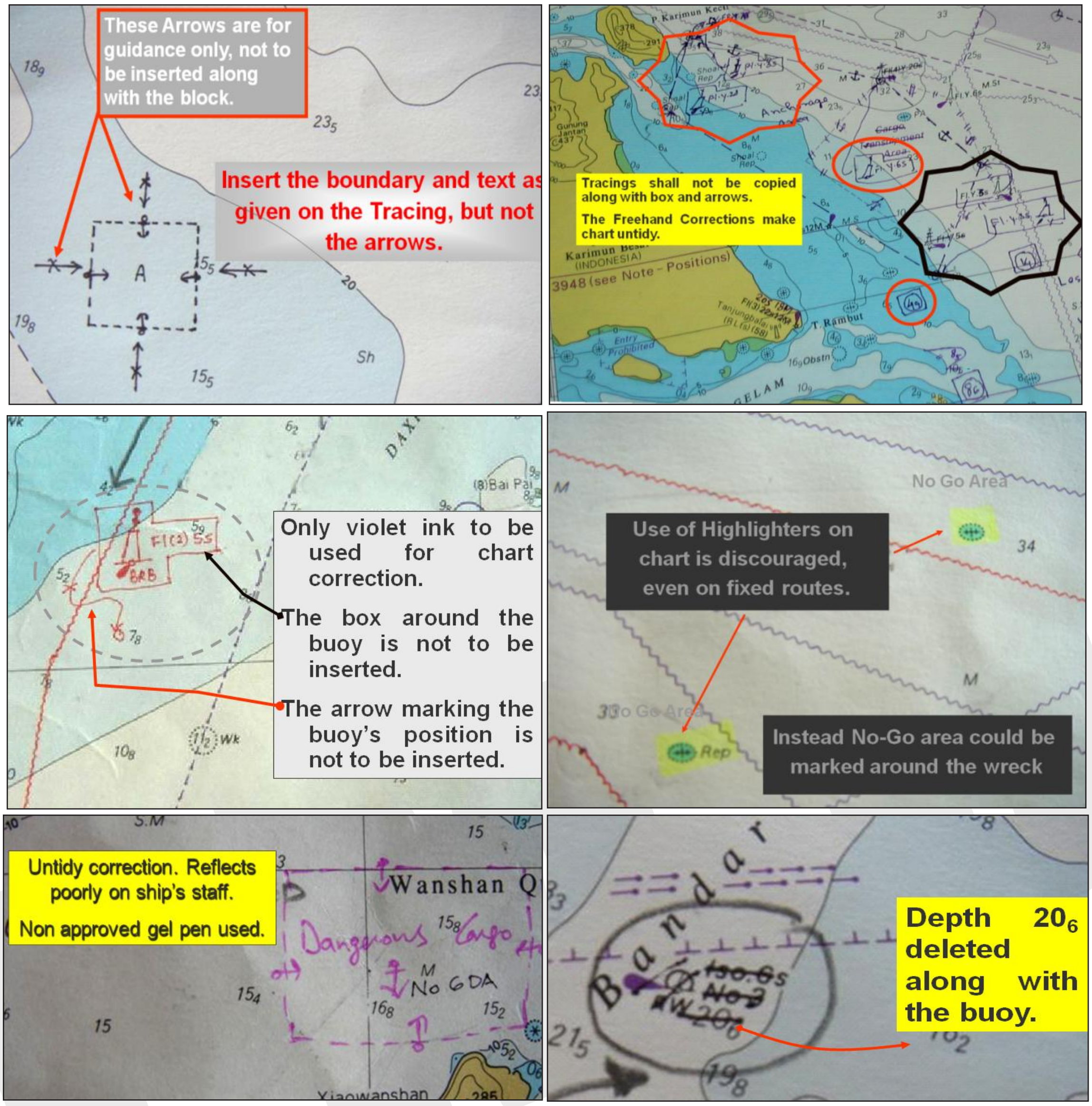
b) Updating digital charts

❖ Electronic updates are supplied weekly via e-mail. ENCs and RNCs are kept up to date by applying regular, update information to the chart data via a data file. The update file may be transferred by email or by a suitable media e.g. CD. The actual updating is applied automatically by the ECDIS to its chart database. A CD containing blocks & publication updates is received monthly. These should be promptly updated in the software of the electronic notices system.

❖ The vessel should maintain up-to-date record of correction to both ENC and Raster charts (if used). A record of all update CDs received must be maintained on board. The CDs shall be maintained in a systematic way, similar to keeping hard copy of the weekly notices and a log should be maintained to identify that received correction CD's have been applied. Each update CD of the current period contains cumulative information since the beginning of the year. During the year, whenever the update CD is received, the previous one can be discarded. At the end of the year, the last CD contains all the updates for the year which shall be specifically marked 'Complete Year' and kept in records. Each CD contains the full software and the installing / operating instructions in PDF format. The ECDIS maintains a list of updates applied and the date of application. This list can be used to check the update status of the ENCs loaded.

❖ In addition, the admiralty updating service is an on-line service for subscribers to admiralty digital chart services that offers immediate access to the latest digital chart updates over the Internet. The service is complementary to the standard CD-based updating service for admiralty digital charts and offers rapid access to the most up-to-date chart information.

Some examples of unacceptable methods of chart correction



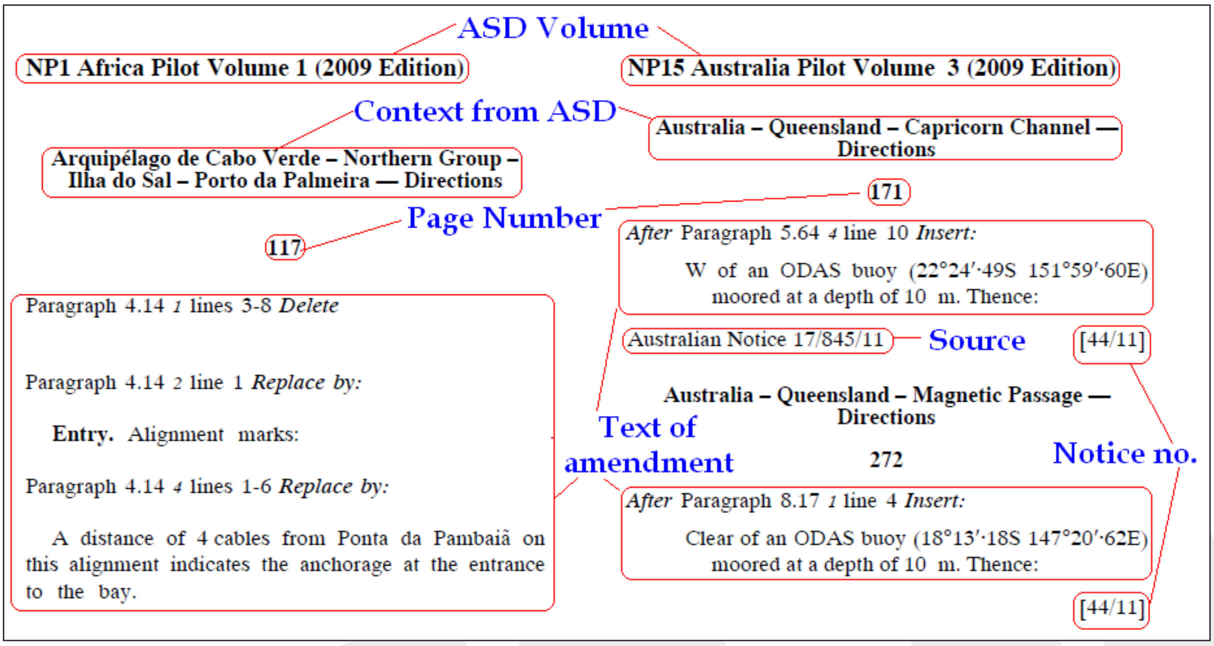
3) Correction of Admiralty Sailing Directions

- Sailing directions are revised by a process of continuous revision, with titles re-published as new editions at approximately three yearly intervals. Some volumes, indicated in the catalogue of Admiralty Charts and Publications (NP131) are on an extended cycle of approximately 5 years.

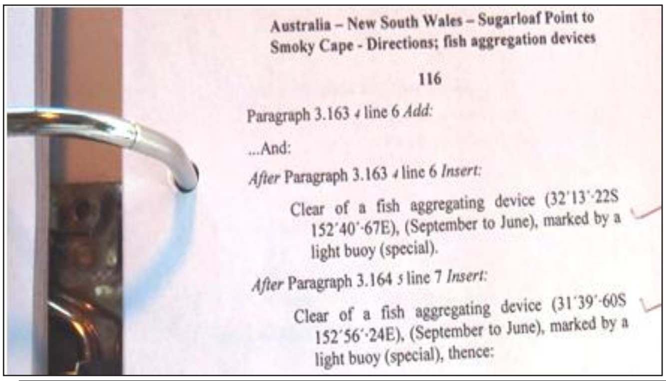
- Some editions of sailing directions continue to be amended by supplement. Supplements are generally published every four years. They are cumulative in nature, so that each Supplement, on publication, replaces its predecessor and any Section IV Notices extant since either publication of the most recent edition or since the previous Supplement, in entirety. When an edition of sailing directions is ordered, any extant supplement pertaining to that volume will be supplied automatically with the parent volume.

- Details regarding the current editions of Sailing Directions and their latest supplements are available in Annual Notices to Mariners Part 2 - Amendments to Sailing Directions. The information is also available in Catalogue of Admiralty Charts and Publications (NP 131), Cumulative List of Admiralty Notices to Mariners (NP 234) and quarterly at Section 1B of Weekly Editions of Admiralty Notices to Mariners.

- Amendments to sailing directions are given in Section IV of Weekly Notice to Mariners. The amendments are printed for each volume specifying the page number and describing the text. The amendments are normally restricted to those changes deemed navigationally significant and information required to be published as a result of changes to national legislation affecting shipping and to port regulations. Information promulgated by a chart updating Notice need not always be repeated in a Section IV Notice unless it requires elaboration in sailing directions.



- ➢ For volumes of sailing directions maintained by continuous revision, amendments are cut and pasted/corrected directly in to the book.
- ➢ For the volumes of sailing directions maintained by supplement, amendments are kept in a file with the latest list of amendments in force on top. The list is consulted when using the parent book to see if any amendments, affecting the area under consideration, are in force. It is not recommended that amendments be stuck in the parent book or the supplement of such sailing directions. When keeping the amendments in a separate file, the file shall be referred to while referring to the ASD volume. It is recommended to make a small note in the respective ASD by pencil to indicate existence of such amendment.
- ➢ Record of amendments is provided under the front cover of the ASD which shall be updated for the record of amendments.
- ➢ A list of amendments in force is published in Section IV of the Weekly Edition quarterly. Amendments in force at the end of the year are reprinted in the Annual Summary of Admiralty Notices to Mariners Part 2 (NP 247(2)).


Australia – New South Wales – Sugarloaf Point to Smoky Cape - Directions; fish aggregation devices

116

Paragraph 3.163 4 line 6 *Add:*

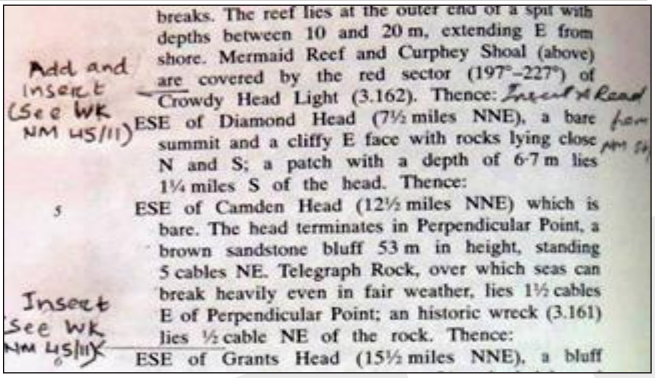
...And:

After Paragraph 3.163 4 line 6 *Insert:*

Clear of a fish aggregating device (32°13'·22S 152°40'·67E), (September to June), marked by a light buoy (special).

After Paragraph 3.164 5 line 7 *Insert:*

Clear of a fish aggregating device (31°39'·60S 152°56'·24E), (September to June), marked by a light buoy (special), thence:


breaks. The reef lies at the outer end of a spit with depths between 10 and 20 m, extending E from shore. Mermaid Reef and Curphey Shoal (above) are covered by the red sector (197°–227°) of Crowdy Head Light (3.162). Thence: Insert & Read

Add and insert (See WK NM 45/11)

ESE of Diamond Head (7½ miles NNE), a bare summit and a cliffy E face with rocks lying close N and S; a patch with a depth of 6·7 m lies 1¼ miles S of the head. Thence:

ESE of Camden Head (12½ miles NNE) which is bare. The head terminates in Perpendicular Point, a brown sandstone bluff 53 m in height, standing 5 cables NE. Telegraph Rock, over which seas can break heavily even in fair weather, lies 1½ cables E of Perpendicular Point; an historic wreck (3.161) lies ½ cable NE of the rock. Thence:

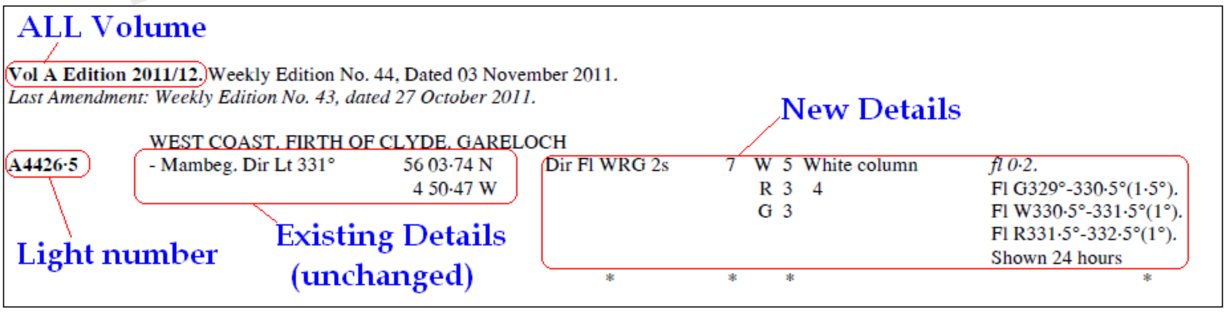
Insert See WK NM 45/11

ESE of Grants Head (15½ miles NNE), a bluff

4) Correction of Admiralty List of Lights and Fog Signals

- List of Lights is the primary source of information on lights. Many alterations, especially those of a temporary but operational nature, are promulgated only as corrections to the List of Lights. Light positions should be regarded as approximate and are intended to indicate the relative positions of lights only. Charts should be consulted for a more authoritative position. The range of a light is normally the nominal range, except when the responsible authority quotes luminous or geographical range.

- The detailed amendments to the Lists of Lights are given in Section V of weekly notices. When a light is affected by a notice its Light List number is quoted. The entire entry for each light amended is printed in the amendments only on one side of the sheet. An asterisk (*) below the column denotes the column contains an amendment. In the case of a new light, or where a new sequence is added below the main light, an asterisk (*) appears under all columns. All Section V entries are intended to be cut out and pasted into the book. It is recommended that a manuscript entry is made for all shorter amendments. "Remove from list" is used when a light is withdrawn, and "Remove Fog Signal" when a fog signal is discontinued.



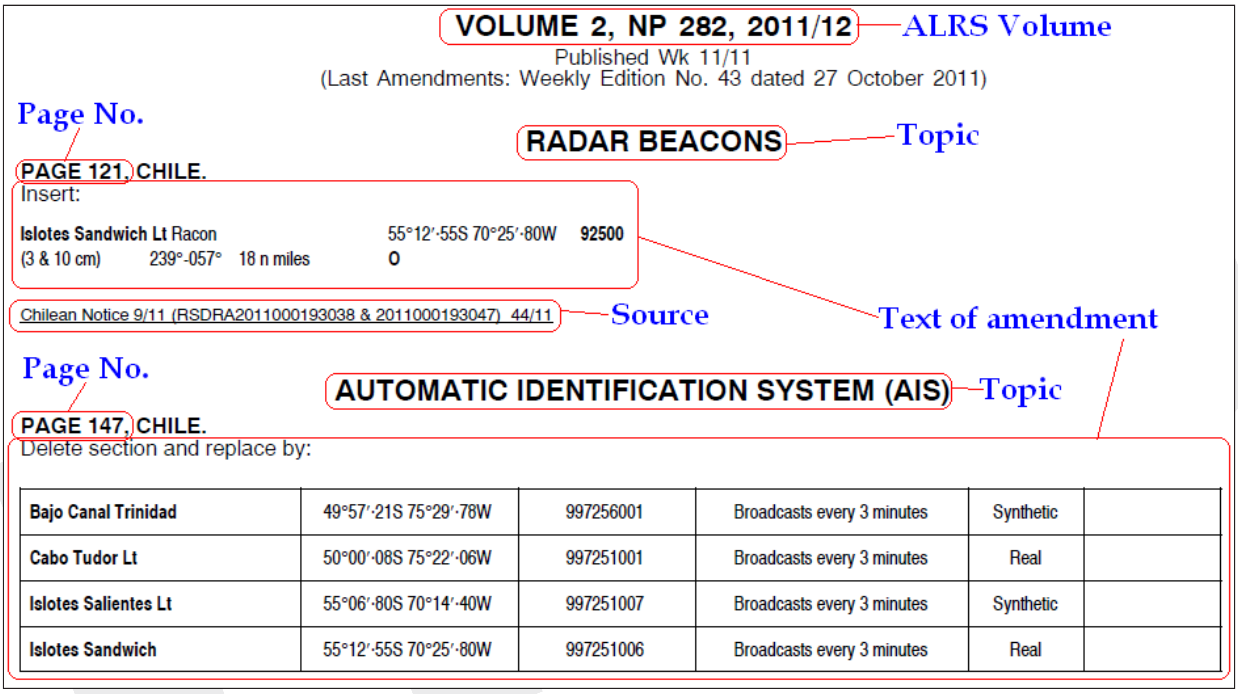
- The publication is revised annually and Publication of a new edition is announced in Part 1 of the Weekly Edition of Admiralty Notices to Mariners.

- Minor amendments are not issued for the paper books but are available in the Admiralty Digital List of Lights (ADLL). All minor and SOLAS amendments are included in each new edition of the book.

- Record of weekly amendments is maintained in the table under the front cover of each volume.

5) Correction of Admiralty List of Radio Signals

- When a chart-updating notice is issued for information that is also included within Admiralty List of Radio Signals, the appropriate volume reference number is quoted, followed in parentheses by the number of the Weekly Edition containing (in Section VI) the corresponding amendment to the service details. The amendments in Section VI should be cut out and pasted into the appropriate volumes. The record of amendments is updated for each amendment in table under front cover.
- Revised volumes are published annually. A cumulative list of amendments is published quarterly in Section VI of the Weekly Edition of Admiralty Notices to Mariners and provides a summary list of the entries in the current editions which have been amended.



VOLUME 2, NP 282, 2011/12

Published Wk 11/11

(Last Amendments: Weekly Edition No. 43 dated 27 October 2011)

RADAR BEACONS

PAGE 121, CHILE.

Insert:

Islotes Sandwich Lt Racon 55°12′·55S 70°25′·80W **92500**

(3 & 10 cm) 239°-057° 18 n miles **O**

Chilean Notice 9/11 (RSDRA2011000193038 & 2011000193047) 44/11

AUTOMATIC IDENTIFICATION SYSTEM (AIS)

PAGE 147, CHILE.

Delete section and replace by:

Bajo Canal Trinidad	49°57′·21S 75°29′·78W	997256001	Broadcasts every 3 minutes	Synthetic	
Cabo Tudor Lt	50°00′·08S 75°22′·06W	997251001	Broadcasts every 3 minutes	Real	
Islotes Salientes Lt	55°06′·80S 70°14′·40W	997251007	Broadcasts every 3 minutes	Synthetic	
Islotes Sandwich	55°12′·55S 70°25′·80W	997251006	Broadcasts every 3 minutes	Real	

6) Correction of Admiralty Tide tables, Mariner's Handbook (NP100) and Ocean Passages for the world (NP136)

- Admiralty Tide Tables are published annually. The publications are usually not amended. Any errata are advised in the weekly notice.
- Corrections to Mariner's Handbook and Ocean Passages for the world are rare. Any such corrections are notified in the Section IV of the Weekly Notices to Mariners and are required to be cut and pasted in the respective publication. The record of amendment is maintained in the table provided in the beginning of the publication.

7) Updating of Admiralty Digital Publications

- Presently, Admiralty Digital Publications available from UK Hydrographic Office are Admiralty Digital Radio Signals (Volume 6) (Pilot Services, Vessel Traffic Services, and Port Operations), Admiralty Digital List of Lights and Admiralty Total Tide. These can be updated by connecting to UKHO website automatically or getting the corrections through email. The corrections may be downloaded through the website.

Apply Your Knowledge

1. Choose any ten British Admiralty charts from the latest cumulative list on board- check, compare and list the current editions of each chart and the numbers of the notices affecting the charts.
2. Locate the last weekly edition of notices to mariners on board and assist the responsible officer in correcting the charts and publications.
3. You are told to plan a voyage from Mumbai, India to St. Petersberg, Russia. List the sailing directions you will use for reference during the voyage.
4. Locate the file where the T&P notices are kept filed on board and discuss its use.

I M U

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task number: A1.3

Sub-task Reference number: A1.3.14

Topic: Charts and publications

Task Heading

- Identify the publication containing information on approved traffic separation schemes.

Objectives

- Understand the use of traffic separation schemes for navigation.

Please read this task in conjunction with taskA1.3.4

Index

1) Ships' routeing
2) Elements used in traffic routeing systems
3) Publication - 'Ship's Routeing'

Description

1) Ships' routeing

- Ships' routeing systems are recommended for use by, and may be made mandatory for, all ships, certain categories of ships or ships carrying certain cargoes, when adopted and implemented in accordance with the guidelines and criteria developed by the organization.
- IMO is recognized as the international body for establishing such systems. SOLAS Chapter V- Regulation 10 specifies the procedure of adopting a traffic separation scheme in a given sea area.
- The governments of member countries in IMO, in reference to IMO's proposals for the adoption of ships' routeing systems develop the traffic separation schemes. Governments intending to establish a new routeing system, or amend an existing one, submit proposed routeing measures to IMO's sub-committee on safety of navigation, which then evaluates the proposal and makes a recommendation regarding its adoption. The recommendation is then passed to the Maritime Safety Committee for adoption. Once approved, the information is disseminated to other countries. At the same time the TSS are incorporated in the Admiralty charts and the publication 'Ship's Routeing'. The local government of the member country to IMO is primarily responsible for developing such TSS systems. Where two or more Governments have a common interest in a particular area, they formulate joint proposals for the delineation and use of a routeing system therein on the basis of an agreement between them.

> It is noteworthy that COLREGs Rule 10 – "Traffic Separation Scheme" applies ONLY in the Traffic Separation Schemes adopted by IMO, the details of which are provided in the IMO publication "Ship's routeing". Some TSS across the globe are NOT

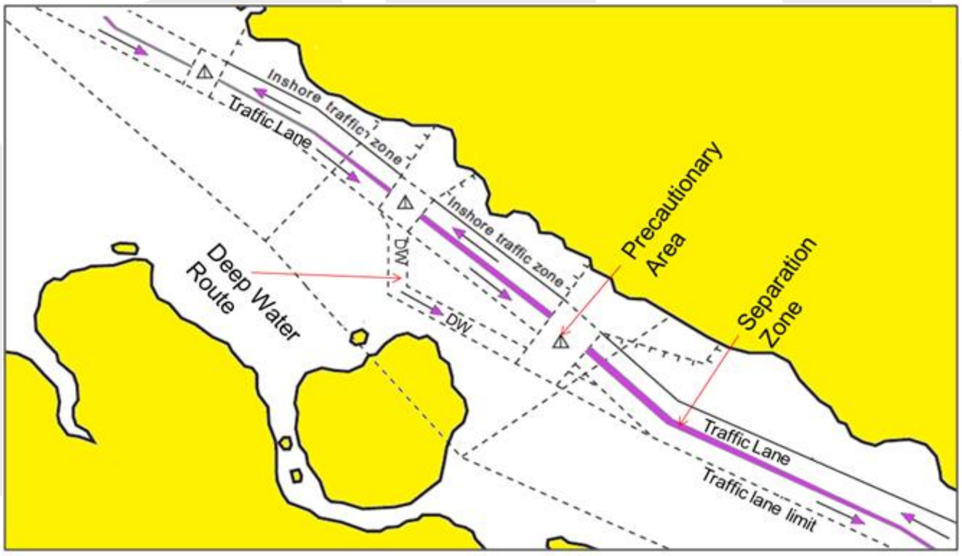
- Ships are required to use a mandatory ships' routeing system adopted by the organization as required for its category or cargo carried and in accordance with the relevant provisions in force unless there are compelling reasons not to use a particular ships' routeing system. Any such reason shall be recorded in the ships' log.
- The precise objectives of any routeing system depend upon the particular hazardous circumstances which it is intended to alleviate. These could be as follows:
- ❖ the separation of opposing streams of traffic so as to reduce the incidence of head-on encounters

- the reduction of dangers of collision between crossing traffic and shipping in established traffic lanes
- the simplification of the patterns of traffic flow in converging areas
- the organization of safe traffic flow in areas of concentrated offshore exploration or exploitation
- the organization of traffic flow in or around areas where navigation by all ships or by certain classes of ship is dangerous or undesirable
- the organization of safe traffic flow in or around or at a safe distance from environmentally sensitive areas
- the reduction of risk of grounding by providing special guidance to vessels in areas where water depths are uncertain or critical
- the guidance of traffic clear of fishing grounds or the organization of traffic through fishing grounds

- For achieving all above, traffic separation schemes and other routeing measures are adopted by IMO which further include two-way routes, recommended tracks, deep water routes, precautionary areas and areas to be avoided.

2) Elements used in traffic routeing systems

- Traffic separation scheme
- Traffic lane
- Separation zone or line
- Inshore traffic zone
- Roundabout
- Recommended route
- Deep-water route



- Precautionary area
- Area to be avoided
- Established direction of traffic flow
- Recommended direction of traffic flow
- Controlled and/or prohibited areas
- Exclusion zone

3) Publication - Ship's Routeing

- Details of Ships' routeing systems and traffic separation schemes that have been approved by IMO are contained in the IMO Publication, 'Ships Routeing'. 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.

- **Contents**
- Introduction
- Part A - General provisions on ships' routeing
  This part specifies SOLAS requirements pertaining to ships' routeing and further discusses objectives of Ship's Routeing, various definitions relating to routeing measures, the procedures and responsibilities of IMO and the local governments in this regard, methods of establishing routeing measures, planning and design criteria, temporary adjustments and suspensions of systems, the use of routeing systems and the representation of various routeing systems on charts.
- Part B - Traffic separation schemes
  This part of the publication includes details of various Traffic Separation Schemes adopted across the globe. The part is divided into sections covering different sea areas. Index in tabular and graphical form is provided to facilitate easy use.
- PART C - Deep-water routes
  This part of the publication includes details of various Deep Water Routes adopted across the globe. The part is divided into sections covering different sea areas.
- PART D - Areas to be avoided
  This part of the publication mentions Areas which shall be avoided from navigation routes across the globe. The part again is divided into sections covering different sea areas.
- PART E - Other routeing measures
  This part of the publication mentions other routeing measures available in specific sea areas such as recommended directions of traffic flow, recommended routes, recommended tracks and special routeing measures in particulars straits.
- PART F - Associated rules and recommendations on navigation
  This part provides specific rules and recommendations on navigation in specific areas such as Recommendations on navigation through the English Channel and the Dover Strait, Rules for ships navigating in the Gulf of Suez, Rules for vessels navigating through the Straits of Malacca and Singapore, Rules for navigation of laden tankers off the South African Coast etc.
- PART G - Mandatory Ship Reporting Systems and Mandatory Routeing Systems
  This part is divided into two sections
    - ✓ Section I - Mandatory Ship Reporting Systems in specific sea areas

  This contains details regarding categories of ships required to participate in the systems, geographical coverage of the systems and the number and edition of the reference charts used for the delineation of the systems, format, content of report, times and geographical positions for submitting reports, authority to whom the reports should be sent, available services, information to be provided to participating ships and procedures to be followed, radio communications required for the systems, frequencies on which reports should be transmitted and the information to be reported, rules and regulations in force in the areas of the systems, shore-based facilities to support operation of the systems and details regarding alternative communications if the communication facilities of the shore-based authority fail.
    - ✓ Section II - Mandatory Routeing Systems in specific sea areas
- PART H - Adopted Archipelagic Sea Lanes
  In accordance with Part IV of the United Nations Convention on the Law of the Sea (UNCLOS), this part of the publication provides details regarding general provisions for the adoption, designation and substitution of archipelagic sea lanes, procedures and responsibilities in this regard, use of Archipelagic Sea Lanes and Normal Passage Routes and representation of such lanes on charts. It further provides details of adopted Archipelagic Sea Lanes.

- The following appendices of the publication mention the instructions on how to use the publication, the role of IMO and the list of member countries.

Apply Your Knowledge

1. Discuss the advantages of having a dedicated deep water route in congested water such as the one in Malacca Straits.
2. Discuss the actions to be taken if the main engine fails while transiting through a TSS.

I M U

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task number: A1.6

Sub-task Reference number: A1.6.2

Topic: Echo sounders

Task Heading

- Assist in record keeping with respect to the echo sounder and markings on the recorder.

Objectives

- Understand the procedure and importance of record keeping with regards to echo sounder.

Index

1) Record keeping with respect to echo sounder

Description

1) Record keeping with respect to echo sounder

- Echo sounders are provided with recording devices to maintain depth records. The past records shall be retrievable for at least last 12 hours. The record could be a paper chart or in the form of a digital storage device. The intention is to have the relevant data available in cases of investigations.
- The echo sounder recorder should be kept on while navigating in shallow waters. Echo sounder is switched on prior to entry in shallow waters, while entering ports and prior to departure. Depth records shall be maintained in accordance with company SMS procedures.
- The date and time (ship's time) of switching on echo sounder should be marked on the recorder chart.
- The date and time of passing significant land or seamarks should be marked on the recorder paper.
- Echo sounder observed depths shall also be recorded in the deck logbook at regular intervals. As an alternative, a separate echo-sounder log may be maintained on board. This is especially important in cases of vessels fitted with digital echo sounder with no printer feed for the recording.
- Used echo sounder paper (printouts) must be carefully labeled and retained on board permanently, as they may be required in case of claims, especially in case of any navigational incident.
- Additionally each paper roll shall be marked with the ship's name at the beginning or end of each roll. The commencing and completion dates of period during which the paper roll is used shall be clearly marked on the completed roll, prior storing.

Apply Your Knowledge

1. Locate the past records of echo sounder on board and mention the occasions when the entries are made on the recorder paper and deck log book.

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task number: A1.7

Sub-task Reference number: A1.7.5

Topic: Compass - Magnetic and gyro

Task Heading

- Use the compass error book, make entries under supervision and compare the deviation obtained with the deviation card readings.

Objectives

- Understand the principles and procedure of checking compass error.

Please read this task in conjunction with taskA1.7.4

Index

Description

1) Compass error

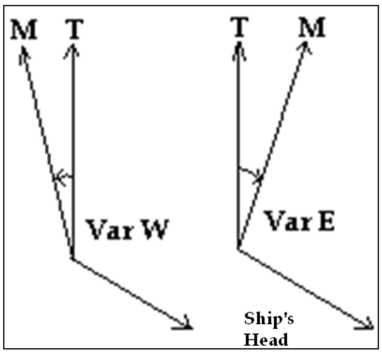
The difference in degrees between the true direction and the direction shown by compass is termed as compass error. Ships are provided with magnetic compass and gyro compass. Both these types of compasses are affected by factors that cause error. These are discussed as follows.

a) Magnetic compass

❖ **True North**
It is the northerly direction of the geographic meridian joining the geographic poles.

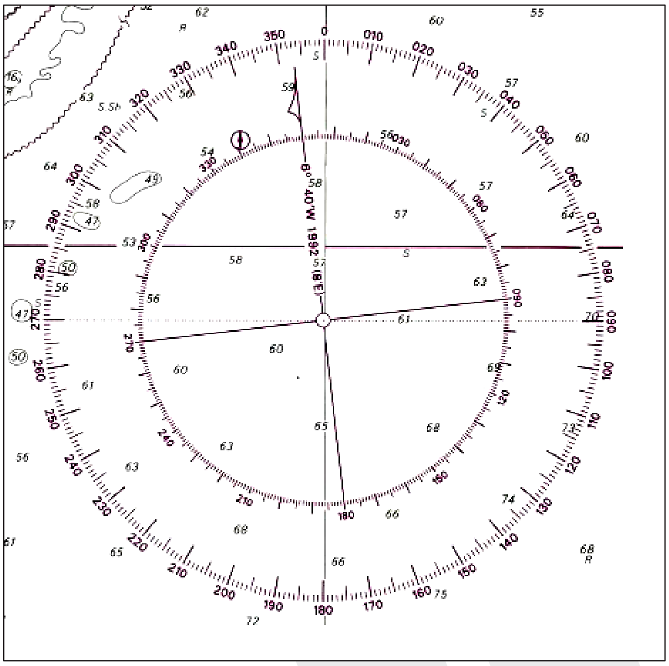
❖ **Magnetic North**
It is the name given to the direction in which the north end of the magnetic needle suspended as to remain horizontal, would point when subject only to the earth's magnetism. It is the northerly direction of the magnetic meridian.

❖ **Compass North**
It is the direction in which the magnetic compass needle points as north as a resultant of Earth's magnetism and the deviation caused due to ship's magnetism.



❖ **Variation**
It is the angle between the geographic (true) and the magnetic meridians at any place. It is measured East or West from the true North. Variation has different values at different places and is gradually changing. Its value at any place may be found from the chart which gives the variation for a certain year together with the note of the annual change. The navigator must always allow for the annual change. Variation may also be obtained from special isogonic charts on which all places of equal variation are joined by isogonic lines and known as isogonals.

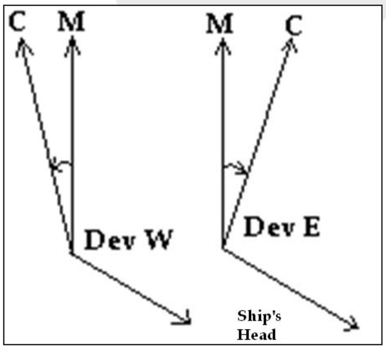
- **Estimating Variation**
  Usually the compass rose printed on the chart shows the variation at the given location, during the year of observation as mentioned. Further it provides the annual rate of change in variation. To estimate the variation in the given location during the current year, the annual change accumulated for the number of year from year of observation to current year, need to be added/ subtracted as applicable.



- In the adjoining picture, the variation given in the compass rose is 8°40'W for the year 1992. Further it changes by 8' E every year. So by calculation the variation in the area for year 2012 will be

Variation = 8° 40'W + (8'E x 20)
= 8° 40'W + 160' E
= 8° 40'W + 2° 40'E
= 6° 00' W

- **Deviation**
  The presences of magnetic fields around the compass, caused due to ship's steel, iron and electrical equipment on a ship, causes the magnetic compass to deviate from the magnetic meridian. The angle between the Magnetic Meridian (Magnetic North) and the direction in which the compass needle points (compass North) is called the Deviation. It is measured East or West from the magnetic north. Deviation is east when the compass north is towards the east of magnetic north and vice versa.

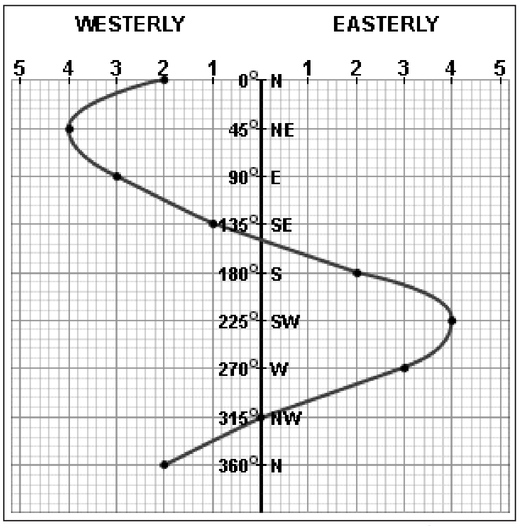


- In practice the deviation in the ship's magnetic compass is reduced to a minimum by the use of corrector magnets. The residual deviation is found for various compass headings and is recorded in the Deviation Table / Chart.

- **Estimating deviation**
  A deviation chart is prepared in tabular and graphical form mentioning deviations on various headings. It is noteworthy that if the corrector magnets are suitably positioned around the magnetic compass, the deviation of the compass observed at any location on the earth will remain more or less the same.

  However, differences in deviation can be expected if the vessel is carrying cargoes of magnetic nature such as steel, iron ore etc. Deviation may also vary from those depicted in the deviation chart when the vessel is transiting areas with magnetic anomaly or when the vessel undergoes major constructional changes or if she stays on the same heading for a considerable time such as on lay-up berths or in dry docks.

- **Deviation curve**
  Value of deviation can be directly read off from the chart for any compass heading or it can be interpolated for any compass heading from the deviation table.



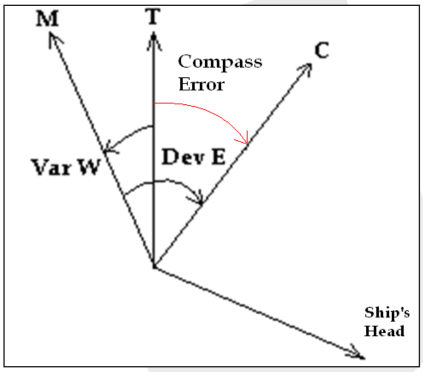
- **Deviation Table**

  Extract from the deviation table

Compass heading	*Deviation*
040°	*2°E*
050°	*3°E*
060°	*3°E*
070°	*3°E*
080°	*2°E*
090°	*1°E*
100°	*1°E*

- **True Course**

  It is the angle between the geographic meridian through the ship's position and the ship's head, measured clockwise from the meridian 000° to 360°, 000° pointing towards North on geographic meridian.



- **Magnetic Course**

  It is the angle between the magnetic meridian through the ship's position and the ship's head, measured clockwise from magnetic meridian 000° to 360°, 000° pointing towards Magnetic North on Magnetic meridian.

- **Compass Course**

  It is the direction as indicated by the ship's compass in the three figure notation from 000° to 360°.

- **Compass Error**

  Compass Error = Variation + Deviation

Example: For a true course of 080°, Calculate the compass course to steer, if the variation in the area is 5°E and the deviation is as per the table given.

Extract from the deviation table

Compass heading	Deviation
040°	2°E
050°	3°E
060°	3°E
070°	3°E
080°	2°E
090°	1°E
100°	1°E

True Course 080°

Variation 5°E

Magnetic Course 075°

Now we need to modify the table given above for the nearing values of heading as follows

Compass heading	Deviation	Magnetic Heading
060°	3°E	063°
070°	3°E	073°
080°	2°E	082°

Now we can interpolate for the required Magnetic course 075°

Magnetic Heading	Deviation
073°	3°E
082°	2°E

So for 075°, Deviation = $\frac{1° \times 2°}{9°}$ = 0.22° E = 13.33′ E

Hence for magnetic heading 075°, Deviation is 13.33′ E

Compass course = 074° 46.67′

b) Gyro compass

The gyro compass, when settled, points towards the geographic North Pole. However an error may be induced in the gyro compass caused due to ship's speed, ship's heading and/ or the latitude of the location. The same is checked taking compass errors using celestial or terrestrial observations. Gyro error is said to be high when for a certain direction gyro compass indicates a higher value. For example a direction 045° is shown as 047°, here the gyro error is 2° high. Vice versa applies for gyro error low.

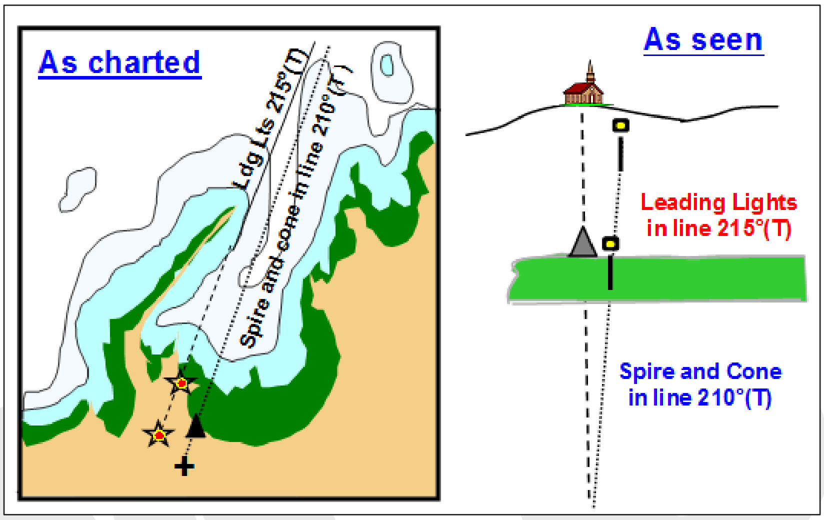
2) Compass error calculation

➢ **Celestial observations**
The topic is discussed under task A1.7.4 which shall be referred to for the same.

➢ **Terrestrial observations**

❖ Compass error can be checked using terrestrial observations using targets provided in the coastal area for transit bearing or leading lights.

❖ In this case two conspicuous targets are positioned near the coastline in a given line. The true direction of this bearing line is mentioned on the chart.



❖ The two objects are observed when in line and the compass bearing is noted. This compass bearing when compared with the true direction of bearing line gives the compass error.

❖ **Horizontal sextant angles**
This method is primarily used for determining the vessel's position However; compass error may be checked using the technique. Horizontal sextant angles are observed between two pairs of light houses. Position circles are drawn using the two values and the point of intersection gives the position of the vessel. The compass bearing of the light house is compared with the true bearing from the determined position of the vessel. This difference between the two bearings gives the compass error.

3) Compass error log

The compass error log is the book for recording compass errors. Compass error shall be checked at least once in every navigational watch. Generally the compass error log book is available in the prescribed format which includes the following details:

✓ Date and time - in GMT
✓ Ship's position - latitude and longitude
✓ Ship's heading - gyro & magnetic heading
✓ Bearing / azimuth of the object - true, gyro & magnetic
✓ Description of the observed object
✓ Computed error of the compasses –gyro and magnetic
✓ Variation in the area
✓ Deviation of the magnetic compass (as calculated)
✓ Any remarks - Vessel if heeled when the observation was taken, state of sea, repeater and compass (on ships with more than one gyro) used.
✓ Signatures of the OOW

Apply Your Knowledge

1. Practice taking compass errors as specified in the activity book.
2. While transiting a given area, the magnetic compass error is observed to be too high. Discuss the probable reasons for the same.

I M U

Function: Navigation

Competence: Plan and conduct a passage and determine position

Task number: A1.9

Sub-task Reference number: A1.9.7, A1.9.8

Topic: Meteorology

Task Heading

- Recognize main cloud types.
- Assist in observing, recording and sending weather observations.

Objectives

- Identify different types of clouds.
- Learn the procedures for making and reporting weather from ships.

Index

1) Clouds
2) Ship's weather reports and voluntary observing ships (VOS)

Description

1) Clouds

The process of cloud formation starts with the evaporation of water on the earth's surface as the sun's energy reaches the earth. The water vapor so formed rises higher and higher in the atmosphere, cooling gradually and finally condensing. The water vapor attaches to a condensation nuclei (any particulate or aerosol in the atmosphere that the water vapor can attach to; the particles may include dust, sea salt, sulfur and other like particulates). Cloud continues to grow as more and more condensation occurs in the atmosphere.

- **Cloud formation**

Clouds are formed by lifting of vapour mass. This lift may be caused in any of the following ways.
- Convection
- Frontal lifting
- Orographic lifting
- Turbulence

- **Different types of clouds** are associated to different weather patterns. Same are used to a great extent for predicting the weather. Based on the form and height clouds are named as follows:

High level clouds at heights at or beyond 6 km		
Name	Description	Picture
Cirrus (Ci)	Fibrous, white filaments, threadlike, white feather clouds composed of ice crystals First sign of an approaching warm front or upper-level jet streak	

Cirrostratus (Cs)	Milky, translucent cloud veil of ice crystals, often associated to halo phenomenon caused by light passing through ice crystals As a warm front approaches, cirrus clouds tend to thicken into cirrostratus	
Cirrocumulus (Cc)	Layered clouds permeated with small cumuliform lumpiness Fleecy cloud, Cloud banks of small, white flakes and rippled elements	
Medium level clouds at heights of 2- 6 km Composed of liquid water droplets, ice crystals, or a combination of the two, including super-cooled droplets		
Name	Description	Picture
Altocumulus (Ac)	cloud bundles generally white with some shading, layered, rippled elements sheds or rollers, compound like rough fleecy cloud often arranged in banks, Altocumulus may align in rows or streets of clouds, with cloud axes indicating localized areas of ascending, moist air, and clear zones between rows suggesting locally descending, drier air. Altocumulus clouds with some vertical extent may denote the presence of elevated instability.	
Altostratus (As)	Dense, gray layer cloud, often spread evenly and opaque, allows sun to appear as if through ground glass These frequently indicate the approach of a warm front and may thicken and lower into stratus, then nimbostratus resulting in rain or snow. However, these clouds themselves do not produce significant precipitation at the surface, although sprinkles or occasionally light showers may occur from a thick alto-stratus deck.	
Low level clouds at heights of 0-2 km consist of liquid water droplets and even super-cooled droplets, (ice crystals and snow during cold winter storms)		
Name	Description	Picture
Strato-cumulus (Sc)	Cloud plaices, layered, series of rounded rolls, generally white with some gray shading Stratocumulus clouds are hybrids of layered stratus and cellular cumulus. These clouds appear frequently in the atmosphere, either ahead of or behind a frontal system.	
Stratus (St)	Even spread grey, low layer cloud Uniform and flat, gray layer of cloud cover which may be precipitation-free or may cause periods of light precipitation or drizzle. Low stratus decks are common behind a storm system when cold, dismal, gray weather can linger for several hours or even a day or two.	

Nimbostratus (Ns)	Grey, dark thick layer, low base cloud indistinct outlines Generally thick, dense stratus or stratocumulus clouds producing steady rain or snow	
Clouds with large vertical extending at heights of 0-13 km		
Name	Description	Picture
Cumulus (Cu)	Heap cloud with flat basis in the middle or lower level, whose vertical development resembles towers, cauliflower or cotton Cumulus clouds are cellular in nature, have flat bottoms, rounded tops and grow vertically. Depending on the degree of vertical development these are further named as scattered cumulus clouds (showing little vertical growth) also called fair weather cumulus. The Cumulus clouds indicate instability to the layering of air with appropriate convection or turbulence.	
Cumulo-nimbus (Cb)	Cumuli-form clouds with a great vertical extent, large cauliflower-shaped towers, often 'anvil tops', If enough atmospheric instability, moisture, and lift are present, then strong updrafts can develop in the cumulus cloud leading to a mature, deep cumulonimbus cloud associated with a thunderstorm producing heavy rain. The Cumulonimbus always indicates a strong instability to the layering of air with appropriate convection or turbulence.	

2) Ship's weather reports and voluntary observing ships (VOS)

➢ In accordance with the provisions of SOLAS regulation V/5, the ships are encouraged to collect meteorological data at sea and transmit in the form of weather reports. Ships are equipped with fairly basic sensors to measure air and sea temperature, pressure and sometimes wind. The other meteorological parameters, i.e. cloud, visibility, weather and wave or state of sea are provided by visual estimate from a ship officer. When in the vicinity of a tropical cyclone or of a suspected tropical cyclone, ships shall try to transmit their weather observations at more frequent intervals.

➢ The worldwide weather reporting schedule for voluntary observing ships is 4 times daily — at 0000, 0600, 1200, and 1800 UTC. These are the "main synoptic" times, when weather forecasts are prepared. Two of these times, 0000 and 1200 UTC, are most important — when the numerical weather prediction models are initialized with data and also when soundings are released from upper air stations all over the world. Observations shall be taken as close to the synoptic hour as possible. In exceptional cases the observation may be taken up to 1 hour earlier in which case the actual time of observation shall be mentioned in the report.

➢ Reporting weather once every 3 hours when within 300 miles of a named tropical storm or hurricane is also standard practice worldwide. Storm (wind speed 48 knots or higher) or special reports for conditions not forecast, much worse than forecast, or for sudden weather changes) should be sent whenever conditions warrant.

➢ Under GMDSS, meteorological observations from ship can be sent free of charge via the Inmarsat satellite system using transmission code 41. The cost of transmission is paid by the meteorological service of the receiving country.

➢ The WMO code form Code FM 13-X is the ships' synoptic code, used by weather reporting ships. The publication is often available in the form of 'Ship's Weather Code' which provides a standard coded procedure for ship's to send the weather reports to port meteorological offices.

The code makes it practical to understand and process data, manually or by computer, for real-time use or later compilation into climatological records. The codes along with the meaning are as explained below.

➢ Code FM-13-X-SHIP, **the ships synoptic code**, comprises of 23 groups of symbolic letters representing meteorological and oceanographic elements, report identification and ship location data. These codes grouped into three sections are as follows:

❖ Ships Synoptic Code Section 0 (mandatory section)

BBXX D….D YYGGiw 99LaLaLa QcLoLoLoLo

❖ Ships Synoptic Code Section 1

4ixhVV Nddff 1snTTT 2snTdTdTd

4PPPP 5appp $7wwW_1W_2$ $8N_hC_LC_MC_H$

❖ Ships Synoptic Code Section 2

$222D_sV_s$ $0_{ss}T_wT_wT_w$ $2\ P_wP_wH_wH_w$ $3\ d_{w1}d_{w1}$ / /

$4P_{w1}P_{w1}H_{w1}H_{w1}$ $5P_{w2}P_{w2}H_{w2}H_{w2}$ $6I_sE_sE_sR_s$ $8\ swT_bT_bT_b$

ICE $c_i\ S_i\ b_iD_iz_i$

The ship's weather code and Mariner's Handbook shall be used to code report as stated above.

Apply Your Knowledge

1. Identify the following clouds

2. Observe and record weather observations in the code format shown below. (minimum 10)

BBXX	CALL SIGN		
YYGGiw	99LaLaLa	QcLoLoLoLo	4ixhVV
Nddff	1SnTTT	2SnTdTdTd	4PPPP
5appp	7wwW$_1$W$_2$	8NhC$_L$C$_M$C$_H$	222DsVs
0SnTwTwTw	2PwPwHwHw	3d$_{w1}$d$_{w1}$d$_{w2}$d$_{w2}$	4P$_{w1}$P$_{w1}$H$_{w1}$H$_{w1}$
5P$_{w2}$P$_{w2}$H$_{w2}$H$_{w2}$	6IsEsEsRs	8swTbTbTb	ICE ciSibiDizi

Function: Navigation

Competence: Maintain a safe navigational watch

Task number: A2.1

Sub-task Reference number: A2.1.4, A2.1.5, A2.1.6

Topic: Watchkeeping

Task Heading

- Demonstrate understanding of procedure for handing over and taking over a bridge watch and the principles of safe watchkeeping and bridge manning levels.
- Assist watchkeeping officer in keeping a safe navigational watch at sea.
- Assist watchkeeping officer in keeping an anchor watch.

Objectives

- To understand the practical aspect of bridge watchkeeping

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

Index

Description

1) Bridge watchkeeping in practice

The principles of handing over / taking over navigational watch, keeping a navigation/ anchor watch have been discussed under Tasks A2.1.1, A2.1.2, and A2.1.3. In this writing we shall be discussing further important aspects of these principles in relation to watchkeeping. The basic purpose of watchkeeping is to ensure safety of navigation. Safe navigation in turn ensures the transport of cargo across the oceans in safe and economical manner.

a) Team work

The ship is manned in accordance with the safe manning regulations so that the requisite qualified manpower is available to address each and every aspect of navigation. However situations are not very uncommon when ships end up into casualties, most of which root to human factors. The concept of team work treats the safe navigation as the responsibility of the bridge team. The team is headed by the master and comprises of navigational officers and the supports staff which includes the lookout men and helmsmen. All the members of the bridge team have individual roles to perform. The important feature of teamwork is that the weak points of one team member are significantly countered by other team members which eliminated the likelihood of single person damages.

b) Situational awareness, alertness and promptness in actions

Effectiveness of bridge watchkeeping depends on the continual situational awareness of the watch-keepers. The OOW shall have complete overview of all the happenings on board and in surrounding. This information shall be continuously updated. This helps him to analyse any limitations affecting the vessel and taking avoiding actions promptly. Being aware of the situation, the OOW shall be able to foresee the hazards and identify timely corrective actions. Alertness will help remove or reduce the likelihood of any hazardous occurrence.

c) Calling master and additional manpower

It is advised to inform master with issues relating to watchkeeping, it is expected that master will, because of his advanced knowledge and experience, be able to control the navigation situation. However it shall be understood that master will also need time in order to assess the situation and to decide on the control measures. Hence whenever required, he shall be notified well in time. Similarly, officers and support staff shall be informed well in time so that suitable manpower is available to take charge of the vessel's navigation. Situations known in advance are organized with the help of watchkeeping levels, whereby the bridge team will have sufficient suitable personnel on bridge to control the navigation of the vessel. The composition of bridge team varies depending on the navigational situation.

d) Fitness for watchkeeping

A member of bridge team might be experiencing temporary illness due to which his physical condition may hinder safe watchkeeping. Some of the members of the bridge team might experience sea-sickness while navigating in rough weather. Such situations may demand re-organizing the watch schedules in order to ensure safe navigation. The people requiring medical attention shall be attended at the earliest. People on sedative medication may also not be fit for watchkeeping.

The watchkeeping officers may experience fatigue due to tight schedules which is usually very common while the ships call at ports for short durations. In such cases the watches shall be so organized that the fatigue factor and fitness for watchkeeping is duly addressed. The watchkeeping schedules shall be so adjusted that the watchkeeping officer and the team is suitably rested prior keeping the navigational watch.

A common problem often experienced by the watch-keepers is disturbing noises or maintenance works during the rest hours. The person in-charge of such operations shall consider these while planning the operation. If the work site or schedule cannot be altered, the person occupying such spaces for rest shall be assigned some other comfortable locations for taking rest. In addition to these, unfavourable conditions within the accommodation such as malfunctioning air-conditioning system etc. are likely to affect the watch-keepers' rest to a great extent. Such issues shall be addressed and rectified at the earliest.

e) Punctuality and discipline

As discussed above, the ship's bridge is manned on a rotation of watches. The watch-keepers shall ensure that they stick to the watch schedule. Punctually maintaining the watch rotation helps to organize the work and rest periods so that none of the members of the bridge team suffer from fatigue. While carrying out bridge watches, discipline is first and foremost. The members of the watchkeeping team shall not undertake any such work/assignment which will interfere with the safe watchkeeping. Any sources of distraction shall be kept away from the navigation bridge.

f) Organizing and prioritizing

Organizing and prioritizing works is very important particularly when a number of operations are going on simultaneously. The watch-keeper shall know the criticality of issues need to be addressed and the priority of those. Most of the situations can be handled by suitable pre-defined bridge watch levels. However, certain unexpected conditions may come up requiring additional support.

g) Reliance on electronic aids

Miscellaneous bridge equipments and electronic aids are provided on navigation bridge for the purpose of watchkeeping. However it shall be remembered that these are ONLY aids for navigation and collision avoidance. The limitations of each such navigational aid shall be well understood by the navigating officer. Over reliance on any of these aids exposes the ship to a hazardous situation. For example, RADAR ARPA may have a visual/ audible alarm set for warning the navigator of a target on a collision course. However, it shall be noted that the alarm will not sound for a target which is left not acquired.

h) COLREGs

International regulations for Prevention of Collision at Sea (COLREGs) define the conduct of vessel in various traffic situations under different conditions such as restricted waters, restricted visibility etc. It shall be noted that the main intention of the COLREGs is to regulate the traffic in suitable manner for safe transit without any collision. Most of the rules use modals ‘May’, ‘Shall’ or clauses such as ‘If practicable”, ‘Circumstances of the case permit” etc. The intention is not to confuse the navigator. Rather, it emphasizes that the OOW is in-charge of the vessel and depending on the prevailing conditions he shall make the full appraisal of the situation and decide the avoiding action in accordance with the COLREGs. This involves considering limitations of the individual ships, or peculiarities of the situation which cannot be listed in the COLREGs. The COLREGs are developed to be accepted internationally in order to ensure uniformity across the globe. This will help the two vessels involved in a traffic situation identify their roles. However, for the safety of the vessel, wherever required, the OOW may make a deviation from these rules.

In a traffic situation, COLREGs identify two vessels as ‘Stand on vessel’ and ‘Give Way vessel’ when vessels are in sight of one another. In restricted visibility both vessels are required to take action. The responsibilities of vessels to avoid collisions and close quarter situations are listed in these rules. Stating that the collision occurred because the “Give way vessel did not take action” as an excuse is not acceptable in justification; because even if the ‘Give Way vessel’ fails to take proper and effective action to avoid collision, the ‘Stand on vessel’ shall ensure that the two ships pass well clear.

i) Use of engines

Ships do not have brakes like road vehicle. The vessel proceeding at Sea has six options in a navigational traffic situation. These are

- ✓ Alter course to port
- ✓ Alter course to Starboard
- ✓ Increase speed
- ✓ Decrease speed
- ✓ Stop Engines
- ✓ Run engines full astern

In open seas the most preferred and effective action for avoiding collision is alteration of course. COLREGs specify a starboard alteration for head on situations. However, the navigator shall have the clear understanding that he has five more options to control the vessel in a traffic situation. Use of engines alone may not always be effective to avoid collision. But, the same when supplemented with the helm may prove effective.

j) Economic aspect of the voyage

The economic aspect of the voyage needs due consideration and the same is required for the financial profits. This involves safety of vessel, crew, cargo, optimum use of machineries and fuel. However, at any point the safety is first and foremost because if the cargo is not transported safely the financial profits are likely to turn into huge losses. Example for this could be vessel proceeding at high speeds through piracy prone areas. The ship in such cases is likely to consume more fuel than what would be consumed while running at economical speed. However, this extra cost is saving the vessel from the likelihood of being hijacked resulting in huge costs.

k) Recordkeeping

The importance of record keeping is discussed in detail under tasks A2.1.10, A2.1.11. It is recommended to keep noting the salient points in the bell (movement) book for records because at the later time it may not be feasible to recollect all the happenings of the processes.

Apply Your Knowledge

1. Discuss the actions as an OOW while seeing a NUC vessel drifting on to your vessel at anchorage.
2. Discuss the action required by ‘stand on vessel’ as per COLREGs.

I M U

Function: Navigation

Competence: Maintain a safe navigational watch

Task number: A2.2

Sub task Reference number: A2.2.2, A2.2.3

Topic: Navigational equipment

Task Heading

- Demonstrate ability to set up and operate:
  - NAVTEX, including selecting and deselecting message types and transmitting stations
  - Weather fax, where fitted
  - Distance/speed logs
  - Bridge controls during maneuvering; e.g. telegraph, whistle / horn, intercom.
- Assist in renewal of recording paper of various equipment; i.e. course and rudder position indicator recorder, echo sounder, telegraph order printer, NAVTEX, weather fax, GMDSS printers, etc.

Objectives

- Understand the principle and demonstrate the operation of NAVTEX receivers.
- Understand the principle and demonstrate the operation of weather fax receivers.
- Understand the principle and demonstrate the operation of distance / speed logs

Please read this task in conjunction with tasks A1.9.9 and A1.9.10

Index

1) NAVTEX
   a) SOLAS convention requirement
   b) NAVTEX report format
   c) Operation and use
2) Weather fax receiver
   a) Principle
   b) Radio facsimile transmissions
   c) Operation and use
3) Distance / speed log
   a) Doppler log
   b) Electromagnetic log

Description

1) NAVTEX

NAVTEX is an information system for receiving MSI (Maritime Safety Information, i.e. navigational and meteorological warnings, meteorological forecasts, and other urgent safety-related messages) and automatic reception of MSI by means of narrow-band direct-printing telegraphy.

- NAVTEX transmissions are made and sent by (Radio TELEX) transmitters at CRS (coast radio stations) on:
  - 518 kHz MF (Medium frequency) - MSI are transmitted in English - known as International NAVTEX and/or
  - 490 kHz MF - MSI and/or other local information are transmitted in the local language primarily for small vessels - known as National NAVTEX and/or

❖ 4209.5 kHz HF (High Frequency) – MSI and/or other local information are transmitted in the local language. It is used exclusively for NAVTEX-type transmission out of the NAVTEX range where MF reception could be difficult.

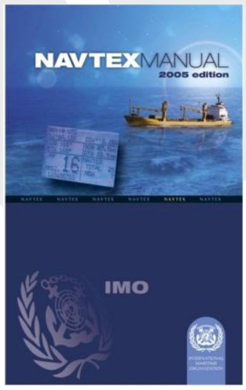
➢ NAVTEX is used for transmitting MSI to vessels in coastal waters (approximately within 400 NM of a NAVTEX station). NAVTEX messages can be received by the NAVTEX receiver.

a) SOLAS convention requirement

NAVTEX is a part of Global Maritime Distress and Safety System (GMDSS) developed by the International Maritime Organization (IMO) and incorporated into the 1988 amendments to the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, as a requirement for ships to which the convention applies.

➢ SOLAS vessels are required to carry a dual frequency receiver if reception on 490 kHz is required since availability to receive messages on 518 kHz must be maintained at all times, or they must carry two single frequency receivers tuned on different frequencies. A receiver should comprise (for displaying or printing the received MSI) either:
❖ an integrated printing device or
❖ a dedicated display device and printer output port or
❖ a connection to an integrated navigation system.

➢ On a non-SOLAS vessel, a single frequency receiver is permitted. The user can switch to the 490 kHz frequency for reception of a message (at a scheduled transmission time) and then switch back to the 518 kHz frequency when the message has been received.



➢ IMO has published a NAVTEX manual, which describes the structure and operation of the NAVTEX service. It is intended primarily for use by maritime administrations and others concerned with the preparation and broadcasting of maritime safety information. It will also be of interest to seafarers, ship-owners and others who need to receive such information in order to safely go about their business at sea.

➢ The GMDSS manual also published by IMO, contains the 2005 NAVTEX manual and the revised NAVTEX manual 2012

➢ The list of Navtex stations is given in Admiralty list of radio signals Volume 5. Referring to NAVAREA, the desired Navtex station needs to be selected in the equipment menu when navigating in a certain area.

➢ 26 Different types of messages are transmitted by NAVTEX stations of which message types A, B, D and L, named as follows are mandatory and cannot be excluded.
A - Navigational warning
B - Meteorological warning
D - Search and rescue information
L - Navigational warnings - additional to letter A

➢ Routine messages are repeated several times a day.

b) NAVTEX report format

❖ Serial number of message DE87- first alphabet 'D' is the transmitting station's identity, the second alphabet 'E' denotes the message type and the 87 is the serial number of the message.
❖ This is followed by the station name and time in UTC.
❖ Then follows the header and text of the message
❖ The message closes with NNNN.

c) Operation and use

- Switch on the unit.
- Carry out a self test.
- Select the NAVTEX stations to be monitored. More than one can be selected. Each NAVTEX transmitting station has its own identifying letter
- Select the type of messages to be received.
- Take a print out of the status to confirm that the correct coast stations and message types have been selected
- Make sure that there are sufficient rolls of NAVTEX paper on board. Check that there is paper in the receiver.
- Turn the NAVTEX receiver on at least four hours before sailing, or better still, leaves it turned on permanently. This avoids the chance of losing vital information that could affect the vessel during its voyage.
- Make sure that the equipment operating manual is available close to the equipment, paying particular attention to the fact that your equipment may be programmed differently from other makes and models.
- Using the equipment operating manual, make a handy guide for programming, status and auto testing procedures for your vessel's equipment, place it in a plastic cover and keep it with the equipment.
- Have available next to the equipment a plasticized copy of the NAVAREAs/METAREAs in which the vessel is likely to sail, showing the NAVTEX stations, their coverage ranges, their respective time schedules and B1 characters.
- Program your receiver to accept only those messages identified with the B1 character of the NAVTEX station which covers the area in which your vessel is currently sailing and the one covering the area into which you are about to sail. This will avoid the equipment printing information which has no relevance to your voyage and will avoid unnecessary waste of paper.
- Program your receiver to accept only those messages identified with the B2 characters (type of message) you wish to receive. It is recommended that most B2 characters (A to Z) be programmed, but you may exclude those for nav aid equipments (Decca or Loran for example) with which your vessel is NOT fitted.
- Take extra care not to confuse the programming of B1 characters (station designators) with those of B2 characters (type of messages). It is very easy for an operator to believe that he/she is programming B1characters when in fact they are programming B2 characters. After programming ALWAYS CHECK the program status to ensure that it is correct.
- If information is received incomplete/garbled, inform the relevant NAVTEX station, giving the time of reception (UTC) and your vessel's position. By so doing, not only will you obtain the information you require, but you will also help to improve the system. In the same way, any safety-critical occurrences observed during the voyage must be passed immediately to the nearest (or most convenient) Coast radio station and addressed to the relevant NAVAREA/METAREA or national coordinator responsible for the area in which you are sailing

2) Weather fax receiver

a) Principle

Weather chart or satellite picture to be transmitted is electronically sliced into narrow strips and transmitted by high frequency (HF) radio piece by piece serially. That is why they are also called as Radio facsimile charts. At the receiver these strips are reconstructed to produce the original chart or picture. This is similar to the principle used in TV broadcasting.


Although with the advent of modern technology now available with ship master and officers, these weather charts can be received by email through internet also from some selected stations. For this task we shall restrict ourselves to weather fax charts received through radio.

b) Radio facsimile transmissions

Many meteorological services worldwide provide daily radio – facsimile transmissions of weather charts. Some of the charts useful to maritime navigation are listed below: -

- Surface weather analysis – These show weather patterns based on current synoptic surface observations. They are normally made a few hours before transmissions.
- Surface weather prognosis – These indicate future weather patterns for 24 hour, 36 hour, 72 hour or 96 hour outlook for specific regions.
- Extended surface prognosis – These indicate forecast positions of fronts and pressure systems at the surface for a projected period of 2 to 5 days.
- Wave analysis – These show characteristics of 'sea waves'. They are based on synoptic wave observations made shortly before transmission, or based on calculations derived from wind and wave patterns. Lines connect points of equal wave heights.
- Wave prognosis – These charts provide a forecast of the positions of wave systems, normally over a 24 hour period.
- Sea temperature – These reflect surface temperatures and forecast contours for a given period which is normally over 1 week, ten days or monthly periods. They are based on mean values for a given period. They may also include anomalies in sea temperatures.
- Sea ice charts – Sea ice areas are depicted together with their ice cover. Also known positions of icebergs are shown.
- Satellite weather pictures – Show cloud cover, tropical cyclones, and the positions of any disturbances in weather patterns.

c) Operation and use

- Switch on the unit few minutes before commencement of transmission from the facsimile station. Ensure that there is sufficient recording paper.
- Tune the receiver to the required frequency.
- Set the correct speed and IOC number for the facsimile station selected. If the speed is incorrectly set, a portion of the picture will be overlapped or a multiple picture will be recorded. If the IOC is incorrectly set, the picture will be fore shortened or expanded to the paper feed direction. Normally the speed available is 60, 90, 120 and 240. The IOC available is 288 & 576. The correct speed and IOC number for each station is given in the facsimile schedule book or the Admiralty list of radio signals.
- When the transmission starts and the printer start recording, check to ensure that the phase matching is correct. Normally the phase matching is carried out automatically but in case the phase is mismatched the recording will be split into two parts by a thick white or black gap called a dead sector. When this occurs, the 'PHASE' key is used to shift the

dead sector to the left edge of the recording paper and thus ensure that there is no split in the recording. The 'SYNC' control can be used to further fine tune phase matching.

- Most facsimile stations transmit a phasing signal before sending pictures.
- The phasing signal is a continuous black signal with narrow white gaps at the seam of the original picture.

❖ In case of manual mode the recording will have to be started and stopped manually. In the automatic mode, the recording will start and stop automatically as long as the receiver is on. To enable fully automatic start and stop of picture recording, most facsimile transmitters send remote start and remote stop signals before and after the transmission of pictures. The remote signals appear as black / white stripes on the recording paper.

❖ Carry out routine maintenance as stated in the equipment manual. Normally this is just a monthly cleaning of carbon and dirt deposits from the inside of the recorder.

❖ Some receivers have a self test to check the print head. Do this monthly to check the condition of the printer head. Do not touch the printer head.

❖ Keep stock of the recording paper. Some receivers use thermal recording paper. These should be stored in a cool dry place.

❖ Regularly check the antennae and its connections especially after experiencing strong winds.

3) Distance / speed logs

a) Doppler log

Doppler transducer - operating principle

❖ The Doppler speed log measures ship's speed by using the ‘doppler effect’, which is observed as a frequency shift resulting from relative motion between a transmitter and receiver or reflector of acoustic/ electromagnetic energy.

❖ Doppler shifted sound waves are used to determine the ship's speed relative to the water.

❖ A transducer fitted in the keel of the ship transmits a beam of sound vibrations in the water at an angle. A second transducer receives the diffused and reflected sound vibration from the seabed or the water below the ship.

❖ The difference in the frequency of the received and transmitted signal is measured. This difference in frequency will be proportional to ship's speed, direction of motion and signal transmission angle with respect to ship's motion vector.

❖ The resultant returning signals are amplified and applied through appropriate signal processing circuits to a computer which performs calculations to determine the fore and aft speed vector of the doppler-shifted reflected signals.

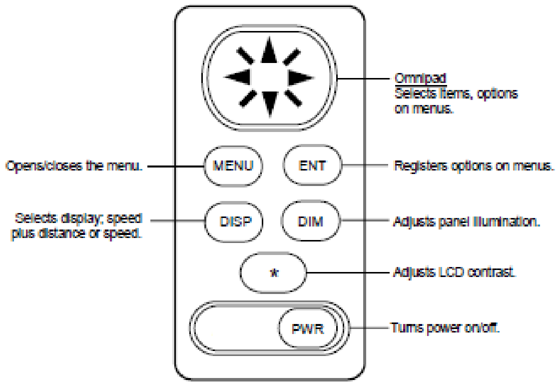
❖ Two pairs of transducers are fitted - one for transmitting and receiving the sound signals in the forward direction and the second pair for the aft direction. This allows the average speed difference to be determined independent of the effect of dynamic forces resulting from ship's pitching or heaving motion.

❖ After transmission of the sound signal, there is a time delay before the next transmission to ensure that the reflected signal from undisturbed water outside the ship's boundary layer is received.

❖ For greater accuracy, the speed data is averaged over several transmit / receive cycles.

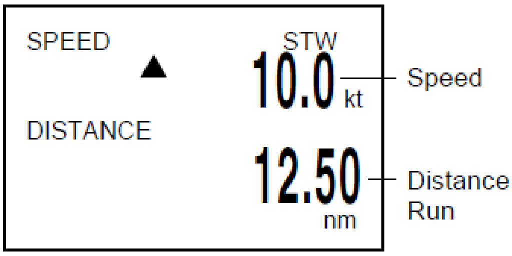
❖ Possible sources of error include temperature, pressure, salinity of water; ship's movements like rolling and pitching, trim of vessel and transducer alignment.

- ❖ Doppler log measures speed to the nearest 0.01 knot. Due to its accuracy, it is useful for berthing at jetties or buoys, dropping or heaving anchor and manoeuvring in close waters. However the doppler log does not function effectively if there are air bubbles below the transducer which can be caused when the ship is going astern or due to the propeller wash of a tug assisting the ship during docking.
- ❖ When the sound signals reflected from the seabed are used to calculate the speed, the log is said to be in bottom track mode.
- ❖ In depths of over 200 metres the sound signals will be absorbed and scattered in which case the reflections received from the water layer at 10 to 30 metres below the keel are used to calculate the speed. This is known as water track mode.
- ❖ The transducer penetrates the hull such that its face is flush with the exterior of the hull. The transducer can be raised in its sea chest and its gate valve closed. This should be carried out before the vessel enters dry-dock or under any other circumstances where there is a possibility of the transducer getting damaged.



Controls

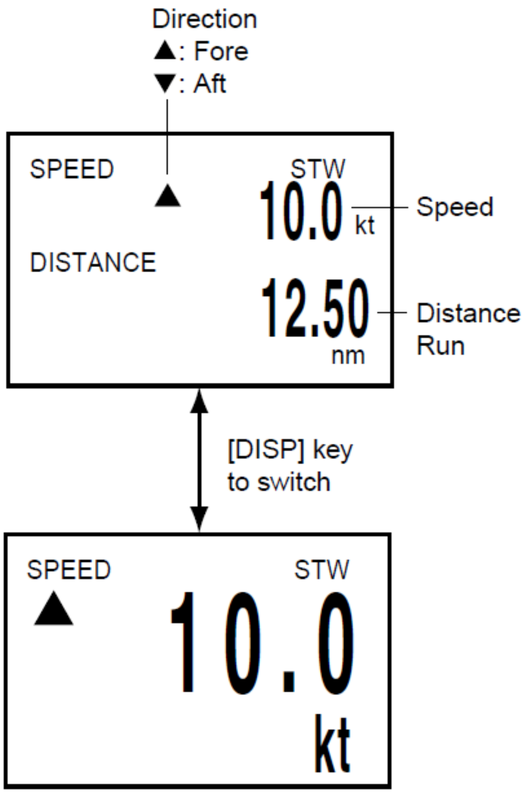
- ❖ Although the controls of ‘doppler logs’ on various ships will be different, reference shall be made to the user manual for the equipment.
- ❖ Press the [POWER] switch to turn on the equipment. The last-used display appears.
- ❖ The example below shows the speed and distance run.



Note: STW means speed through water. This indication flashes when transducer temperature, which can be monitored on the TEST display, is abnormal. This means speed accuracy is less than stated in the specifications.

Selecting a display

- ❖ Press the [DISP] key to select display desired. Each time the key is pressed the display shows speed and distance run or speed alone as below.



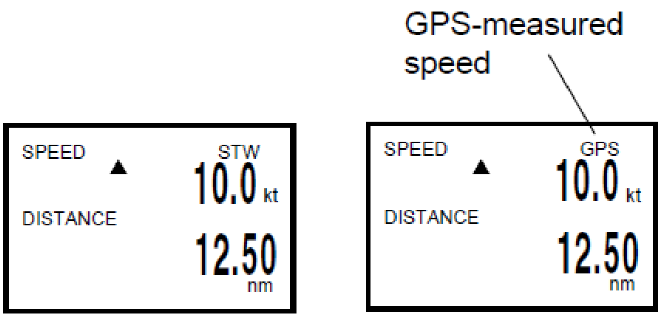
- Arrow indicates direction: ▲ indicates fore; ▼, aft.
- The distance run indication shows the total distance run in forward speed only.
- The distance run is backed up when the power is turned off.

Speed data selection

When the instrument fails to work as a speed and distance measuring equipment (SDME), the display unit can be used as a monitor display tool for a GPS speed or other equipment measuring the ship's speed.

i. Open the SYSTEM MENU.
ii. Select SPD DATA SELECT and press the [ENT] key.
iii. Select the option GPS and press the [ENT] key.
iv. Press the [MENU] key twice to close the menu.

See the illustration below for speed display information. If the speed displayed is unstable perform the check described in troubleshooting section of the manual.



Doppler speed GPS speed

b) Electromagnetic log

This type of log uses the Faraday-Maxwell induction law. This states that if a conductor cuts through a magnetic field, a small electro-magnetic force will be induced within itself which is proportional to the speed of the movement of conductor.

Electromagnetic sensor - operating principle

The electromagnetic sensor houses a coil which, when energized with an AC current, produces a magnetic field around the sensor in the surrounding water. The ship's motion through the water produces an electrical field (E) perpendicular to the magnetic field (B) and the ship's motion (V). The resulting signal is picked up by the sensor electrodes and fed to the preamplifier where it is converted into a digital format and transmitted to the electronics unit.

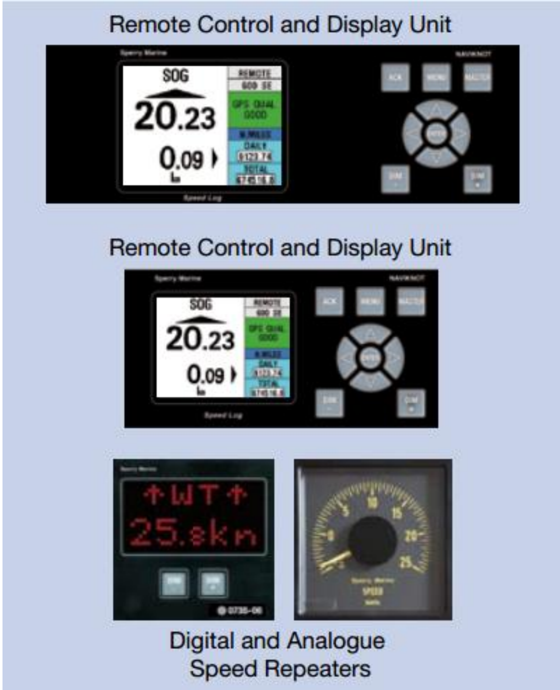
The coil of the E.M. log is enclosed in a watertight flow probe which projects through the ship's hull into the water. An alternating current is supplied to this coil to create the magnetic field. Flush type sensors with sea valve are also available. The sensor of the flush type can be replaced without dry-docking.

Flush probe

On-board retractable flush probe

- ❖ Since seawater is a conductor of electricity, it acts as a conductor.
- ❖ When the seawater flows past the sensor, the magnetic field induces a voltage in the water that is proportional to the speed of the ship relative to the water.
- ❖ Electrodes are fitted on both sides of the sensor and these electrodes are connected to a voltmeter device to measure the induced voltage and thus the speed is obtained.
- ❖ The speed can be displayed in analog or digital form. Total distance traveled is also indicated.

IMU



- ❖ The flow probe can be retracted into a tube by an electrical control either from the bridge or engine room. This should be done when the vessel is in shallow waters and before entering dry dock.

Some precautions that needs to be exercised when using SPEED/ DISTANCE LOGS

- ❖ The speed/distance logs must be kept on whenever it is practical to do so.
- ❖ The distance reading should be entered in the log at the end of each watch. A close check should be kept on the error of the speed/ distance log
- ❖ The accuracy of the speed/ distance log input to the ARPA or other navigation equipment must be checked frequently.
- ❖ Special caution must be exercised when an E.M. Log is used as input for speed, especially in strong tides/currents, as the speeds may not be accurate.

The operation and set up of Bridge controls during maneuvering; e.g. telegraph, whistle / horn, intercom is a very hands on task and so is the procedure of renewing recording paper of various equipment; i.e. course and rudder position indicator recorder, echo sounder, telegraph order printer, NAVTEX, weather fax, GMDSS printers, etc. Reference shall be made to the equipment's operation manual for same and manufacturer's instructions followed.

Apply Your Knowledge

1. List the checks to be carried out on the navigational equipment each noon to confirm that the equipment is performing to its optimum efficiency.
2. Check the significant NAVTEX stations you will encounter during your next voyage.

Function: Navigation

Competence: Maintain a safe navigational watch

Task number: A2.2

Sub-task Reference number: A2.2.4

Topic: Navigational equipment

Task Heading

- Locate and identify all the navigational and emergency equipment being supplied by the emergency switchboard for safe navigation.

Objectives

- Understand the provision of sources of electrical power on board in case of an emergency;

Please read this task in conjunction with task C3.1.17

Index

1) Emergency source of electrical power

Description

1) Emergency source of electrical power

- The emergency source of power is provided on board primarily for supplying power during emergency when the main power supply unit fails. During normal operation of the vessel, the main power supply feeds in the emergency switch board and in case of blackout the emergency generator/ battery feeds in to the ESB.
- The emergency generator is driven by a suitable prime mover with an independent supply of fuel, having a flashpoint (closed cup test) of at least 43°C. It is required to start automatically upon failure of the main source of electrical power supply and connects to the emergency switchboard within maximum 45 sec.
- Where an accumulator battery is provided as the emergency source of electrical power is it shall be capable of carrying the emergency electrical load without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal voltage. It is also connected automatically to the emergency switchboard in the event of failure of the main source of electrical power

- A main switchboard is directly supplied by the main source of electrical power or power transformer and intended to distribute electrical energy to the unit's services. The emergency switchboard is provided to be directly supplied by the emergency source of electrical power and/or the transitional source of emergency power in the event of failure of the main electrical power supply system. Emergency switchboard distributes electrical energy to supply all services essential for safety in an emergency. The emergency switchboard is installed near to the emergency source of electrical power. In the case of emergency generator it is usually installed in the same compartment. However in case of batteries, it is NOT allowed to be fitted in the battery compartment.

- The navigation bridge equipments connected to emergency power supply are as follows. The emergency power supply shall be available for all these equipments for at least18 hrs.

- Magnetic compass lamps
- Gyro-compass and repeaters
- Auto pilot
- Navigation lights and other lights
- Telegraph
- GPS
- RADAR and ARPA
- VHF
- Echo-sounder
- Speed log
- AIS
- Daylight signaling lamp
- Ship's whistle
- ECDIS
- Sound reception system if fitted
- Rudder angle indicator
- Tachometer and propeller thrust, pitch and operational mode indicators
- Rate-of-turn indicator
- Integrated bridge systems
- GMDSS – MH/HF radio installations, ship earth station satellite communication terminals
- All internal communication equipment (including public address system) as required in an emergency

- In addition to above, the following systems are also connected to the emergency power supply
- Emergency lighting at every muster and embarkation station and over the sides for a period of at least 3 hours.
- Emergency lighting for a period of at least 18 hours.
  - ✓ in all service and accommodation alleyways, stairways and exits, personnel lift cars and personnel lift trunks
  - ✓ in the machinery spaces and main generating stations including their control positions
  - ✓ in all control stations, machinery control rooms, and at each main and emergency switchboard
  - ✓ at all stowage positions for firemen's outfits
  - ✓ at the steering gear
  - ✓ at the fire pump
  - ✓ at the sprinkler pump, if any,
  - ✓ at the emergency bilge pump, if any
  - ✓ in all cargo pump-rooms of tankers

- The fire detection and fire alarm system (and emergency fire pumps if dependent upon the emergency generator for its source of power), the emergency bilge pump, and all the equipment essential for the operation of electrically powered remote controlled bilge valves, any power operated watertight doors together with their indicators and warning signals for a period of at least 18 hours.

- The emergency sources of electrical power shall be maintained and tested as per company PMS. This is also tested during safety surveys.

- Batteries require regular inspection and maintenance, the most common being replenishing the water in the batteries. However, prior carrying out any maintenance work on batteries following safety precautions shall be taken. Use of maintenance free batteries is common nowadays.
- Ventilate the battery room prior entering as there could be toxic/ flammable gases inside the battery locker.
- Wear suitable insulating shoes and gloves.
- Use safe equipments for use with batteries. Metallic equipments may cause spark.
- Care shall be taken to protect contact with the acid contained in the batteries.

Apply Your Knowledge

1. Locate the emergency generator on board your vessel and check its starting procedure.

Locate the batteries (if fitted) on board your vessel and check it's on/ off voltages.

IMU

Function: Navigation

Competence: Maintain a safe navigational watch

Task number: A 2.3

Sub-task Reference number: A 2.3.2

Topic: Ship reporting systems

Task Heading

- Assist watchkeeping officer in making various reports pertaining to ship reporting systems, as per their prescribed formats given in the publications and assist in sending such reports.

Objectives

- Understand the procedure for preparing reports pertaining to ship reporting systems.

Please read this task in conjunction with taskA2.3.1

Index

1) Ship reporting system
2) Standard formats for reporting
3) AUSREP reports
4) StraitRep
5) JASREP reports
6) INSPIRES and INDSAR

Description

1) Ship reporting system

- A ship reporting system shall be used by all ships, or certain categories of ships or ships carrying certain cargoes in accordance with the provisions of each system so adopted. SOLAS chapter V - regulation 11, mentions regarding ship reporting systems.

- Ship reporting systems gather and/or exchange information through radio reports. The information is used to provide data for purposes such as search and rescue, vessel traffic services, weather forecasting and prevention of marine pollution etc. The information provided should be restricted to that necessary for the proper operation of the system and for safety.

- IMO recommends use of a standard reporting format for ship reporting system in order to ensure uniformity and avoid confusions. The format in general is as follows. The sections of the ship reporting format which are inappropriate should be omitted from the report. Use of English and the standard marine navigational vocabulary is recommended for verbal reporting.

- Reports should contain only information essential to achieve the objectives of the system. Reports should be simple and use the standard international ship reporting format and procedures. English language and standard marine navigational vocabulary, or alternatively the International Code of Signals shall be used in reporting.

- The number of reports so made shall be kept to a minimum.

- Reports concerning pollution, release of harmful or dangerous goods, marine pollutants into sea should be transmitted to the nearest coastal State. When the ship is within or near an area for which a ship reporting system has been established, reports should be transmitted to the designated shore station of that system.

- Reports generally include the following:

- Sailing plan (SP) - Before or as near as possible to the time of departure from a port within a system or when entering the area covered by a system
- Position report (PR) - When necessary to ensure effective operation of the system or on a regular basis
- Deviation report (DR) - When the ship's position varies significantly from the position that would have been predicted from previous reports, when changing the reported route, or as decided on board
- Final report (FR) - On arrival at destination and when leaving the area covered by a system
- Dangerous goods –For an incident involving the loss or likely loss over-board of report packaged dangerous goods and/ or marine pollutants, including those in freight containers, portable tanks, road and rail vehicles and ship borne barges, into the sea
- Harmful substances - For an incident involving discharge or probable discharge of harmful substances as listed in Annex I & II of MARPOL
- Any other report - Any other report should be made in accordance with the system procedures as deemed necessary

2) Standard formats for reporting

Radio Telegraphy	Radio Telephony (alternative)	Function	Information required
Name of system (e.g. AMVER/ AUSREP/MAREP/ ECAREG/JASREP	Name of system (e.g. AMVER/ AUSREP/MAREP/ ECAREG/JASREP)	System identifier	Ship reporting system or nearest appropriate coast radio station
SP PR DR FR DG HS MP Give in full	State in full	Type of report	Type of report: Sailing plan Position report Deviation report Final report Dangerous goods report Harmful substances report Marine pollutants report Any other report
A	Ship(alpha)	Ship	Name, call sign or ship station identity and flag
B	Time(bravo)	Date and time of event	A 6-digit group giving day of month (first two digits), hours and minutes (last four digits). If other than UTC state time zone used
C	Position (charlie)	Position	A 4-digit group giving latitude in degrees and minutes suffixed with N (north) or S (south)and a 5-digit group giving longitude in degrees and minutes suffixed with E (east)
D	Position(delta)	Position	True bearing (first 3 digits) and distance (state distance) in nautical miles from a clearly identified landmark(state landmark)
E	Course (echo)	True course	A 3-digit group

Radio Telegraphy	Radio Telephony (alternative)	Function	Information required
F	Speed (foxtrot)	Speed in knots and tenths of knots	A 3-digit group
G	Departed(golf)	Port of departure	Name of last port of call
H	Entry (hotel)	Date, time and point of entry into system	Entry time expressed as in (B) and entry position expressed as in (C) or (D)
I	Destination and ETA (India)	Destination and expected time of arrival	Name of port and date time group expressed as in (B)
J	Pilot (Juliet)	Pilot	State whether a deep-sea or local pilot is on board
K	Exit (kilo)	Date, time and point of exit from system or arrival at the ship's destination	Exit time expressed as in (B) and exit position expressed as in (C) or (D)
L	Route (lima)	Route	Intended track
M	Radio-communication (mike)	information Radio-communications	State in full names of stations/frequencies guarded
N	Next report (november)	Time of next report	Date time group expressed as in (B)
O	Draught (oscar)	Maximum present static draught in metres	4-digit group giving metres and centimeters
P	Cargo (papa)	Cargo on board	Cargo and brief details of any dangerous cargoes as well as harmful substances and gases that could endanger persons or the environment
Q	Defect, damage, deficiency, limitations (quebec)	Defects/damage/ deficiencies/ other limitations	Brief details of defects, damage, deficiencies or other limitations
R	Pollution/dangerous goods lost overboard (romeo)	Description of pollution or dangerous goods lost overboard	Brief details of type of pollution (oil, chemicals, etc.) or dangerous goods lost overboard; position expressed as in (C) or (D)
S	Weather (sierra)	Weather conditions	Brief details of weather and sea conditions prevailing
T	Agent (tango)	Ship's representative and/or owner	Details of name and particulars of ship's representative or owner or both for provision of information

Radio Telegraphy	Radio Telephony (alternative)	Function	Information required
U	Size and type (uniform)	Ship size and type	Details of length, breadth, tonnage, and type, etc., as required
V	Medic (victor)	Medical personnel	Doctor, physician's assistant, nurse, personnel without medical training
W	Persons (whiskey)	Total number of persons on board	State number
X	Remarks (x-ray)	Miscellaneous	Any other information - including, as appropriate, brief details of incident and of other ships involved either in incident, assistance or salvage (See detailed reporting requirements)
Y	Relay (yankee)	Request to relay report to another system e.g., AMVER, AUSREP, JASREP, MAREP etc.	Content of report
Z	End of report (zulu)	End of report	No further information required

- AMVER System has been discussed under CRB Task A2.3.1. We shall be discussing some more ship reporting systems operating in specific areas.

3) AUSREP reports

AUSREP is a ship reporting system operated by the Australian Maritime Safety Authority (AMSA) through the Australian Rescue Coordination Centre (RCC Australia) in Canberra. Participation in AUSREP is mandatory for certain ships but other commercial ships visiting Australia or transiting Australian waters are encouraged to participate voluntarily. The reports under AUSREP system are processed at Rescue Coordination Centre (RCC) Australia.

- Categories of ships required to participate in the system are
- All Australian registered ships engaged in interstate or overseas trade and commerce, while in the AUSREP area
- Ships not registered in Australia, but engaged in the coasting trade between Australia and an external territory, or between external territories, while in the AUSREP area
- Ships not registered in Australia, but demised or as arranged under charter parties to charterers whose residence or principal places of business are in Australia, while in the AUSREP area
- Foreign ships, other than the above mentioned ships, from their arrival at their first Australian port until their departure from their final Australian port. However, they are encouraged to participate in AUSREP from their entry into and final departure from the AUSREP area
- Australian fishing vessels

4) StraitRep

- STRAITREP is the mandatory ship reporting system used in the Straits of Malacca and Singapore. The operational area of STRAITREP covers the Straits of Malacca and Singapore between longitudes 100°40'E and 104°23'E. The area includes the routing system in the Straits of Malacca and Singapore. The area is divided into 9 sectors for which the reporting authority and the VHF channels are mentioned below. STRAITREP is based on VHF voice radio communication and it is interactive.

- STRAITREP provides information to ships about specific and critical situation that could cause conflicting traffic movements and other information concerning safety of navigation. Every ship needs to maintain a VHF radiotelephone listening watch on the appropriate VHF Channel depending on the sector where a ship is. The VHF channel 16 and any other channel specified by the appropriate VTS authority are used to broadcast information of general interest to ships. This broadcast starts with an announcement on the appropriate VHF channel assigned to the sector.

- The call to the appropriate VTS authority must be made on the VHF channel assigned to the particular sector where the ship is located. The report must be transmitted on that channel or any other available channel assigned by the appropriate VTS authorities. The language used for communication is English combined with the use of the IMO Standard Marine Communications Phrases where necessary.

- Categories of ships required to participate in the system
- vessels of 300 GT and above
- vessels of 50 metres or more in length
- vessels engaged in towing or pushing with a combined GT of 300 and above, or with a combined length of 50 metres or more
- vessels of any tonnage carrying hazardous cargo
- all passenger vessels that are fitted with VHF, regardless of length or GT
- any category of vessels fitted with VHF that uses the appropriate traffic lane or separation zone in an emergency situation to avoid immediate danger

- Report shall be made when transiting the reporting points as marked on the strait chart. Reference shall be made to ALRS volume 6 and Strait Rep user manual when participating in the system.

5) JASREP reports

- Japanese Ship Reporting System (JASREP) covers is the sea enclosed by the parallel of latitude 17°N and the meridian of longitude 165°E. Any ship regardless of tonnage, flag or type is welcome as far as a ship is within the service area of the system and participation is voluntary in the JASREP System.

- There are four types of JASREP Reports namely Sailing Plan, Position Report, Deviation Report and Final Report. Position Report is the information to verify if ship's position input according to the Sailing Plan in correct. The 1st report should therefore be sent at an optional time within 24 hours of departure from a port or entering the service area, and then the reports should be sent subsequently no less frequently than every 24 hours until Final Report. In case where delayed reporting is anticipated due to change of radio operator's duty hours or else, reports should be sent earlier than the scheduled time of reporting as far as practicable. Reports should be sent more frequently than the above schedule, when the ship is in heavy weather or under other adverse conditions.

- When intending to participate in JASREP, reference shall be made to ALRS Volume 6 and JASREP user guide.

6) INSPIRES and INDSAR

- Indian Navy in co-ordination with Directorate General of shipping (India) established an Indian Ship Position and Information Reporting System (INSPIRES). This reporting system has wider area of coverage in the Indian Ocean. The main objective of the system is Open Ocean Vessel management for security of all vessels navigating in the Arabian Sea and Bay of Bengal. An Indian Naval Communication Centre (COMCENs) Mumbai and Vishakhapatnam are functioning as the shore stations for receiving INSPIRES messages from all vessels. All Indian vessels including coasting / fishing vessels of tonnage 300 GRT and above shall participate in this reporting system. All vessels other than Indian ship of tonnage 100 GRT and above are encouraged to send the reports in the prescribed format when they are transiting within the INSPIRES ship reporting areas.

- INDSAR, the Indian Maritime Search and Rescue developed by the Indian Coast Guard, is a voluntary ship reporting system used by search and rescue authorities to arrange for assistance to people in distress at sea. Participating ships send voyage messages to the INDSAR centre managed by the Coast Guard at MRCC Mumbai via INMARSAT 'C' Toll Free Code 43 through LES ARVI. The prescribed reports may also be sent by email to the address indsar@vsnl.net.
- Information sent to INDSAR is protected, and used only by a bonafide maritime emergency. INDSAR reports also satisfy arrival reporting requirement for entry to Indian ports and INDSAR provides on additional measure of safety "assurance" by allowing rescue coordinators to compress the search area in the event a participating ship is not reported or is overdue.
- Ships which can participate include ships transiting through the Indian Maritime Search and Rescue Region (ISRR), Ships entering/leaving Indian ports, Ships operating within the ISRR, and Fishing vessels operating within the ISRR above 300 GRT.

Apply Your Knowledge

1. Prepare sample reports (Sailing plan, position report, deviation report and final report) for any two systems in which your vessel has participated.

I M U

Function: Navigation

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

Task number: A3.1

Sub-task Reference number: A3.1.7, A3.1.8

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

Task Heading

- Demonstrate understanding of the limitations of the radar and ARPA and be aware of the possibility of misinterpretation of information, false echoes, sea returns, reliance on scanty data/information, etc.
- Use radar performance monitors and analyze results by comparing them with the original readings.

Objectives

- Understand the limitations or RADAR and ARPA and the use of performance monitor.

Index

1) Limitations of radar
2) Limitations of ARPA
3) Performance monitor

Description

1) Limitations of radar

Radar equipment is an excellent aid to keeping lookout. However the user shall be well familiar with the limitations of the equipment in order to make optimum use of the equipment. The following factor elaborate the functional limitations of radar which shall be given due consideration when using radar.

- **Minimum detection range of radar which is affected by**
- Pulse length (PL)
- De-Ionisation delay
- Vertical Beam Width (VBW) and height of the scanner
  Considering all above minimum detection range for a scanner 15m high shall not be more than 50m. Targets between 50m & 1 M should be displayed without resetting any control other than range selector

- **Maximum detection range of radar which is affected by**
- Height of scanner
- Transmission power of the set
- Wavelength
- Pulse Repetition Frequency (PRF)
- Pulse length
- Receiver sensitivity
- Vertical and Horizontal Beam Width (VBW/ HBW)
- Nature of target
- Sea and swell, weather effects and anomalous propagation

- **Range accuracy of radar**
  Range accuracy of the RADAR depends on the following factors
- Correctness in synchronisation between transmission of pulse and the commencement of the trace on the RADAR screen
- Uniformity of the time base means that the speed of the tracing spot must be very steady. Rectilinearity of the time base means that each trace created should be perfect straight line. To measure ranges correctly, the speed of the spot on the scale of PPI, must exactly be the half that of radio waves.

- ❖ Size of tracing spot will represent a certain area depending upon the range scale in use. The accuracy of the range will be limited to the spot size.
- ❖ The radar measures the range from the scanner to the target whereas the correct range should be the distance along the surface of the earth. In case of targets located close by this difference may be significant.
- ❖ Considering above points, radar is required to have range accuracy - within 30 m or 1% of the range scale in use, whichever is greater.

➢ **Bearing accuracy of radar**

Bearing accuracy of the radar is affected by the following:

- ❖ Gyro error if any when the display is gyro stabilised
- ❖ Correct alignment between the heading marker and the scanner
- ❖ Correct alignment between the heading marker and the bearing scale
- ❖ Type of bearing marker used
- ❖ Rectilinearity of the trace
- ❖ Beam width distortion
- ❖ Scale size of the spot
- ❖ Considering above points, radar is required to have bearing accuracy - within ±1°.

➢ **Permissible accuracy/ error levels for radar**

- ❖ Range discrimination – on a range scale of 1.5 NM or less, capable of displaying two point targets on the same bearing, separated by 40 m in range, as two distinct objects
- ❖ Bearing discrimination- on a range scale of 1.5NM or less, capable of displaying two point targets at the same range, separated by 2.5° in bearing, as two distinct objects
- ❖ The target detection performance of the equipment should not be substantially impaired when own ship is rolling or pitching up to ±10°
- ❖ Radar may take up to 4 minutes to start from cold and 5 sec from standby to transmission.
- ❖ Range rings/ Variable Range Marker (VRM) – accuracy within 1% of the maximum range of the range scale in use or 30 m, whichever is greater
- ❖ Electronic Bearing Lines (EBL) - maximum system error of 1° at the periphery of the display

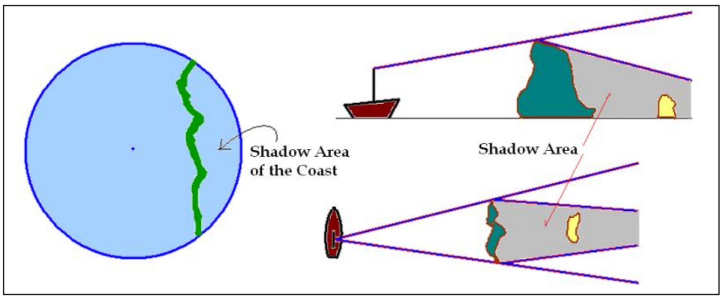
➢ **Factors affecting radar performance**

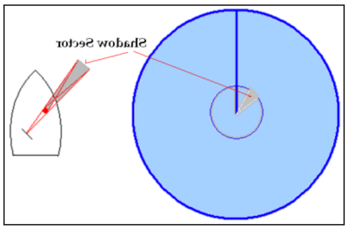
In addition to above limitations there are factors which affect RADAR performance.

❖ **Weather**

Weather affects the radar detection to a great extent. Same is countered using anti-clutter controls (sea clutter/ rain clutter). Sea clutter can cause the small targets in vicinity not getting displayed. Rain clutter may cause the target inside the raining area or beyond, to go undetected. In heavy tropical rains, the rainfall areas appear as bright solid block inside which targets cannot be distinguished, despite adjustments of the controls. Targets within the drizzle area generally show up clearly.

❖ **Shadow areas, shadow sectors and blind sectors**





Targets lying directly beyond large targets are said to lie in shadow areas. Such targets will usually go undetected and not seen on PPI until these are very radar conspicuous. Shipboard structures like masts, posts etc. partly obstruct the radar beam. However, because of diffraction, targets lying directly beyond these structures get some energy of the RADAR beam to reflect. Hence these do appear on the PPI, but their detection ranges are considerably reduced. Such spaces are called shadow sectors and they are mentioned in the ship's radar log. Shipboard structures such as funnel completely obstruct the radar beam, to the extent that targets beyond them are not detected at all. Such locations are called the 'Blind Sector' of the scanner because no echoes are received from them.

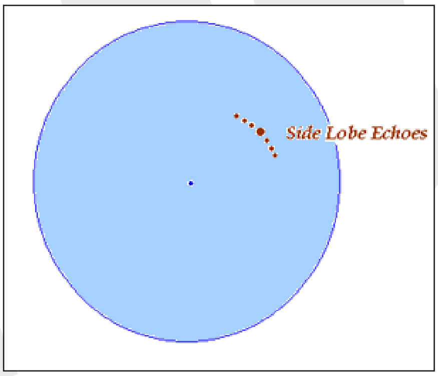
❖ **Spurious echoes and radar interferences**

✓ Indirect echoes

The radar energy may get reflected by shipboard obstructions or some good radar reflecting targets at a very close range, towards another target. The echo from target, in such cases, follows the same route back to the scanner and is painted on the PPI. The indirect echo from the target gets painted as a second object on the PPI in the direction of the obstruction. Adjusting gain or sea clutter setting may help remove the echo.

✓ Side lobe echoes

In commercial marine radar sets, all the available energy is not transmitted in the form of a single narrow beam. Some of the energy is radiated as weak beams at various angles on either side of the main beam. These weaker beams are known as side lobes. The side lobes produce a series of small echoes on either side of the main echo, all at same range. Side lobe echoes are considerably reduced when using a slotted wave guide type of scanner. The effect can be eliminated by adjusting the gain or sea clutter settings.



✓ Multiple echoes

When two ships pass on parallel courses at close range, the transmitted energy is reflected back and forth between the hulls of the two ships, painting a series of echoes on the same bearing line on the PPI. The closest echo represents the correct position of the target. Other such echoes are known as multiple echoes.

✓ Second trace echoes

Echoes sent back from the targets just outside the range scale in use may get painted in the next trace. In such cases the target is painted on the correct bearing line but an incorrect range.

❖ **Anomalous propagation**

Changes in atmospheric conditions are likely to cause changes in distance of radar horizon. Theoretical detection range of a target is given by the formula

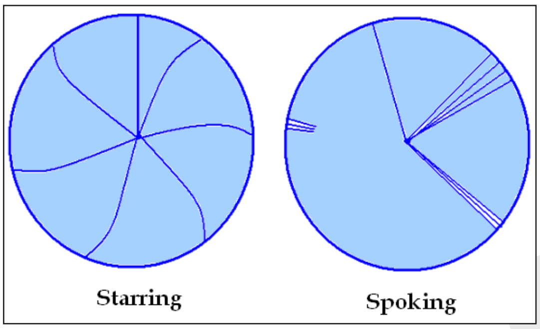
$$d = 2.20\sqrt{h} + 2.20\sqrt{x},$$

Where d is the detection range, h is the height of scanner and x is the height of target. Any change in prevailing climatic conditions such as the lapse rate of temperature and change of relative humidity with height or a considerable difference between the temperatures of air and sea will cause a change in distance of the radar horizon. The cause of the anomalous propagation is the refraction of the RADAR pulse. Depending upon the pattern the waves may suffer sub-refraction (decrease in radar horizon distance), Super Refraction (increase in radar horizon distance) or Ducting. These are illustrated in the picture below.

❖ **Interferences to radar**

✓ Spoking
Faults such as dirty contacts, either of the heading marker circuit at the scanner, or of the slip rings of the rotating deflection coils, or heavy sparking of motors located nearby may cause radial lines to sometimes appear on the full screen or confined within certain arcs.

✓ Starring
Another ship's radar, whose transmitting frequency is within the band width of the own ship's radar, operating in the vicinity may cause echoes to appear on the screen in the form of curves or spirals of dotted lines which change position for every rotation of the scanner.



2) Limitations of Automatic Radar Plotting Aid (ARPA)

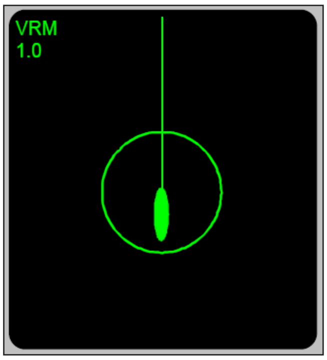
- Automatic Radar Plotting Aid (ARPA) is a plotting aid using which the navigator can check the target details. These details are automatically calculated based on the target plot and own vessel inputs. Any error affecting the own vessel's equipment inputs will lead to provide wrong values. The most important sources of error are the gyro error and speed log error. The time taken by gyro to stabilise will directly affect the heading input to RADAR.
- It usually takes upto 3 minutes for the ARPA to track and calculate the target details. Any data available before such period shall be used with utmost caution. Sufficient time shall be allowed for the target details to settle.
- The range scale in use may not permit the ARPA to be used as set by the manufacturer. Regulations require ARPA to function at least on ranges 3, 6 and 12 NM.
- ARPA turns off as soon as the RADAR unit is set to stand-by mode. Any data for tracked targets is lost in such case. It will again take at least 3 minutes after the radar is switched on to acquire and plot targets.
- Failure to correctly set the pulse length, tuning and gain & anti-clutter controls on the radar system will reduce the ability of the system to detect the targets and therefore the tracking ability of the ARPA.
- The ARPA is required automatically to track, process, simultaneously display and continuously update information on at least 20 targets, whether automatically or manually acquired.
- The ARPA is required to continue tracking an acquired target which is clearly distinguishable on the display for 5 out of 10 consecutive scans, provided the target is not subject to target swop.
- When a tracked target, or own ship, has completed a manoeuvre, the system is designed to present in a period of not more than 1 min an indication of the target's motion trend, and display within 3 min the target's predicted motion, In this context, a "manoeuvre of own ship" should be deemed to consist of an alteration of course of ± 45° in 1 min.
- ARPA can acquire and plot targets moving at relative speed of up to 100kts.

- When two targets plotted on ARPA pass close together (located within the same tracking window within the ARPA memory), the vectors of the two target are likely to be swapped showing data of one target for other. This may lead to causing confusion and misinterpretation of target details.
- Guard zone facility is available with ARPA when any of the targets CPA/ TCPA exceeds the set limits. However the same should not be over relied. The navigating officer shall keep a close watch on the targets movement visually and through RADAR. In open waters it is recommended to practice manual RADAR plotting and compare the results with the ARPA.

3) Performance monitors

- A performance monitor is provided for checking the efficiency of the RADAR unit. The performance of the radar is checked using performance monitor as per the manufacturer's instructions. Records of the same shall be maintained in accordance with shipboard SMS procedures.
- The performance monitor box is usually installed on the RADAR mast behind the scanner. It works like a transponder installed in the proximity of the radar antenna, it is triggered by part of the transmitted microwave energy and sends back a coded signal to the antenna for display on the radar screen. Overall performance can be checked from the range, size and number of arcs or similar shape displayed on the radar screen.
- Testing using performance monitor involves measuring the extent of artificial echo produced on the radar display unit. This echo is in the shape of a plume / feather or a sun. The artificial echo is produced by energy collected and re-radiated from a small box (echo box) incorporated in the rotating part of the scanner unit (sun pattern) or mounted on special stand (plume pattern).
- In some radar sets, transmitter and receiver performance can be measured separately, where plume length on the display or length of tuning bar gives a check on transmission.
- A sample performance monitor may function as follows. As soon as performance monitor switch is activated, most of the radar sets will show "PM" on the radar display confirming that the performance monitor is active. The radar automatically switches to pre-set settings, such as:

  Range: 24 nm
  Pulse length: Long
  Shadow Sector: Off
  STC: Off
  Rain: Off
  Echo Stretch: Off
  Tune: Auto
  Gain: Initial setting (as set with PM GAIN ADJ at installation)



- The radar screen will show one or two arcs. By measuring the extent of the artificial echo (arc) for given gain and clutter and comparing this with the value given in the radar manual, an independent check is made on the action of radar transmitter, receiver and overall reliability. If the radar transmitter and receiver are in good working conditions in as much as the original state when the monitor was turned up, the innermost arc should appear at range mentioned in the manual, any lesser measurement means radar unit requires soonest repairs.
- Decrease in number of arcs, length of plume or diminishing sunny pattern/ sector may indicate decrease in transmitter power, weakening of amplification system, mistuning or moisture trapping in the system, and may require service and/or magnetron renewal.
- Performance monitor value noted at the time of any major changes such as magnetron / oscillator renewal should be posted adjacent to the radar. Based on this PM value,

minimum permissible PM value as per maker's manual should be determined and old post deleted.

Apply Your Knowledge

1. Electronic navigation equipment has limitations. It is important that you are aware of these limitations and can take additional safety measures to counter them. List the limitations of the "X" band and "S" band Radar/ARPA on your ship.
2. How do you test the performance of radars on board your ship?

IMU

Function: Navigation

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

Task number: A3.2

Sub-task Reference number: A3.2.2, A3.2.3, A3.2.4, A3.2.5

Topic: Using radar/ ARPA for collision avoidance

Task Heading

- Demonstrate ability to identify and track small boats.
- Practice parallel indexing techniques.
- Demonstrate understanding of correct setting of CPA/TCPA alarms with respect to area of navigation.
- Carry out long range scanning by changing radar scales at regular intervals.

Objectives

- To understand the functions of RADAR/ ARPA, their uses and their limitations.

Index

10) Identifying and tracking small targets
11) Parallel indexing
12) CPA/TCPA alarms
13) Long range scanning

Description

1) **Identifying and tracking small targets**

- Radar detection of targets is affected by the technical limitations of radar, prevailing weather conditions and target characteristics (reflective surfaces) as discussed under tasks A3.1.7 and A3.1.8. The efficiency is further affected by the radar settings of range scale in use, gain setting and anti-sea clutter and anti-rain clutter. The possibility of losing weak echoes is greater when both A/C sea and A/C rain are used to reduce clutter.

- The radar equipment is designed to detect the targets (of specific features) at minimum specific ranges as mentioned below.

Minimum detection ranges in clutter-free conditions

Target Description	Target Feature	Detection Range in NM	
Target description	Height above sea level in metres	X-Band NM	S-Band NM
Shorelines	Rising to 60	20	20
Shorelines	Rising to 6	8	8
Shorelines	Rising to 3	6	6
SOLAS ships (>5,000 gross tonnage)	10	11	11
SOLAS ships (>500 gross tonnage)	5.0	8	8
Small vessel with radar reflector meeting IMO Performance Standards	4.0	5.0	3.7
Navigation buoy with corner reflector	3.5	4.9	3.6
Typical Navigation buoy	3.5	4.6	3.0
Small vessel of length 10 m with no radar reflector	2.0	3.4	3.0

- With own ship at zero speed, an antenna height of 15 m above the sea level and in calm conditions, the navigational buoy in Table 2 should be detected at a minimum horizontal range of 40 m from the antenna position and up to a range of 1 NM, without changing the setting of control functions other than the range scale selector.

➢ **Detecting and tracking small targets**

In order to detect and track small targets the following points shall be considered.

❖ Long pulse provides less clear picture, but since more energy is contained in the radar pulse it increases the possibility of detection of poor targets at long range. Therefore for long range scanning, radar on long pulse should be used to achieve good detection even for poor targets.

❖ To detect small targets, the RADAR may be turned to smaller range scale, preferably 3' which will facilitate detection.

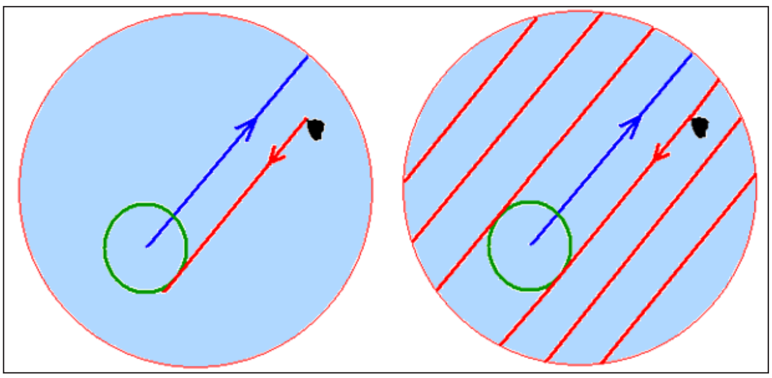
❖ The gain control adjusts the sensitivity of the receiver. The gain setting shall be adjusted to an optimum level, in order that the screen is not unduly over-cluttered. The proper setting is such that the background noise is just visible on the screen.

❖ The A/C sea control reduces the amplification of echoes at short ranges and progressively increases amplification as the range increases. So amplification will be normal at those ranges where there is no sea clutter. Sea anti-clutter setting is adjusted to remove the clutter to an optimum level. 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. If the setting is set too low, targets will be hidden in the clutter, while if the setting is too high, both sea clutter and targets will disappear from the display. In most cases the control shall be adjusted until clutter has disappeared to leeward, but a little is still visible towards the windward.

❖ 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 also detects rain clutter (rain, snow, or hail) in the same manner as normal targets. When echoes from precipitation mask solid targets, the A/C rain setting is adjusted to split up these unwanted echoes into a speckled pattern, making recognition of solid targets easier. Anti- rain clutter shall be used ONLY during rains. Else the setting shall be kept on a minimum.

2) Parallel indexing

➢ On a relative motion gyro-stabilized radar display, the echo of a fixed object will move across the display in a direction and at a speed which is the exact reciprocal of own ship's ground track. Parallel indexing uses this principle of relative motion. Reference is made to the planned ground track. A fixed prominent radar conspicuous target is taken as reference point.The index line is drawn using a floating EBL or the parallel indexing grid,parallel to the planned ground track at a perpendicular distance equal to the planned passing distance off the fixed target. Observation of the fixed object's echo movement along the index line on the Planned Position Indicator (PPI) will indicate whether the ship is maintaining the planned ground track. Any displacement of the echo from the index line indicates that own ship is not maintaining the desired ground track and requires corrective. Use of parallel indexing technique to monitor the ground track is very much effective as a monitoring tool in areas where the variable currents and tidal streams prevail. Parallel indexing may further be used in occasions where a reference target is available near an alter course point.



3) CPA/TCPA alarms

> CPA/ TCPA alarm will sound only for the tracked targets. The CPA and TCPA alarm feature should never be over relied. There may be a possibility of a target on a collision course going undetected

- CPA and TCPA are calculated as discussed in task A3.2.7. ARPA provides the calculation being carried out automatically for the acquired targets. ARPA further provides the facility of setting alarm ranges for the CPA and TCPA also named as collision alarm. The target tracker continuously monitors the predicted range - CPA and predicted time to CPA - TCPA. When the predicted CPA of any tracked target becomes smaller than a preset CPA range and its predicted TCPA less than a preset TCPA limit, the audio-visual alarm sounds. Collision warning appears on the screen. Further the target indicator symbol may start to flash. This feature, when used correctly, helps prevent the risk of collision by alerting the navigator of threatening targets. To silent the alarm, option is provided on the on screen ARPA menu.

- The shipping companies/ master may require maintaining a minimum CPA from targets. CPA and TCPA ranges must be set up properly taking into consideration the factors as mentioned below. Setting CPA limits will ensure that the vessel passes well clear of the targets. By setting the TCPA, the intention is to be aware of the risk of collision well in time so that proper and effective action to avoid collision may be taken. Factors are
  - Size of the vessel
  - Tonnage of the vessel
  - Speed of the vessel
  - Stopping distance
  - Maneuvering characteristics of the vessel
  - Traffic density in the area
  - Availability of sea room and proximity to hazards

4) Long range scanning

- Radar is provided to operate at different ranges. When tuned to a large range, it provides detecting and tracking targets well in advance. Detecting targets at long range also provides observing the target’s track which in turn improves situational awareness. For effective detection long pulse is recommended to be used when high range scales are in use.

- Approaching targets not detected at adequate range may not allow sufficient time to plot the target, assess risk of collision and decide what action is necessary. The prominent factor that needs to be considered is the relative speed of approach.

- Long range scanning is recommended but it shall be done regularly at suitable intervals. Continuous operation of radar at long range may lead to smaller targets in vicinity to go undetected.

Apply Your Knowledge

1. Check the CPA and TCPA of tracked targets during your watch.

Function: Navigation

Competence: Use of ECDIS to maintain the safety of navigation

Task number: A4.1

Sub-task Reference number: A4.1.4, A4.1.5, A4.1.6, A4.1.7

Topic: Use of ECDIS

Task Heading

- Assist watch-keeper in correcting/ updating electronic charts – manual, semi-automatic and automatic methods.
- Demonstrate understanding of the limitations of ECDIS and dangers of over reliance.
- Plan and monitor a route using ECDIS.
- Demonstrate understanding of the optimum ECDIS settings and use of various alarms and indicators; e.g. watch vector, safety contour, cross track, arrival WPT, anchor watch settings.

Objectives

- Understand the procedure of ECDIS charts, route planning on ECDIS and other alarms and settings.

Please read this task in conjunction with tasks A4.1.8, A1.4.1 to A1.4.4 and A1.5.2.

Index

14) Correcting/ updating electronic charts
15) Limitations of ECDIS
16) Planning and monitoring route using ECDIS
17) ECDIS alarms

Description

1) Correcting/ updating electronic charts

- ECDIS that is not updated for the latest version of IHO Standards may not meet the chart carriage requirements as set out in SOLAS regulation V/19. Updating is mandatory if the ship is using ECDIS for primary navigation.

- Each ECDIS is provided with a license permit or security key, which acts as the access code for the system software, allowing charts and permits to be acquired. The permits for the charts are long alphanumeric numbers and can be sent by email. If so, the permit number should be kept on a memory stick. The permit is put into the ECDIS and this allows it to display the chart as a SENC and receive updates. When a license expires updating of the displayed chart is not possible. The licensing loading system is designed to function automatically carrying out the license acquisition.

- Updating of ECDIS charts is usually carried out using CDs. There are 'Base CDs' and 'Update CDs'. The update CDs are produced every week and should be loaded as soon as possible they are received. The British Admiralty update CDs are accumulative over a ten week period. So if one is missed the corrections are included in all following update CDs until the next base CDs is issued. The base CD contains all the chart information installed on the ECDIS hard drive but updated. So each base CD will include all the changes in the previous ten weeks. British Admiralty provides services to update ENCs as well as RNCs in the same manner.

- New base CDs are issued from time to time and ships require new ENC licenses as she sails to new ports. Updates to ENCs are sequential, and the sequence is unique to each ENC. During the updating process, ECDIS always checks that all updates in the sequence have been applied. If an update is missing then the ECDIS will indicate this; it is not possible to load later updates until the missing update is applied.

- ENCs and RNCs can also be updated via the internet. However the point to remember is that ECDIS computer does not have firewall or anti-virus protection and could easily be corrupted, if directly connected to internet. Hence, updates through internet are received on a communication terminal and put on a memory stick dedicated for the purpose, which are then loaded onto ECDIS.
- Notices to Mariners and Temporary & Preliminary Notices are issued by the maritime authorities to cover the changes in charted details. T&P Notices are sometimes not included in updates by some Hydrographic offices. T&P Notices are updated into the ECDIS manually. Some chart providers, including the British Admiralty, provide Notices to Mariners and T&P notices in their updates to both raster and vector charts. The same needs to be checked with the ship's chart supplier.
- Records shall be maintained for all updating done to the charts. It's also important to keep all memory devices with permits and updates, update CDs and base CDs safely, until they are replaced with new issues. A record of all update CDs received must be maintained on board. It may be inserted in the Chart correction log – NP133A for ease of reference.
- The ECDIS maintains a list of updates applied and the date of application. This list can be used to check the update status of the ENCs loaded. In case all available ENCs show the same date for the latest update, it is likely that they have not been updated regularly, and the distributor should be contacted for verification. Furthermore traditional sources of information, such as Notices to Mariners may be used to verify updates. Loading a new license when no updates have been loaded for a while will result in the ECDIS generating error messages. During updating of ECDIS system, temporary files need to be deleted and old log files need to be cleared out to avoid clogging up the system and slowing down the operation of the ECDIS.
- No other software shall be installed on the ECDIS other than that provided by the maker. Health checks against virus attacks are to be carried out at regular intervals as per manual.
- Charts for US territorial waters and South China Sea are an exception to the usual procedures. The ENCs and RNCs for these areas can be downloaded free of charge; for US territorial waters from the National Oceanic and Atmospheric Administration (NOAA) Office of Coast Survey website. The charts for the South Chinas Seas are available from the East Asia Hydrographic Commission. These charts are also provided in the normal way by chart distributors. It's important to check for updates of these charts when sailing in those waters.

2) Limitations of ECDIS

- The accuracy of the data is limited to the latest update to which the chart is corrected.
- Prior using ECDIS, limitations of the equipments which are interfaced with the ECDIS must be kept in mind. In particular, the ship's position fixing systems must be properly monitored. Limitations of the primary position fixing systems must be known and it must be clearly understood when to switch over to the secondary position fixing system. Position being plotted automatically on ECDIS chart is likely to lead to complacency and reduction in alertness levels. Cross checking position by alternatives means of position fixing shall always be a standard practice. Facility provided for plotting LOPs (bearings) must be practiced and used for plotting positions by visual observation.
- When using a radar overlay, the picture on the ECDIS and the radar may not always match. The fact being that radar shows only those targets whose echo is reflected. The overlay of target data on an electronic chart does not reduce the need for the targets to be observed on the radar display. Caution should be exercised where target vectors based on the vessel's water-track are overlaid on an electronic chart which displays the vessel's ground track.

- The displayed information on ECDIS shall be limited suiting the requirements of navigation though the given sea area. Too much information on the screen can be distracting, but at the same time de-selecting too much data may lead to errors.
- 'Standard Base' is intended to be the minimum that is to be used for route planning and monitoring. If any data from Standard Base is deselected, an indication is given. The "Display Base" is not intended to be used for navigation.
- With vector charts the data is "layered", enabling the user to de-select certain categories of data, such as textual descriptions, which may clutter the display and may not be required at the time. The facility to de-select data must be used with extreme caution as it is possible to remove data essential for the safe navigation of the vessel. On taking over watch, a watch-keeping officer must check and apprise himself of what data is selected and deselected.
- Recommended chart scales shall be used; though scanning of various scales may be done. An indication is given if larger scale ENC is available and also if the chart is over-scaled.
- With raster charts in use the inherent limitations include that it cannot be interrogated and hence, certain safety parameters are not selected. The alarms do not get triggered off by the chart data. Excessive zooming of the display may degrade the display. The chart themselves look cluttered as they are produced by converting paper charts to digital image by scanner. An extra effort will be required to read and obtain information when using raster charts.
- The navigating officers shall be thoroughly familiarized with the function/ operation of ECDIS especially for vessel involved in paperless navigation.

3) Planning and monitoring route using ECDIS

- The principals for of route planning are the same whether using paper charts as discussed under section A 1.4. The same shall be referred to for this portion of the task. The salient features when using ECDIS for route planning and monitoring are as follows.
- ECDIS software facilitates simpler processes in a more user friendly notation. Many ECDIS will have much of the information required in their library. If not, the navigating officer must gather the appropriate reference books. The navigating officer must check that all the information is up to date before starting. The route must always comply with the ship's safety parameters, company orders and procedures and the ship's safety management system, SMS.
- Route planning on ECDIS begins with constructing a draft route. ECDIS provides the ease of working with the waypoints. Waypoints can be added by putting the cursor on the required position on the chart and clicking, or putting the latitude and longitude of positions in a text box. Waypoints can be deleted from the text box or from the chart. The ECDIS automatically joins up the waypoints to construct route leg lines. Waypoints can further be moved by dragging and dropping them using the cursor.
- Once the main route is selected, the length of the leg and details of waypoints are saved. This list forms the basis of the route plan. It is further optimized by moving waypoints to avoid individual dangers at a safe distance, allowing for the current, the width of the channel, lining the route up to leading lights and so forth. Allowance is made for ship's parameters including the turning radius and engine performance. For each route leg, ECDIS will work in accordance with the safety contour and depth settings. The maximum speed for each leg needs to be entered. The navigating officer should review these for each leg to ensure that they are accurate and appropriate. The equipment automatically selects the best available SENC. If there is a larger scale chart the system indicates the same.
- Having laid down the route and cross checking, it shall further be cross checked using an automatic safety check. During this, the ECDIS checks the entire area between the cross

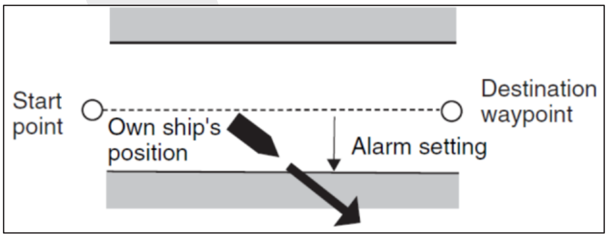
track limits. ECDIS will warns regarding chart alarms when the route passes safety contour, an isolated danger (closer than the set limit), boundary of a prohibited area, closing the land (closer than the set limit), passing into shallows, crossing safety depths or when passing under objects lower than the safe height. ECDIS further gives a warning if the turn radius is too small for the ship's characteristics, if the speed is too high and if the waypoints are too close together. All such alerts shall be checked and rectified.

- Master's approval is required before the route plan can be put into action. Once the master has approved the plan if there are any changes, the safety check must be fully run again.
- Once the route if finalized, an adequate back up for the same shall be taken. If paper charts are being used the entire route will have to be prepared and plotted on them including any alterations required.
- Having completed the route planning and setting the speeds, the ECDIS calculates the total time for the voyage and produces an estimated time of arrival (ETA). Seeing this, the officer in charge may adjust the planned speed for the sake of slow steaming for better fuel efficiency, weather routeing or to provide a more convenient arrival time as per charterers requirements in consultation with master. Finally the route plan must be named and saved.
- Having planned the route, the route shall be carefully monitored during the voyage as discussed under modules A 4.1.

4) ECDIS alarms

- **Cross track distance**

Cross track distance limits the ship's deviation from the planned course towards either side of the planned track. Usually the limits are shown as a dotted red line on either side of the planned course. The sea area within the limits is thoroughly checked for being free of any hazards to navigation. An alarm is generated when the ship goes outside the set track limits. The width of the cross track limits varies from area to area. Congested areas will require the ship to strictly adhere to the planned track, due to limited sea room and proximity of hazards, whereas little yawing is more economical in open seas. Depending upon the scenario the cross track limits needs be set in to warn the navigator in due time. Inappropriate setting of limits is likely to result in unnecessary alarms. The cross track distance can be adjusted by changing its numerical value in the text table of waypoints.



- The arrival waypoint alarm, and anchor watch alarm are same as those set in GPS. Task A1.5.2 shall be read in conjunction for further details on the topic.

Apply Your Knowledge

1. Make a route plan for a voyage of at least five days duration. List the procedure for making a route plan, carry out a route check and state the alarm limits to set.
2. List set-by-step the procedure for correction of ENCs.

Function: Navigation

Competence: Respond to Emergencies

Task number: A5.1

Sub task Reference number: A5.1.2 (A5.1.2.1- A5.1.2.10)

Topic: Emergencies at sea

Task Heading

- Understudy team leaders during emergency response exercises; e.g.:
  - Heavy weather damage
  - Collision
  - Grounding
  - Flooding
  - Rescue of survivors / assisting a ship in distress
  - Shipboard oil pollution incident at sea
  - Gyro failure
  - Steering failure,
  - Main engine/ power failure
  - Security incident/ drill at sea.

Objectives

- Understand the procedures followed by the team leaders of various teams in response to various emergencies.

Index

1. Emergency
2. Emergency response procedures in cases of
   a) Heavy weather damage
   b) Collision
   c) Grounding
   d) Flooding
   e) Rescue of survivors / assisting a ship in distress
   f) Shipboard oil pollution incident at sea
   g) Gyro failure
   h) Steering failure,
   i) Main engine/ power failure
   j) Security incident/ drill at sea.

Description

1) Emergency

Emergency is an unforeseen situation or incident that causes or is likely to cause loss of life, environment or property. The primary objective of shipboard emergency prevention, preparedness and response activities is to develop and implement an efficient and effective system which will minimize risks to life, the environment and property.

The three main elements of an emergency response system are:

i. Planning
ii. Training and
iii. Preparedness

There are various types of emergencies for which all persons on board the ship should be ready at all times. It is of utmost importance that all crew members actively participate in all emergency drills on board. A debriefing should be conducted after every drill and all the short comings of the drill should be highlighted and discussed. This will improve the efficiency of the personnel involved and will show in the performance of the next drill. The vessel will have a better trained person next time for dealing with an emergency situation.

2) Emergency response procedures

a) Heavy weather damage

In all cases of heavy weather damage, an accurate assessment must be made of the extent of damage and its impact on the structural integrity and stability of the vessel. Heavy weather damage could include the following:

- ✓ Structural damage
- ✓ Equipment damage
- ✓ Cargo damage, etc.

If the vessel has sustained structural damage, which may affect the watertight integrity of the vessel, then additional measures as required for flooding/structural failure should be initiated.

Actions to be taken by emergency teams can be summarized as follows. Reference shall be made to vessel's SMS manuals for contingency plans.

Bridge team

- ✓ Inform master
- ✓ Sound the general emergency alarm (if applicable)
- ✓ Announce on public address system nature and location of the emergency
- ✓ Alter course / reduce speed and hove to the wind to minimize the impact due to vessel's motion
- ✓ Check for pollution (Note: Activate plan as per SOPEP/SMPEP/VRP/state plan/national plan if required)
- ✓ Initiate damage assessment and appropriate control measures
- ✓ If required send safety and/or urgency message
- ✓ S-VDR/ VDR - Data backed up and kept prepared for further recording as per ship specific procedure.
- ✓ Keep record of time, name of party contacted, how contacted (telex/fax/tel) and brief details of all communication
- ✓ Keep detailed records of all actions taken

Emergency team

- ✓ Mount a search operation on board if anyone is found missing. (Note: Man overboard procedures to be initiated if confirmed that person not on board)
- ✓ Check the extent of damage to equipment or part of vessel
- ✓ Check damage to cargo
- ✓ Check anchor lashings and lashings of all other gear/equipment
- ✓ Assess the impact on vessel's watertight integrity (NOTE: Procedures for flooding/structural failure to be initiated as applicable)
- ✓ Sounding of all compartments even if they are not remotely related to ensure all is well and not breached.
- ✓ Consider effecting temporary repairs to the damaged part or equipment

Engine team

- ✓ Prepare engines as required by the bridge
- ✓ Check for hull damages in the engine room
- ✓ Check propeller / rudder / steering for damage
- ✓ Keep additional A/E ready for use
- ✓ Prepare pumps to pump out seawater from E/R or cargo spaces.

Note: Procedures for flooding/structural failure to be initiated as applicable

- **Support team**
  - ✓ Check all water tight doors and fire doors are closed
  - ✓ and all compartments are shut
  - ✓ Prepare tools
  - ✓ materials and other equipment as required for carrying out repairs
- **Medical team**
  - ✓ Keep stretcher and first aid kit ready for attending to any injury

b) Collision

Actions to be taken by emergency teams can be summarized as follows.

- **Bridge team**
  - ✓ Raise general emergency alarm (internal / external). If possible announce on public address system.
  - ✓ Inform master.
  - ✓ Inform the traffic in vicinity on VHF Channel 16 / DSC
  - ✓ Check angle of contact.
  - ✓ Switch on deck lighting & display appropriate nav. lights / shapes.
  - ✓ Ascertain extent of damages.
  - ✓ Check for pollution around the vessel.
  - ✓ Initiate damage control measures.
  - ✓ Update vessel's position to radio room / GMDSS console/ send urgency message.
  - ✓ Download and back up data from vessels VDR / S-VDR
  - ✓ Note down the following:
    - Time of collision
    - Own vessel's course & speed at the time of collision
    - Own vessel's position at the time of collision
  - ✓ Mark course recorder trace for actual time of collision.
  - ✓ Mark engine data logger with date & time of collision.
  - ✓ Note other vessels details & serve notice to master. Inform company.
  - ✓ If own vessel is not in an immediate danger of sinking, offer to render / render assistance to other vessel.
- **Engine team**
  - ✓ Prepare engines as required by bridge.
  - ✓ Check condition of machinery & hull damage in E/R.
  - ✓ Check propeller / rudder / steering for damage.
  - ✓ Prepare pumps to pump out sea water from E/R or cargo spaces.
  - ✓ Inspect piping / valves / equipment for any ingress of water. Shut valves if required.
- **Emergency team**
  - ✓ Check for hull or any structural damage
  - ✓ Sound all hold bilges, void spaces, cargo tanks including ballast & fuel oil tanks to check ingress of water. Positive air pressure from any sounding pipe will indicate breach of that compartment.
  - ✓ Check extent of damage and ascertain rate of flooding (tons / second) by following formula: 3 x Area of hole in sq m x Sq. root of (depth of hole in metres below sea level.). $=3A\sqrt{h}$
  - ✓ If area of hole is halved then rate of flooding will also be halved. Therefore any makeshift plugging is better than nothing
  - ✓ Start pumping out immediately to list / trim the vessel to bring the hole above water line.
  - ✓ Transfer liquid cargo to minimize pollution.

IMU

- **Support team**
  - ✓ Close all water tight doors and fire doors. Check all compartments are shut.
  - ✓ Check for fire & prepare all firefighting equipment.
  - ✓ Prepare lifeboats/liferafts for launching.
  - ✓ Remove anchor lashings.
- **Medical team**
  - ✓ Bring stretcher & first aid kit to the emergency headquarters.
  - ✓ Assist in preparation of life boat launching.

c) Grounding / stranding

Actions to be taken by emergency teams can be summarized as follows.

- **Bridge team**
  - ✓ Stop main engines.
  - ✓ Sound general emergency alarm (internal & external)
  - ✓ Call master.
  - ✓ Inform engine room to change to high sea suction & check for damages.
  - ✓ Display appropriate lights & shapes as per COLREGS.
  - ✓ Make appropriate sound signals.
  - ✓ Switch on deck lighting.
  - ✓ Send urgency message & inform nearest coast state.
  - ✓ Inform the traffic around on VHF Channel 16.
  - ✓ Check for pollution around the vessel.
  - ✓ Initiate damage control measures
  - ✓ Check for timing of high tide & range. Check direction of current.
  - ✓ Consider if vessel can be lightened by pumping out any ballast / FW or in extreme cases cargo.
  - ✓ Consider possibility to change trim by internal transfer.
  - ✓ Use engines to refloat after assessing the situation as per reports from other teams. Avoid too many astern movements especially if the nature of bottom is such that, the ship is likely to dig in deeper into the seabed. Preferably wait for high tide.
  - ✓ Update vessel's position to radio room / GMDSS Console
  - ✓ Download and back up data from vessels VDR / S-VDR
  - ✓ Note down
    - Time of grounding
    - Vessel's course & speed at the time of grounding
    - Vessel's position at the time of grounding
  - ✓ Check echo sounder sounding fore & aft. Compare with charted sounding.
  - ✓ Mark
    - Course recorder Trace for actual time of grounding
    - Engine data logger with data & time of grounding
  - ✓ Keep a record of time, name of party contacted. How contacted (Tlx / Fax / Tel) & brief details of all communication.
- **Engine team**
  - ✓ Check condition of machinery & hull damage in E/R.
  - ✓ Change over to high sea suction.
  - ✓ Check tail shaft for oil loss.
  - ✓ Check propeller / rudder / steering for damage.
  - ✓ Prepare pumps to pump sea water from E/R or Holds.
  - ✓ Inspect piping / valves / equipments for any ingress of water. Shut valves as required.
  - ✓ Turn M/E on turning gear & hammer test foundation bolts.

- **Emergency Team**

  - ✓ Check for hull damage.
  - ✓ Sound all hold bilges, void spaces, cargo tanks including ballast & fuel oil tanks to check ingress of water. Positive air pressure from any sounding pipe will indicate breach of that compartment.
  - ✓ Take over-side sounding all around the vessel by the hand lead line. Note down height of tide.
  - ✓ Check draft fore & aft after the grounding. Check draft at regular intervals.
  - ✓ Check actual sea bottom condition.
  - ✓ Inform distribution of cargo weights to bridge.
  - ✓ Inform original and current ballast / FW distribution to bridge.
  - ✓ Inform original and current bunker distribution on bridge.
  - ✓ Check for any movement / loss of cargo or any damage.

- **Support team**

  - ✓ Close all water tight doors. Check all compartments are shut.
  - ✓ Check for "Fire" and prepare all firefighting equipment.
  - ✓ Remove anchor lashings.
  - ✓ Prepare lifeboats for launching.

- **Medical team**

  - ✓ Bring stretcher & first aid kit to the emergency headquarters.
  - ✓ Assist in preparation of lifeboat launching.

d) Flooding

Actions to be taken by emergency teams can be summarized as follows.

- **Bridge team**

  - ✓ Sound general emergency alarm (internal & external)
  - ✓ Inform master
  - ✓ Announce on public address system (nature & location of emergency)
  - ✓ Update vessel's position to radio room / GMDSS console
  - ✓ Alter course / reduce speed to reduce pressure on the bilged (damaged) compartment
  - ✓ Check for pollution. (Activate plan as per SOPEP/SMPEP/VRP/state plan/national plan if required)
  - ✓ Initiate damage control measures
  - ✓ Send urgency message.
  - ✓ Keep a record of time, name of party contacted, How contacted (Telex / Fax / Tel) & brief details of all communication
  - ✓ Consider diversion to port of refuge.
  - ✓ If vessel is flooding very fast, consider voluntary beaching.
  - ✓ On bulk carriers, especially cape size bulk carriers with heavy cargo in alternate holds, evaluate the risk of bulkhead collapse if the flooding rate is higher than rate of pumping out.

- **Emergency team**

  - ✓ Mount rescue operation if anyone is trapped in the bilged compartment.
  - ✓ Sound all hold bilges, tanks including ballast & fuel oil tanks to check ingress of water. Positive air pressure from any sounding pipe will indicate breach of that compartment.
  - ✓ Check extent of damage and ascertain rate of flooding (Tonnes / second) by following formula: 3 x Area of hole in sq m x Sq. root of (depth of hole in metres below sea level.)
  - ✓ If area of hole is halved then rate of flooding will also be halved therefore any makeshift plugging is better than nothing.
  - ✓ Start pumping out the bilged compartment. Use all available portable pumps
  - ✓ Shoring of bulkheads to be started immediately.

- ✓ Consider transfer of weights distribution onboard to list / trim the vessel to bring the hole above water line. Reduction in head will reduce rate of flooding.
- ✓ If fracture hole is in way of bunker tank or cargo oil tank then try to transfer the bunkers / oil to another tank to mitigate pollution.

Engine team

- ✓ Prepare engines as required by bridge
- ✓ Check for hull damage in E/R
- ✓ Use pumps to pump out sea water from engine room or cargo spaces
- ✓ Inspect piping / valves / equipment's for any ingress of water. Shut valves if required.

Support team

- ✓ Close all water tight doors and fire doors. Check all compartments shut.
- ✓ Check for any fire & prepare all firefighting Equipment
- ✓ Prepare lifeboats/liferafts for launching
- ✓ Remove anchor lashings

Medical Team

- ✓ Bring stretcher & first aid kit to the emergency head quarters
- ✓ Assist in preparation of life boat launching

e) Rescue of survivors / assisting a ship in distress

A vessel is required to comply with SAR request when within reasonable and practical distance from the search area and without endangering own ship, its crew, or cargo. The procedures laid down in IMO publication, International Aeronautical and Maritime Search and Rescue Manual for Mobile Facilities (IAMSAR) Manual Vol. III are to be followed.

- ✓ When distress message is received, plot position & try to obtain bearing (Course to steer).
- ✓ Distress message shall be acknowledged or relayed in accordance with GMDSS procedures.
- ✓ Attempt to establish communication with vessel in distress.
- ✓ Continuous listening watch on all distress frequencies maintained.
- ✓ If own vessel first at scene it may be designated as CSS (Coordinator Surface Search)
- ✓ Own vessel may also be designated as OSC (On Scene Commander)
- ✓ If CSS and OSC already established, then full co-operation to be given, as possible.
- ✓ Communications between other surface units and SAR aircraft on 2182 KHz and / or VHF channel 16 to be established as available in the circumstances.
- ✓ Position, course and speed of other assisting units plotted. Pattern of search agreed.
- ✓ Good lookout to be maintained visually and by Radar for locating distressed vessel and / or survival craft. Keep 'X Band Radar' on for SART signals.
- ✓ Rescue lifeboat and rescue team ready. In cold climate full rescue boat crew must wear immersion suit otherwise lifejackets must be worn. Rescue boat crew must take spare immersion suits / lifejackets and blankets for the victims. Rig nets, ladders, cranes etc. to pickup survivors.
- ✓ Stop the ship when in close vicinity of survivors / survival craft taking set and drift into account and make a good lee for launching the rescue boat. Maintain radio communication between the rescue boat and vessel. Switch on all deck lights.
- ✓ All personnel onboard to be informed of rescue operations, and vessel prepared for rescuing and reception of survivors. Prepare accommodation and provisions for additional people.
- ✓ A strict record of all pertinent timings to be kept.
- ✓ Download and backup data from vessels VDR / S – VDR

❖ **Rescue and recovery of survivors**

- ✓ Circumstances affecting the rescue of survivors will vary considerably but might be divided into three groups.

- Recovery from survival craft or wreckage.
- Recovery from water.
- Recovery from parent ship before she sinks.

✓ Recovery from survival craft or wreckage

- Prepare hospital and other reception areas to receive casualties.
- Give medical aid for burns, oil cleansing and treatment of minor injuries.
- Treat for shock and hypothermia.
- Rig scrambling nets and boarding ladders to assist survivors to board.
- Derricks and cranes may be swung over-side along with cargo baskets if available to pick up injured people.
- Try to maneuver the rescue ship to windward of the survival craft to create a lee to aid recovery.
- Establish communications with the survival craft as soon as in practical.
- Acknowledge distress signal flares by sound or light signals.
- Have plenty of long heaving line available and also the rocket line throwing gear.
- Maintain normal bridge watch, checking navigation hazards in the vicinity.
- Display correct flag signals and keep other shipping as well as the coastal radio station informed of movements and situation.

✓ Recovery from water
In addition to as mentioned in first four points above the following should be carried out:-

- Depending on weather conditions, the best method of recovering a person or people from the water would be by use of your own boats. A ship's rescue boat is desirable and this should be launched within sight of the survivor(s) in a lee made by the parent ship.
- Injured parities should be hoisted aboard individually with the aid of stretchers.
- The condition of persons in the water, especially after a lengthy immersion, will be poor. Assistance may be required by ship's personnel to bring survivors aboard. Crew members should always wear safety harness and lifejacket in this situation or they may need rescuing themselves.
- Shooting the rocket line towards survivors may prove a worthy option if the state of the sea is so dangerous that it would be foolhardy to attempt to launch a ship's boat.
- Persons in the water without floating aids cannot be expected to remain afloat for long periods. It might be necessary to provide some form of buoyancy, such as a lifebuoy.

✓ Recovery from parent vessel before she sinks
Two methods are possible when a rescue ship is in the vicinity of the stricken ship.

- By bringing the rescue ship alongside the ship in distress, or
- By using the ship's rescue boat

f) Shipboard oil pollution incident at sea

The procedure to be followed in case of any kind of shipboard pollution incident at sea or port are specified in the vessel’s ‘Shipboard Oil Pollution Emergency Plan’ (SOPEP) / Shipboard Marine Pollution Emergency Plan (SMPEP). Actions to be taken by emergency teams can be summarized as follows.

✓ Sound emergency alarm
✓ Activate pollution prevention team
✓ Cease all bunkering / cargo operations
✓ Stop or reduce outflow and try to prevent oil from going overboard
✓ Locate source of spill and evaluate cause
✓ Take corrective actions, for e.g.:
✓ Isolate damaged area
✓ Close, cut off related piping
✓ Adjust ballast/ trim to reduce outflow
✓ Start on board clean up
✓ Inform all parties as per notification procedures given in SOPEP / SMPEP / VRP
✓ Render full assistance to all authorities
✓ Request shore assistance if required from clean up contractors or authorities

- ✓ Stow residues from clean up carefully prior disposal
- ✓ Keep proper records

g) Gyro compass failure

The procedure is as follows:

- ✓ As soon as detected, change to hand steering and steer by standard compass.
- ✓ Inform master, engine room / duty engineer, and electrical officer.
- ✓ Quick check of compass error book for compass error. Check compass error on each course
- ✓ Obtain compass error as soon as possible.
- ✓ Bear in mind all electronic instruments that will be affected by the gyro failure. Radar/ ARPA/ course recorder / Satcom etc. Adjust as necessary, where possible, radars to head up, etc. Bear in mind Satcom A will lose antenna tracking.

h) Steering failure

Actions to be taken by emergency teams can be summarized as follows.

❖ **Bridge team**

- ✓ Sound general emergency alarm
- ✓ Inform master and engine room
- ✓ Switch over to hand steering, if no response then switch over to 'Non Follow up' system
- ✓ Start the second steering motor
- ✓ Switch over to other steering system
- ✓ If still no response, Stop / slow down main engines. Use emergency stop if vessel is in imminent danger (e.g. grounding / collision)
- ✓ In case of any immediate danger of collision / grounding: Sound emergency alarm. (Refer appropriate section in this manual on collision / grounding)
- ✓ Send deck officer and helmsman to steering flat. (Master may send OOW, if required).
- ✓ Ask engine team or emergency team whoever is available quickly to change over to local emergency Steering in steering room.
- ✓ Establish communication with emergency steering gear compartment.
- ✓ Display NOT UNDER COMMAND Signals.
- ✓ Warn traffic around the vessel on VHF channel 16 or by using ship's whistle / aldis lamp.
- ✓ Broadcast the warning at regular intervals. (safety messages on VHF/DSC)
- ✓ Update ships position in GMDSS console
- ✓ Broadcast urgency message to ships in the vicinity, if appropriate

❖ **Engine team**

- ✓ Inform chief engineer
- ✓ Change over to emergency steering control
- ✓ Man the emergency steering flat, establish communication with bridge
- ✓ Prepare engines as required by bridge.
- ✓ Isolate the system as per maker's instructions.

❖ **Emergency team**

- ✓ Man the emergency steering flat and establish communication from bridge
- ✓ Change over to emergency steering controls
- ✓ Remove anchor lashings and prepare to use the anchors.
- ✓ Transfer gyro repeater to steering position if possible

Other teams should assist as required.

i) Main engine / power failure

Actions to be taken by emergency teams can be summarized as follows.

❖ **Bridge team**

- ✓ Inform master and engine room
- ✓ In case of main engines failure or slow down: To avoid an immediate danger -Depress "Emergency run / Shut down Bypass" switch on bridge panel, if available. Otherwise inform engine control room to bypass safeties, if possible.
- ✓ Change over to hand steering and steer away from immediate danger / traffic lane.
- ✓ In case of an immediate danger of collision/ grounding: Sound general emergency alarm.
- ✓ Display 'Not Under Command' signals
- ✓ Warn traffic around the vessel on VHF channel 16 or by using ship's whistle / aldis lamp.
- ✓ Broadcast the warning at regular intervals.
- ✓ Provide extra lookouts as necessary.
- ✓ If in shallow waters or moving towards danger, call anchor stations. Do not hesitate to let go both anchors to prevent running aground.
- ✓ If vessel is going to stop, maneuver the vessel to take wind / sea on such a side that the drift will be away from the danger.
- ✓ Update ship's position to radio room / GMDSS console.
- ✓ Broadcast urgency message to ships in the vicinity, if appropriate.

❖ **Engine team**

- ✓ Call chief engineer
- ✓ Change over controls from bridge to engine control room
- ✓ Locate the fault and inform bridge approximate repair time
- ✓ Stop fresh water generator
- ✓ Start auxiliary boiler

❖ **Main engine failure**

- ✓ Adjust jacket cooling water temperature
- ✓ Engage turning gear
- ✓ Open indicator cocks
- ✓ Turn engine on turning gear

❖ **Power failure**

- ✓ If standby power has not come on and/or is not on load, then start it manually
- ✓ Confirm sequential start of all essential machinery
- ✓ Confirm all cooling water lines and fuel lines to generators are in order

❖ **Emergency team**

- ✓ Remove anchor lashings and keep them ready for letting go.
- ✓ Close all water tight doors and fire doors. Check all compartments shut.
- ✓ Check stores and lashings, if vessel is likely to roll in bad weather when stopped
- ✓ Provide torches / batteries

Other teams should assist as required

j) Security incident/ drill at sea

The drill for the type of security incident will be mentioned in the ship security plan (SSP) detailing the procedure that should be followed. Any decision to navigate in areas where vessel security may be threatened requires careful consideration and detailed planning. Information shall be gathered through piracy alerts, navigational warnings etc. Piracy areas shall be identified and preferably avoided if possible. Prevailing weather condition may help in reducing piracy risk as the small pirate boats may not be able to operate when the waves are high. Formal risk assessment is required while planning such a transit and appropriate contingency plan developed. Publications such as Anti-Piracy Planning chart Q6099 – Red sea, Gulf of Aden and Arabian sea may be used for reference.

❖ In case of a pirate attack at sea, the following procedures shall be followed:
  - ✓ Plan the transit through high risk area as discussed above alongwith contingency plan.

- ✓ Identify precautionary measures and proper vigilance procedures.
- ✓ Maintain a 24 hour visual and security watch to detect attackers/ pirates
- ✓ Emergency radio contacts shall be highlighted for use in emergency. Procedures shall be established when and how to activate ship security alert system.
- ✓ Lights, water hoses, ship's whistle etc may be used to reduce opportunities for preventing pirate boarding.
- ✓ Procedures to deal with attack on vessel whilst at sea as per the ship security plan shall be followed. This will include
  - Actions in case of hijacking or seizure of ship or personal
  - Actions in cases whereby a ship is hijacked to be used as weapon or means to cause damage
  - Procedures for dealing with terrorists in cases of hijack including cooperation with terrorists and identifying dangers of provocation
  - Procedures for preservation of life and personal safety of all innocent parties involved
  - Procedures to be followed in cases of military action by authorities

Apply Your Knowledge

1. You are keeping a navigation watch with the OOW in coastal waters. List the action required in case of main engine failure.

IMU

Function: Navigation

Competence: Respond to Emergencies

Task number: A5.2

Sub task Reference number: A5.2.3, A5.2.4, A5.2.5

Topic: Emergencies in port

Task Heading

- Understudy team leaders and participate in an emergency response exercise for a pollution incident in port
- Understudy the team leaders and participate in an emergency response exercise for a security incident in port.
- Understudy the team leaders and participate in an emergency response exercise for a fire in the cargo area while in port.

Objectives

- Understand what procedures would the team leaders respond in all the above mentioned emergencies at port.

Please read this task in conjunction with tasks C3.2.3 and A5.1.2

Index

1) Introduction
2) Shipboard oil pollution incident at port
3) Security incident in port
4) Response for a fire in the cargo area while in port.

Description

1) Introduction

The procedures to follow in case of emergencies remain the same while at sea or in port. However the factors that differ are the increased probability of occurrence, risk of increased damage and availability of shore assistance while the vessel is in port. These factors are discussed in detail in the following sections in the subjected emergency situations emphasizing on the perspective while being in port. Tasks A5.1.2 and C3.2.3 shall be read for emergency procedures in general.

2) Shipboard oil pollution incident at port

- SMS procedures shall be followed for the operations involving pollution risk. The checklists shall be used to cross check the effectiveness in the beginning of operations and at regular intervals. In case of an oil spill, immediate action shall be to stop the operation leading to oil spill. The bunker barge or the tanker terminal operations need to be notified immediately for stopping pumping the oil. This could be done using a pre-agreed emergency signal.

- Means shall be employed to contain the spill on board or if overboard, to control the spread. Oil on deck shall be transferred to SOPEP drums or available tanks. Rigging oil boom around the vessel will help to control the spread of oil on water. Port authorities, vessel's agents, owners and the P&I club representatives shall be informed as advised in the SOPEP.

- Clean up onboard shall be started at the earliest. However the cleanup of oil overboard will be carried out in consultation of parties mentioned in SOPEP. Oil spill dispersant can be used **only if** the port authorities approve the use. Evidences shall be collected for settling claims in future as the same are likely to be huge.

3) Security incident in port

- Probability of occurrence of a security incidents increases while in port or in the vicinity such as anchorages. The most common incidents include stowaways, piracy/ theft and bomb threat. Most ports employ security measures within the port areas and security patrolling in anchorages. However, suitable security measures need to be employed on board the vessel, which include security patrolling on deck and in accommodation. The procedures to follow while operating at different security levels in port are described in ship security plan which shall be followed. Shore based assistance is available in the form of security guards, stowaway search parties which may be employed to facilitate these security procedures.
- Search procedures for stowaways on board shall be followed in accordance with the ship security plan. Shore based stowaway search parties sometimes use sniffer dogs to facilitate the operation. Suitable precautions shall be taken when a stowaway is detected. Personal safety measures shall be taken against any physical attack by the stowaway. Stowaways detected on board shall be handed over to the port police authority. Appropriate entry shall be made in the ship's logs for the same.
- In case of a theft on board, the same shall be reported to the port police authorities. Suitable FIR shall be lodged. In addition, the local agents, P&I club, owners and charterers may need to be informed as the case may be. Evidences and pictures of the site shall be taken. The area affected shall not be disturbed for checking by investigation authorities. Important equipments required for safe operations may need to be replenished prior the vessel sails from the port.
- In case of a bomb threat the same will require the vessel to be searched thoroughly taking adequate safety precaution against accidental activation of the bomb. Shore based bomb squads may need to be employed for search of bomb and disposal when the bomb is detected. The vessel may need to be evacuated in cases or the port authorities may require the vessel to be moved out to a safe position outside the port. Again the full operation shall be completed in accordance with the ship security plan in consultation with port authority.

4) Response for a fire in the cargo area while in port

- In case of a fire in cargo compartment, the cargo operations shall be stopped immediately. Emergency stations shall be called and the port authorities informed. The medium/ means to extinguish fire shall be selected depending upon the nature of cargo.
- There are various fixed firefighting systems like CO_2 / HALON / FOAM which are used to extinguish major cargo space fires. The decision to use the system is made by the master acting on advice from the chief engineer / chief officer. Before releasing fixed fire extinguishing medium in the compartment, all vents to be shut and the space sealed completely. All personnel shall proceed to emergency stations and head count to be taken.
- Prompt actions such as boundary cooling shall be taken to prevent fire from spreading into other cargo spaces or accommodation.
- The shore based firefighting services shall be used as required. 'International Shore Connection' on fire line may be used in order have water supply from shore. The port authorities may require the vessel to be moved to a safe position for fighting fire in order to minimize the risk to the surroundings and other vessels in the vicinity.

Apply Your Knowledge

1. Discuss the duties that shall be performed on a priority basis in case of emergencies discussed above while the ship is at port.

Function: Navigation

Competence: Respond to a distress signal at sea

Task number: A6.1

Sub task Reference number: A6.1.6

Topic: Distress signals

Task Heading

- Read and discuss with a navigating officer the contents of the International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual Volume III.

Objectives

- Understand the requirement of carriage of International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual Volume III on board the ships.
- Know the content of IAMSAR Manual Volume III

Please read this task in conjunction with taskA5.1.2.5

Index

1) Introduction
2) Purpose
3) Contents & description
4) Search patterns

Description

1) Introduction

IAMSAR manual is jointly published by IMO and the International Civil Aviation Organization (ICAO), the three-volume International Aeronautical and Maritime Search And Rescue (IAMSAR) manual provides guidelines for a common aviation and maritime approach to organize and provide search and rescue (SAR) services. Each volume (available separately in loose-leaf form, binder included) can be used as a standalone document or, in conjunction with the other two volumes, as a means to attain a full view of the SAR system.

The IAMSAR manual is divided into three volumes:

- **Volume I**, Organization and Management
- **Volume II**, Mission Co-ordination
- **Volume III**, Mobile Facilities

SOLAS chapter V, Safety of navigation, regulation 21.2 requires ships to carry an up-to-date copy of Volume III of the International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual.

Few Glossaries from the Manual:

Commence search point (CSP)	Point, normally specified by the SMC, where a SAR facility is to begin its search pattern
On-scene	The search area or the actual distress site.
On-scene coordinator(OSC)	A person designated to co-ordinate search and rescue operations within a specified area.
Rescue	An operation to retrieve persons in distress, provide for their initial medical or other needs, and deliver them to a place of safety.

Rescue action plan	A plan for rescue operations normally prepared by the SMC for implementation by the OSC and facilities on-scene.
Rescue co-ordination centre (RCC)	A unit responsible for promoting efficient organization of search and rescue services and for coordinating the conduct of search and rescue operations within a search and rescue region.
Search	An operation, normally coordinated by a rescue co-ordination centre or rescue sub-centre, using available personnel and facilities to locate persons in distress.
Search action plan	Message, normally developed by the SMC, for passing instructions to SAR facilities and agencies participating in a SAR mission.
Search and rescue mission coordinator (SMC)	The official temporarily assigned to co- ordinate response to an actual or apparent distress situation.
Search and rescue region (SRR)	An area of defined dimensions, associated with a rescue co-ordination centre, within which search and rescue services are provided.
Search and rescue unit (SRU)	A unit composed of trained personnel and provided with equipment suitable for the expeditious conduct of search and rescue operations.
Track spacing (S)	The distance between adjacent parallel search tracks.

2) Purpose

The purpose of this manual is to provide guidance to those who:-

- Operate aircraft, ships or other crafts and who may be called upon to use the facility to support SAR operations.
- May need to perform on-scene coordinator functions for multiple facilities in the vicinity of a distress situation.
- Experience actual or potential emergencies and may require search and rescue (SAR) assistance.

3) Contents & description

The broad contents of the IAMSAR manual are:

Section 1 – Overview contains:
- Purpose
- Responsibilities and obligations to assist
- National and regional SAR system organization
- SAR co-ordination
- Ship reporting systems
- Aircraft reporting system

Section 2 - Rendering assistance contains:
- Initial action by assisting craft
- Vessels assisting
- Vessels not assisting
- Aircraft assisting

Search function

Rescue function
- Rescue action plan and message
- Assistance by SAR aircraft
- Helicopter operations
- Rescue by maritime facilities
- Rescue by aircraft

- ❖ Rescue by land facilities
- ❖ Care of survivors
- ❖ Handling of deceased persons
- ❖ Other assistance
- - *Intercept and escort service*
- - *Aircraft intercepts*
- - *Aircraft ditching*
- ❖ Training
- - *Search and rescue personnel*
- - *Air search and rescue facilities*
- - *Maritime search and rescue facilities*
- - *Land search and rescue facilities*
- - *Para-rescue and paramedical personnel*
- - *Depot personnel*
- - *Masters and officers of merchant ships*

Section 3 - On-scene co-ordination contains:

- ❖ Co-ordination of search and rescue operations
- ❖ Communications
- ❖ Planning and conducting the search
- ❖ Conclusion of search

Section 4 - On-board emergencies, contains:

- ❖ General advice
- ❖ Distress alert notification
- ❖ Cancellation of distress message
- ❖ MEDICO
- ❖ Medical evacuation (MEDEVAC)
- ❖ Person overboard
- ❖ Ship emergencies at sea
- ❖ Aircraft emergencies

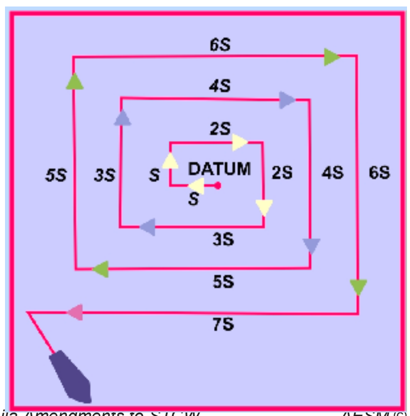
Further reference on the search and rescue, with special reference to search patterns as contained in section 3 - On-scene co-ordination of the manual, should be made to task A5.1.2.5, as described therein for "Understudy team leaders during emergency response exercises; rescue of survivors / assisting a ship in distress".

Appendices

- ❖ Appendix A: Regulation V/33 of the International Convention for the Safety of Life at Sea, 1974, as amended
- ❖ Appendix B: Search action message
- ❖ Appendix C: Factors affecting observer effectiveness
- ❖ Appendix D: Standard format for Search and Rescue Situation Report (SITREP)
- ❖ Appendix E: SAR briefing and debriefing form

4) Search patterns

Various search patterns are described under IAMSAR manual for carrying out SAR operations at sea. These are employed to search for a distressed unit at sea both by ships and aircraft. Some of these search patterns are as follows:



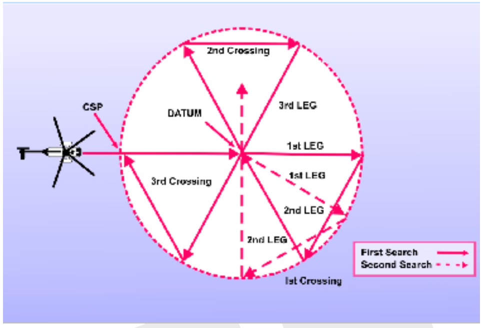
- ➢ **Expanding square search**

- ❖ Most effective when the location of the search object is known within relatively close limits.
- ❖ The commence search point is always the datum position.
- ❖ Often appropriate for ship or small boats to use when searching for persons in the water or other search objects with little or no leeway.

- ❖ Due to the small area involved this procedure must not be used simultaneously by multiple aircraft at similar altitudes or by multiple ships.
- ❖ Accurate navigation is required; the first leg is usually oriented directly into the wind to minimize navigational errors.

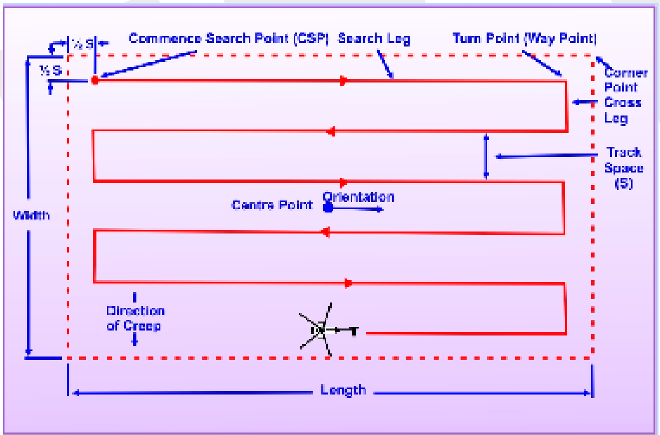
➢ **Sector search**

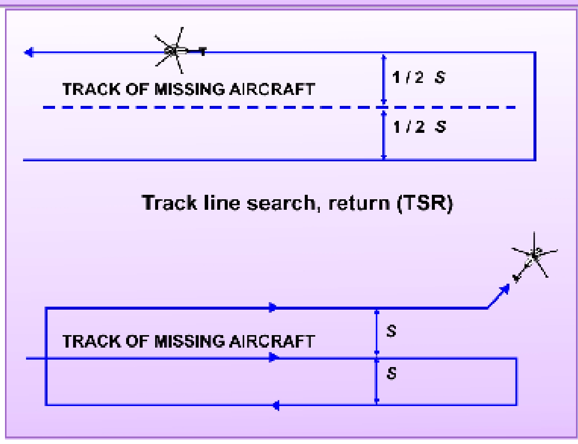
- ❖ Most effective when the position of the search object is accurately known and the search area is small.
- ❖ Used to search a circular area centred on a datum point.
- ❖ Due to the small area involved, this procedure must not be used simultaneously by multiple aircraft at similar altitudes or by multiple ships.



- ❖ An aircraft and a ship may be used together to perform independent sector searches of the same area.
- ❖ A suitable marker (for example a smoke float or a radio beacon) may be dropped at the datum position and used as a reference or navigational aid marking the centre of the pattern.
- ❖ For aircraft, the search pattern radius is usually between 5 and 20 nautical miles.
- ❖ For ships, the search pattern radius is usually between 2 and 5 nautical miles, each turn is 120 degrees, normally turned to starboard.

➢ **Track Line Search**





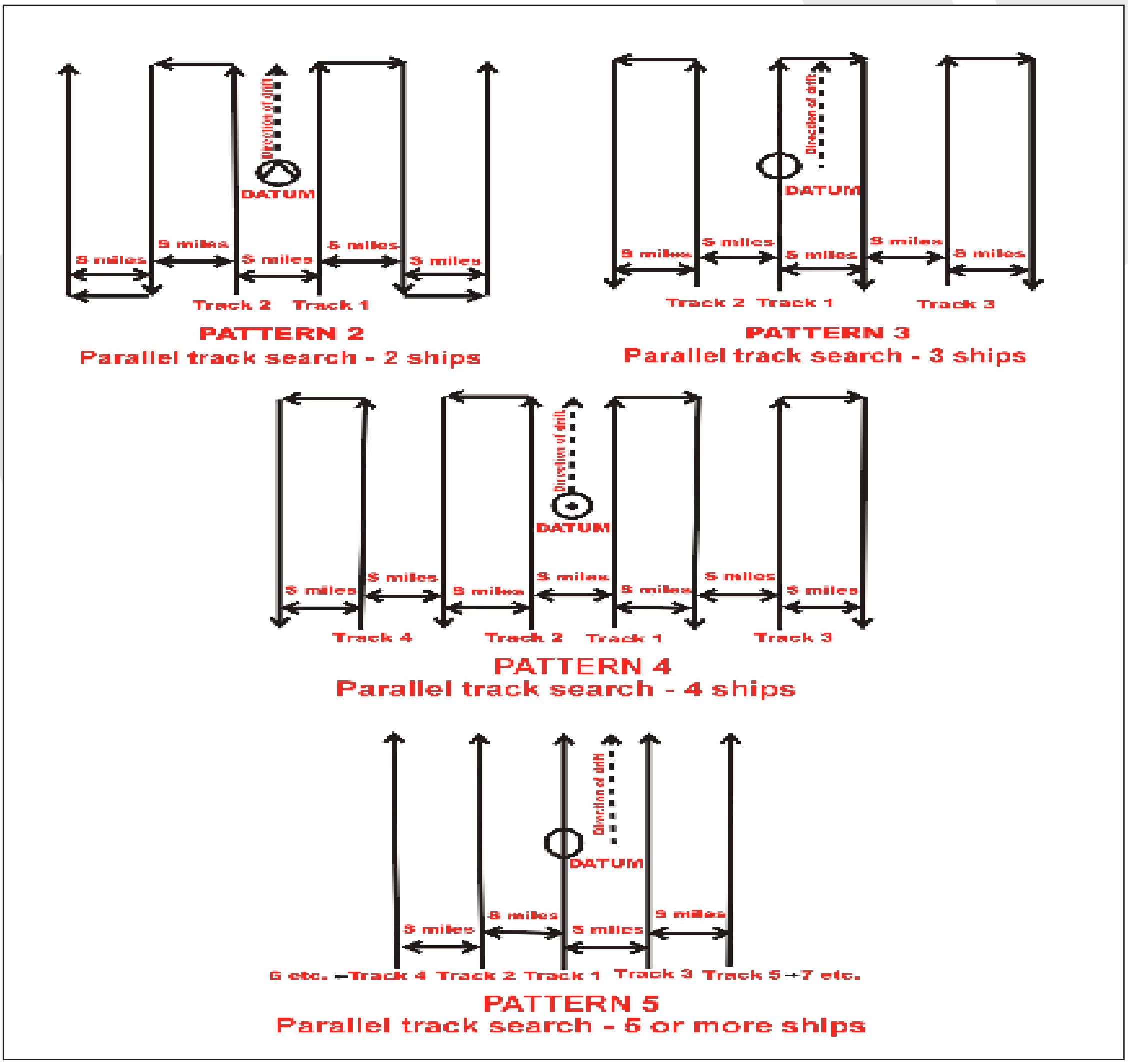
Track Line Search (return) **Track Line Search (non-return)**

- ❖ Normally used when an aircraft or ship has disappeared without a trace along a known route.
- ❖ Often used as initial search effort due to ease of planning and implementation.

- ❖ Consists of a rapid and reasonably thorough search along intended route of the distressed craft.
- ❖ Search may be along one side of the track line and return in the opposite direction on the other side.
- ❖ Search may be along the intended track and once on each side, then search facility continues on its way and does not return.
- ❖ Aircraft are frequently used for track line searches due to their high speed.

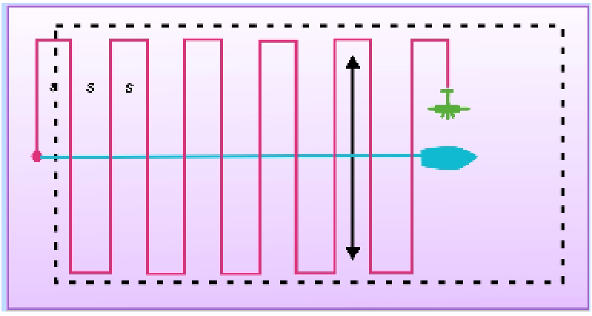
➢ **Parallel sweep search**

- ❖ Used to search a large area when survivor location is uncertain.
- ❖ Usually used when a large search area must be divided into sub-areas for assignment to individual search facilities on scene at the same time.
- ❖ The commence search point is in one corner of the sub-area, one-half track space inside the rectangle from each of the two sides forming the corner.
- ❖ Search legs are parallel to each other and to the long sides of the sub-area.
- ❖ Multiple ships may be used as shown:
    - Parallel sweep: for use by two ships.
    - Parallel sweep: for use by three ships.
    - Parallel sweep: for use by four ships.
    - Parallel sweep: for use by five or more ships.



Parallel Sweep Search (various pattern)

- **Coordinated ship aircraft search pattern**



- Normally used only if there is on-scene coordinator present to give direction to and provide communications with the participating craft.
- Creeping line search, co-ordination is often used.
- The aircraft does most of the searching, while the ship steams along a course at a speed as directed by the on-scene coordinator so that the aircraft can use it as a navigational checkpoint.
- The aircraft, as it passes over the ship, can easily make corrections to stay on the track of its search pattern.
- Gives a higher probability of detection than can normally be attained by an aircraft searching alone.

Apply Your Knowledge

1. Discuss the advantages and disadvantages of parallel sweep search.

IMU

Function: Navigation

Competence: Respond to a distress signal at sea

Task number: A 6.1

Sub-task Reference number: A6.1.7, A6.1.8, A6.1.9

Topic: Distress signals

Task Heading

- Understudy the designated distress communication officer with regards to his duties and responsibilities.
- Demonstrate sending DSC routine and test alerts under supervision.
- Assist watchkeeping officer in carrying out required daily, weekly and monthly checks and testing of GMDSS equipment.

Objectives

- Understand the responsibilities of the designated distress communications officer and procedures to carry out routine tests of GMDSS equipments.

> Please read this task in conjunction with tasks A6.1.2 to A6.1.5 and C4.1.2

Index

1) Responsibilities of the Designated distress communication officer
2) DSC/ Sat - C routine tests
3) Testing of GMDSS equipments
a) Daily tests/ checks
b) Weekly tests / checks
c) Monthly tests/ checks

Description

1) Responsibilities of the Designated distress communication officer

One of the deck officers holding a valid GMDSS GOC license is designated by the master as the "Designated distress communication officer". Alternatively, the shipping company may designate one of the certified deck officers as distress communication officer. Designated distress communication officer is assigned the primary responsibility for radio communications during distress incidents, emergencies on board and in vicinity. Name of this officer is recorded in the GMDSS logbook. The duties and responsibilities assigned to designated distress communication officer are as follows:

- Ensure that a continuous watch is maintained for distress and safety communication on
- ❖ VHF channel 16 and VHF DSC channel 70,
- ❖ Distress and safety DSC frequencies 2187.5 kHz and 8414.5 kHz and also on at least one of the distress and safety DSC frequencies 4207.5 kHz, 6312 kHz, 12577 kHz or 16804.5 kHz, appropriate to the time of day and the geographical position of the ship, which may be kept by means of a scanning receiver
- ❖ Satellite shore-to-ship distress alerts through Inmarsat ship earth station
- ❖ Relevant broadcasts of maritime safety information on the appropriate frequency or frequencies for the area in which the ship is navigating
- Carrying out distress communication duties for emergencies on board
- Carrying out communication duties when involved in search and rescue operation including relaying distress alerts
- Testing and maintenance of GMDSS equipment

➢ Record keeping in GMDSS log book with respect to daily records and distress communications and Record keeping for GMDSS equipments test and maintenance

2) DSC/ Sat - C routine tests

➢ The processes of transmitting distress alerts have been discussed under tasks A6.1.2-6.1.5 in cases of emergency.

➢ For routine testing of VHF and MF/HF DSC, tests are conducted as follows:

❖ The contents of the DSC call alert are set as follows:

- Call category – set as **Test Call**
- Station ID of the station called – checked from ALRS Vol - V
- Station ID for sending station ID – Own ship ID automatically set in
- Message priority – set as **Safety**
- Communication type – Telephone/ NBDP
- Communication frequency - Working frequency to be used for radio telephony or NBDP
- Position – usually set in automatically
- DSC frequency - DSC frequency to use for alerting, (One of the six frequencies, 4207.5, 6312.0, , 12577.0, 16804.5kHz on which the station called is keeping watch, checked from ALRS - Vol 5, 2187.5/ 8414.5 not preferred for routine calls).
- End code – to be set in as ACK RQ (acknowledge request)

Dedicated Distress Alert push button should be used ONLY for distress alerts and no other purpose. Also, Routine Test messages shall be addressed to Only One station.

❖ Having set the above details in the alert message, the 'Call' button is pressed. The equipment then awaits acknowledgement of the call.

❖ The station called acknowledges the alert by DSC alert by 'Ack BQ' in the message.

❖ After receiving the ACK BQ signal, one can communicate with other party; the radiotelephone automatically sets the

Options
Test
PV Test Result
Ctrl+P: Print ESC: Quit

Test Date & Time	02-02-25 01:58 (UTC)
Attempts	First attempt
BBER	Pass
Shore-to-Ship Attempts	First attempt
Ship-to Shore Attempts	First attempt
Distress Alert	Pass (Test OK)
Signal strength	Pass (Greater than Std level + 10dB)
Overall Result	Pass (Applicable tests pass)

Sample PV test results

working frequency and class of emission you specified. In case of VHF, the set automatically shifts to the set VHF channel for communication.

- Printouts of the test and acknowledgement shall be suitably filed for records.

- For Inmarsat C, the PV test is conducted in accordance with the operator's manual by selecting PV test from the "Test menu".

3) Testing of GMDSS equipments

a) Daily tests/ checks

- Checking proper functioning of the DSC facilities (watchkeeping receiver) by means of a self-test of the VHF and MF / HF DSC equipment, in accordance with the user's manual, without radiation of signals
- Checking VHF and MF / HF DSC watch is maintained on appropriate frequency
- Checking the position is updated in VHF, MF / HF DSC
- Checking battery ON Load / OFF Load voltages, batteries kept charged
- Satellite communication equipment (INMARSAT A, B, F, Mini-M, etc.) signal levels (logged on to correct satellite)
- Checking INMARSAT-C signal level, tuned to present and next Navarea to be transited by the vessel, position updated
- EPIRB checked properly mounted/ secured not transmitting
- Checking search and rescue transponders in position
- Checking Navtex receiver set to appropriate stations with sufficient paper roll
- Checking all three VHF walkie-talkie sets for lifeboats are fully charged, working and ready for use
- Checking printers - DSC and INMARSAT printers have adequate paper and working
- Checking all aerials & antennas visually inspected intact
- Checking ship's clock correctly set and radio console clocks to be synchronized
- Listening watch maintained on VHF Channel 16 at all times

b) Weekly tests / checks

- The proper functioning of the MF/HF DSC facilities by means of a test call when within communication range of a coast station.
- A receipt of acknowledgement from the coast radio station is must to confirm that the equipment is working. Alternatively, the equipment may be tested with another vessel providing suitable receipt.
- Inmarsat C – self test and diagnostic test in accordance with the operator's manual.
- Where the reserve source of energy is not batteries, the reserve source to be tested.
- Each survival craft two-way VHF equipment, on a frequency other than channel 16.

c) Monthly tests/ checks

- The emergency position indicating radio beacon (EPIRB) is to be tested to determine its capability to operate properly using the in-built test facility provided on the device and without using the satellite system.
- Each search and rescue radar transponder (SART) is to be tested using the in-built test facility and checked for security and signs of damage.
- The security and condition of all batteries, for lead-acid batteries the specific gravity of the electrolyte shall be checked monthly with the help of a hydrometer.
- The condition of all aerials and insulators
- In addition, where a reserve source of energy consists of rechargeable accumulator batteries, there capacity shall be checked, using an appropriate method, at intervals not exceeding 12 months, when the ship is not at sea. It is recommended to test the MF/HF equipment on battery power and to also fully discharge and recharge the battery whilst vessel is in port/anchorage.

Apply Your Knowledge

1. Refer to vessel's GMDSS test records and the operator's manuals and mention the test procedures for the following and when were these test carried out last:
   - MF/HF DSC
   - VHF DSC
   - Sat – C
2. Assist the designated officer while testing MF/HF DSC with a shore station.

IMU

Function: Navigation

Competence: Use the IMO Standard Marine Communication Phrases and use English in written and oral form

Task number: A 7.1

Sub-task Reference number: A7.1.1

Topic: IMO Standard Marine Communication Phrases

Task Heading

- Communicate with other ships, coast stations and VTIS using the SMCP (IMO's Standard Marine Communication Phrases) ensuring that communications are clear and understood.

Objectives

- Understand importance of use of Standard Marine Communication Phrases to communicate with other ships, coast stations and VTIS.

Please read this task in conjunction with task A7.2.6

Index

1) Use of Standard Marine Communication Phrases

Description

1) Use of Standard Marine Communication Phrases

Use of IMO's Standard Marine Communication Phrases facilitates unambiguous effective communication with other ships, coast stations and VTIS. The precautions to ensure effectiveness of communications are discussed under task A7.2.6 which shall be observed. Publication SMCP shall be read and followed for various phrases to be used. When communicating with other ships, coast stations and VTIS, SMCP recommends use of message markers as mentioned below. These markers are used as a prefix to the message.

- **Instruction**
  Indicates that the following message implies the intention of the sender to influence others by a Regulation
  Example: "INSTRUCTION. Do not anchor in this area."

- **Advice**
  Indicates that the following message implies the sender has a recommendation which shall be considered by the receiver; the decision whether to follow the ADVICE or not, lies with the recipient.
  Example: "ADVICE. Keep a check on the wind speed."

- **Warning**
  Indicates that the sender wishes to inform others about danger; recipient of a WARNING should pay immediate attention to the danger mentioned.
  Example: "WARNING. Buoy 4 is unlit"

- **Information**
  Indicates that the following message carries information regarding observed facts, situations, etc. which may be significant for safe navigation;
  Example: "INFORMATION. Dredging operations are in progress near buoy no.6"

- **Question**
  Indicates that the following message is of interrogative character whereby the sender asks a question to be answered by the recipient

Example: "QUESTION. What is your ETA to the fairway buoy?"

- **Answer**
  Indicates that the following message is the answer to a previous question
  Example: "ANSWER. My ETA fairway buoy is 1300hrs local time."

- **Request**
  Indicates that by the following message, the sender is asking for action from others with respect to the vessel; REQUEST must not be used involving navigation, or to modify COLREGS.
  Example: "REQUEST. I require three tugs."

- **Intention**
  Indicates that the sender is informing others about immediate navigational action intended to be taken; this message is restricted to messages announcing navigational actions by the sender.
  Example: "INTENTION. I will reduce my speed."

Apply Your Knowledge

1. Observe the duty officer while making reports to VTIS while transiting through traffic separation schemes.

I M U

Function: Navigation

Competence: Respond to a distress signal at sea

Task number: A7.2

Sub task Reference number: A7.2.4

Topic: Use of English in written and oral form

Task Heading

- Make log book entries in English. Demonstrate understanding of the content and use of nautical publications such as Sailing Directions / Mariner's Hand Book / Ocean Passages for the World.

Objectives

- Use English to make various log book entries
- Understand and use the content of nautical publications such as Sailing Directions / Mariner's Hand Book / Ocean Passages for the World

> The guidelines for making logbook entries are covered under tasks such as A1.7.5, A2.1.10, A2.1.11, A6.1.11, C1.2.4, and C6.1.10 which shall be referred

Description

The current task is entirely practical in nature whereby the trainees are advised to practice use of English and evaluate effectiveness through self-analysis. Further regular use of nautical publications shall be practiced in order to ensure thorough understanding of the content.

Apply Your Knowledge

1. Practice the use of English and familiarize yourself with the nautical vocabulary.

Function: Navigation

Competence: Use the IMO Standard Marine Communication Phrases and use English in written and oral form

Task number: A 7.2

Sub-task Reference number: A7.2.5

Topic: Use of English in written and oral form

Task Heading

- Communicate in English with a multi-lingual crew.

Objectives

- Understand the procedures to effectively communicate with multi-lingual crew.

> Please read this task in conjunction with task A7.2.1, A7.2.2, A7.2.3 and A7.2.6

Index

1) General

Description

1) General

- Effective communications are vital for smooth operations on board. Linguistic barriers arise from strange accents, improper use of multi-word lexical units and lack of a basic knowledge of English.
- Use of standard marine communication phrases is a must.
- The current task is entirely practical in nature whereby the trainees are advised to practice use of communication phrases and evaluate effectiveness through self-analysis.

> Principles and procedures of effective communication have been discussed in detail under tasks A7.2.1, A7.2.2, A7.2.3 and A7.2.6 which, along with the SMCP publication shall further be referred for this task.

Apply Your Knowledge

1. Refer to various guidelines for effective communication and practice the same. Discuss the difficulties observed when personally communicating with the multilingual crew.

Function: Navigation

Competence: Transmit and receive information by visual signaling

Task number: A8.1

Sub-task Reference number: A8.1.1, A8.1.2

Topic: Communications- Morse light signaling

Task Heading

- Transmit and receive the distress signal (SOS) by Morse light.
- Visually signal International Code of Signals single letters.

Objectives

- Understand the use of Morse signaling in communications.

Please read this task in conjunction with tasks A8.2.1 to A8.2.4

Index

1) Introduction
2) Morse code
3) Meaning of single letter signals
4) Flashing light signaling process
5) Sound signaling
6) Distress signals in morse code
7) Morse signaling by hand flags or arms

Description

1) Introduction

- International Code of Signals (INTERCO) provides ways and means of communication in situations when language difficulties arise. INTERCO uses following modes of communication
- Flag signaling
- Flashing light signaling - using morse code
- Sound signaling - using morse code
- Morse signaling by hand-flags or arms

2) Morse code

Morse code uses symbols representing letters and numerals expressed by dots and dashes which are signaled either singly or in combination. The dot is called 'Dit' and the dash as 'Dah'. The Dits and Dahs are identified by their duration which is as follows:

- Dot is taken as one unit (●)
- Dash is equivalent to three units (—)
- The space of time between any two consecutive elements of a symbol is equal to one unit
- The space of time between two complete symbols is equal to three units
- The space of time between two words or groups is equal to seven units

- The standard rate of signaling by flashing light is regarded as forty letters per minute.

- **Symbols for alphabets & numerals in Morse code**

Letter	Code Word	Code	Letter	Code Word	Code
Alphabets			**Numerals**		
A	Alpha	●—	1	Una One	●— — — —

IMU

Letter	Code Word	Code	Letter	Code Word	Code
B	Bravo	—●●●	2	Bisso Two	●●— — —
C	Charlie	—●—●	3	Terra Three	●●●— —
D	Delta	—●●	4	KarteFour	●●●●—
E	Echo	●	5	Panta Five	●●●●●
F	Foxtrot	●●—●	6	SoxiSix	—●●●●
G	Golf	— —●	7	SetteSeven	— —●●●
H	Hotel	●●●●	8	OktoEight	— — —●●
I	India	●●	9	Nove Nine	— — — —●
J	Juliette	●— — —	0	Nada Zero	— — — — —
K	Kilo	—●—	**Procedure Signals**		
L	Lima	●—●●	AR	●—●—●	
M	Mike	— —	AS	●—●●●	
N	November	—●	Decimal	AAA	●—●—●—
O	Oscar	— — —			
P	Papa	●— —●			
Q	Québec	— —●—			
R	Romeo	●—●			
S	Seirra	●●●			
T	Tango	—			
U	Uniform	●●—			
V	Victor	●●●—			
W	Whiskey	●— —			
X	X-Ray	—●●—			
Y	Yankee	—●— —			
Z	Zulu	— —●●			

3) Meaning of single letter signals

Can be made by any method of signaling; the meaning of the single letter signals are discussed under tasks A8.2.1 – A8.2.4.

4) Flashing light signaling process

A signal made by flashing light from the day light signaling lamp or the signaling light provided on the top of main mast. The signaling process comprises of the following:

a) The call
The general call or the identity signal of the station being called, answered by the answering signal

b) The identity
The transmitting station then gives its identity. This comprises of prefix "DE" followed by its identity signal or name. The receiving station acknowledges the same by repeating the same. The process is then repeated by the receiving station and acknowledged by the sender.

c) The text
The text of the message in the form of code groups or plain language then follows. Message in the form of code groups is preceded by the signal "YU". Words of plain language such as names, places, etc. may also be in the text of such coded messages. Receipt of each word or group is acknowledged by "T".

d) The ending
The message ends by the ending signal "AR" acknowledged by "R".

5) Sound signaling

Single letter codes on sound signaling appliances shall preferably be used only in case of emergency. It is recommended to use the sound signals preferably only for the purpose of COLREGs.

6) Distress signals in Morse code

- NC
  I am in distress and require immediate assistance
- SOS (**●●●▬ ▬ ▬●●●**)
- Slowly and repeatedly raising and lowering arms outstretched to each side.

7) Morse signaling by hand flags or arms

Single letter codes as discussed above may be transmitted using hand flags or arms. The cedes used are as follows

- The call signal is “AA AAAA”. Alternatively, a station which desires to communicate with another station by Morse signaling by hand flags or arms may indicate the requirement by transmitting to that station the signal “K1”.
- On receipt of the call, the station addressed uses the signal “T” or “YS1” is used to acknowledge.
- All signals end with the ending signal “AR”.

Dot

Dash

Separation of "*dots*" and/or "*dashes*"

Separation of letters, groups or words

Erase signals, if made by the transmitting station.
Request for repetition if by the receiving station.

Apply Your Knowledge

1. Locate the Morse signaling light on the main mast of the vessel and the key for its operation.
2. Identify any five Racon transmitting Morse code observed on the RADAR screen while navigating in coastal areas.

I M U

Function: Navigation

Competence: Transmit and receive information by visual signaling

Task number: A8.1

Sub-task Reference number: A8.1.3

Topic: Communications- Morse light signaling

Task Heading

- Use and maintain the daylight signaling lamp and its battery.

Objectives

- Understand use and maintenance of the daylight signalling lamp.

Index

1) Daylight signalling lamp
a) Working
b) Maintenance and care

Description

1) Daylight signalling lamp

Daylight signalling lamps are portable lamps provided for transmitting light signals to an observer by focused light beams. It is used for communicating by means of light signals and mostly for attracting attention in accordance with COLREGs, both by day and by night.

All ships of over 150 tons gross tonnage, when engaged on international voyages, are required to have on board an efficient daylight signalling lamp. The lamps are operated using an independent source of power in the form of battery. The lamp can also be operated using the ship's main source of electrical power for which the plug point are provided in the navigation bridge.

All parts of daylight signalling lamps are made of anti-magnetic material and are able to withstand heat generated by the lamp. The outer parts of daylight signalling lamps are suitable insulated not to get heated by the lamp making it unbearable for manual use. The lamp shall be provided with user's manual providing instructions for operation of equipment, troubleshooting, maintenance and service.

a) Working

The instrument generally contains a lamp powered by the battery. This lamp is positioned at the focal point of a parabolic mirror. The lamp is enclosed in a movable shutter which can be retracted using a lever, when the lamp is required to flash. During operation, the lamp is lit by pressing the lighting lever. The signalling lever is then pressed which retracts the shutter. Doing this the light from the bulb is projected on the parabolic mirror. This light gets converted into a focused beam when reflected by the parabolic mirror. Colored glass shades are provided to produce colour light beams to be used in the daylight. A telescope is provided on the top of the lamp to focus on the point where the signal is targeted. The visibility of light signals emitted by daylight signalling lamps is at least 2 nautical miles.

b) Maintenance and care

The lamp is recommended to be kept connected for use during the navigation/ anchor watch. It shall be tested ready for operation while taking over the watch. The lamp shall be handled carefully and kept in secure position preventing any fall. Spare bulb, mirror and shades shall be kept available in accordance with the manufacturer's instructions and shipboard PMS and replaced as required. The battery shall be kept charged, placed in a prominent position ready, for use. Dry cell batteries are virtually maintenance free. The wet batteries shall be maintained in accordance with the shipboard PMS.

Apply Your Knowledge

1. Discuss the use of Aldis lamp to attract attention in accordance with COLREGs.
2. Locate the Aldis lamp power supply sockets in the navigation bridge.

I M U

Function: Navigation

Competence: Transmit and receive information by visual signaling

Task number: A8.2

Sub-task Reference number: A8.2.5

Topic: Communications- Signaling by flags

Task Heading

- Demonstrate understanding of signals covered by 2 and 3 letter hoists

Objectives

- Understand the procedure of communication using flag hoists.

Please read this task in conjunction with tasks A8.2.1, A8.2.2, A8.2.3 and A8.2.4

Index

1) Use of flag signaling for communicating
a) Making a call
b) Answering a call
c) Completing a call

Description

1) Use of flag signaling for communicating

For this purpose a minimum of 40 flags are provided on each ship:

- ✓ 26 Alphabetical flags
- ✓ 10 Numeral pennants
- ✓ 3 Substitutes
- ✓ 1 Answering pennant

a) **Making a call**

The identity signal of the station addressed is hoisted. This may be hoisted with the message or the message may follow. The receiving station hoists her answering pennant to the dip (halfway up the halyard) to acknowledge that she is receiving.

b) **Answering a call**

When a signal is received and understood by the receiver, the answering pennant is hoisted close up. If the signal cannot be read DO NOT close up the answering pennant. If the signal is distinguished but is not understood, “ZL” is hoisted which indicates ‘Your signal has been received but not understood’.

The transmitting vessel on seeing the answering pennant close up lowers his hoist. The receiving vessel on seeing the hoist being lowered lowers his answering pennant to the dip and awaits the transmitting vessels next hoist

c) Completing a call

The transmitting station hoists the answering pennant close up and the receiving station acknowledges as above, except that instead of lowering to the dip it is lowered completely.

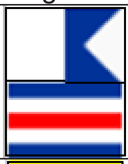
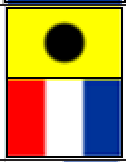
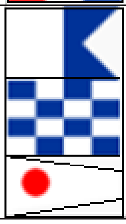
Three "substitute" flags namely - first substitute, second substitute and third substitute are provided for use whereby the characters of the code need to be repeated. These substitutes repeat the flag at the indicated position and enable the same signal flag i.e. alphabetical flag or numeral pennant to be repeated one or more times in the same group, in cases only one set of flags is carried on board.

The answering pennant is used for answering/ acknowledging as discussed above. However the same may be used to indicate a decimal point but is to be disregarded when determining which substitute to be used.

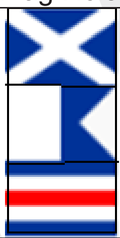
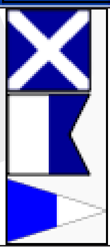
Details of signaling using two/ three letter codes have been covered under tasks A8.2.1 - A8.2.4.

Examples:

- ✓ Two-letter signals

Flag Hoist	Code	Meaning
	AC	I am abandoning my vessel.
	IT	I am on fire.
	AN1	I need a doctor, I have severe burns.

- ✓ Three-letter signals

Flag Hoist	Code	Meaning
	MAC	I request to arrange hospital admission.
	MAA	I request urgent medical advice.

Apply Your Knowledge

1. Locate the flags in the wheelhouse. Check the occasion and the location of hoist for the following flags.
   - ❖ Flag ‘B’
   - ❖ Flag ‘Q’
   - ❖ Ensign Flag
   - ❖ Courtesy flag

Function: Navigation

Competence: Maneuver the ship

Task number: A9.2

Sub-task Reference number: A9.2.6, A9.2.7, A9.2.8

Topic: Anchoring and mooring procedures

Task Heading

- Operate mooring winches and windlass under supervision. Check brake lining and brake adjustment bolt clearance.
- Use rope and chain stoppers under supervision and demonstrate the procedure for turning up mooring lines.
- Demonstrate safe handling of moorings, with reference to snap back zones, minimum turns on the winch drum, lead from the warping drum to the fairlead and precautions when using self-tensioning winches.

Objectives

- Understanding the procedure of testing winch brakes, use of stoppers during mooring operations and other safety precautions.

Please read this task in conjunction with tasks A9.2.1 to A9.2.5 and A9.2.17

Index

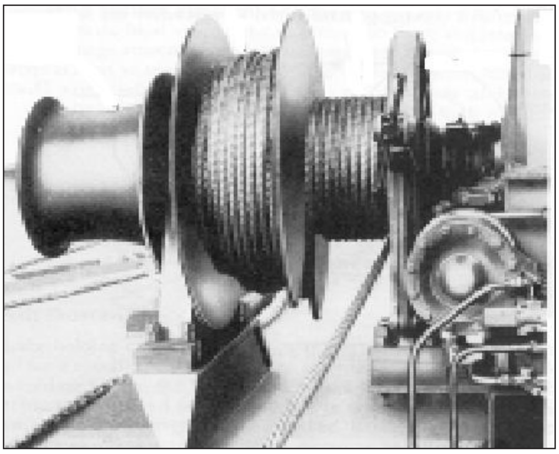
1) Mooring winches
2) Self-tensioning winches
3) Winch brake inspection for condition monitoring
   a) Factors effecting winch brake holding capacity
   b) Testing the winch brake
4) Rope and chain stoppers
5) Lead of ropes

Description

1) Mooring winches

- Based on the type of control winches are classified as self tensioning winches and winches with manual controls. Self-tensioning winches automatically render to the tension in the lines whereas, in the winches with manual control are operated manually using levers. The winches can be driven by steam, hydraulically or electrically. The winches may have a single drum, double drum or more. These drums may be single undivided or split into two drums. For control the winches may be equipped with disc brakes, band brakes, mechanical screw brakes or brakes applied with spring.

Winch with Split Drum



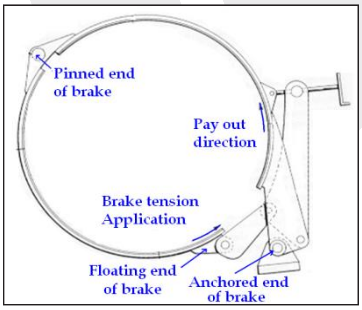
- Reference shall be made to safe procedures for winch operation discussed under task A9.2.1 – A9.2.5 and A9.2.17.

2) Self-tensioning winches

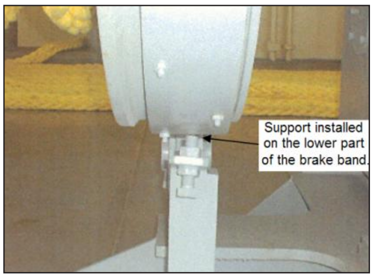
- Self-tensioning winches are designed to automatically heave-in whenever the line tension falls below a certain pre-set value and pay out if the line tension exceeds a pre-set value. Manual winches require manual operation of winch controls for heaving or rendering.
- The use of the self-tension winch is not recommended except for moorings deployed at 90° to the ship's axis (breast lines). The spring lines are positioned to oppose each other. Similar are the headlines. When used for spring lines or headlines, these winches are left only with the difference between the heaving and rendering values of the winches to resist longitudinal environmental forces.
- In automatic mode, such winches are likely to render when under load allowing the vessel to move out of position, with consequent risk to cargo arms or hoses. Further it may be dangerous to use such winches when there is not much space available between ships moored ahead and astern of the own vessel.
- Self-tensioning winches shall not be used where the vessel is likely to experience strong tidal streams or off-shore winds. Regular check is required on the vessel's position alongside when self-tension winches are in operation.

3) Winch brake inspection for condition monitoring

a) Factors effecting winch brake holding capacity



- ❖ The physical conditions of the winch gearing and brake shoe lining/ block significantly affect brake holding capacity. If the deterioration is significant, the linings or blocks must be renewed. Oil, moisture or heavy rust on the brake linings or drum affect the coefficient of friction of surfaces and hence seriously reduce the brake holding capacity. Oil contaminated brake linings shall be renewed. Disc brakes are usually less likely to be affected by wear. The holding capacity of a winch brake is inversely proportional to the number of layers of the mooring wire or rope on the drum.



- ❖ Whenever brakes are opened up for any reason, the brake drum should be examined for build-up of rust or worn brake material and should be de-scaled as necessary. The link mechanism of the brake must be free up and greased.
- ❖ The abrasion state of the brake band, brake drum and the slot and pin of the brake link shall be checked. Also, the support which is installed in the lower part of the brake band to prevent early abrasion in the upper part of the brake band should be adjusted appropriately, following the mooring winch instructions. (Generally the opening is set 2 - 3mm. After a lining change, adjusting the support is sometimes forgotten.)

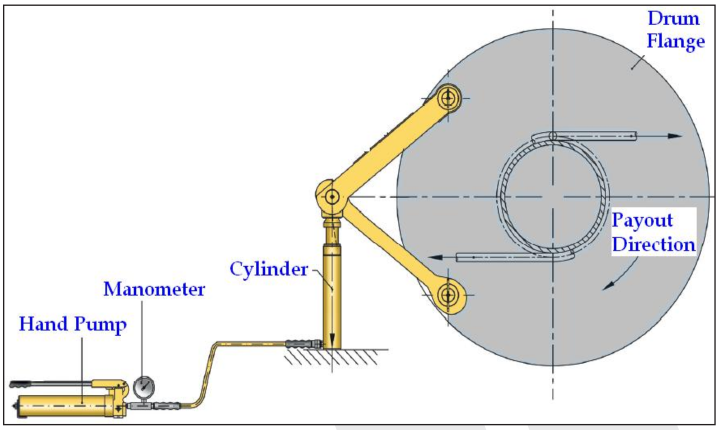
b) Testing the winch brake

- ❖ Mooring winch brakes should be tested usually every twelve months or as specified in the ship's PMS. Further, the winches shall be tested after any modification or repair involving winch brakes or upon any evidence of any brake malfunctions or slippage. A record, both of regular maintenance and inspections and of tests, should be kept on the ship. Kits are provided on board for testing winch brake holding capacity and can be placed on board for use by the crew.

❖ Prior proceeding for winch brake testing general condition of the winch brake shall be checked for wear and tear, corrosion, rust traces of oil and grease. The mounting screw on deck shall be checked for general condition. For constant results the winch should be operated for a short period with the brake set slightly on in order to dry the brake surface.

❖ The winch testing operation shall be carried out under supervision of senior officers as advised in the SMS manuals.

❖ Equipment used for testing the brakes is as shown in the above picture. Lever consisting usually of two pieces of bar is secured to the drum of the winch by means of bolts furnished with the test kit and fitted through holes provided in the drum flange. A hydraulic jack with pressure gauge is then connected a shown, jack being placed on the foundation. The winch brakes are then as

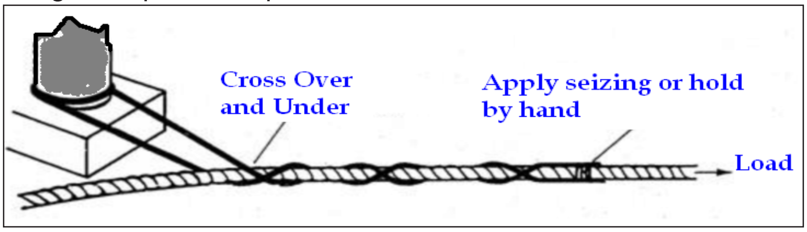


recommended in the test specification. If the winches are set normally, a torque wrench should be used. If they are set hydraulically, the pressure gauge should first be calibrated. Having set the above, the test specifications for the brakes shall be checked, that is, the hydraulic jack pressure at which the brake is designed to render. Now, pressure is applied to the hydraulic jack and the winch drum carefully observed.

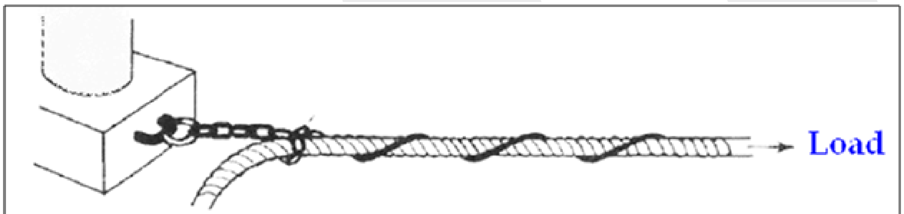
❖ As soon as any movement is observed on the drum the hydraulic pressure applied to the jack is recorded. For being apparent a chalk mark may be used on the winch and drum. If the brake is observed to slip at a pressure less than designed, the brake should be tightened or repaired and jack pressure reapplied. If the brake slips at pressure same as the design pressure, the jack should be released and the test gear removed. And if the brake does not slip at the design pressure, the brake setting should be adjusted so the brake can render at the design load. The primary brake should be set to hold 60% of the mooring line's MBL. Once the brakes are tested and calibrated, the proper setting should be recorded. It is recommended that new equipment be designed to hold 80% of the line's MBL, since brakes are likely to deteriorate in service.

4) Rope and chain stoppers

Rope and chain stoppers are used to temporarily hold the load of a line while the line is in the process of being transferred from warping drum to the bitts. Stopping off a line is a risky operation and suitable precautions need to be taken while undertaking such operation. The stopper should be secured to the base of the bitts by a shackle, or around one of the bollards, so as to lead away from the direction of heaving. Material used for the stoppers shall generally be of the same type as the mooring lines except in case of nylon ropes, where polypropylene ropes shall be used. Prior using, the stopper should be carefully examined for any signs of deterioration, wear and tear. The double rope used for the stopper should, where possible, have a combined strength equal to 50% of the breaking load of the mooring rope on which it is to be used. There is no requirement for fibre handling tail ropes to be proof tested.



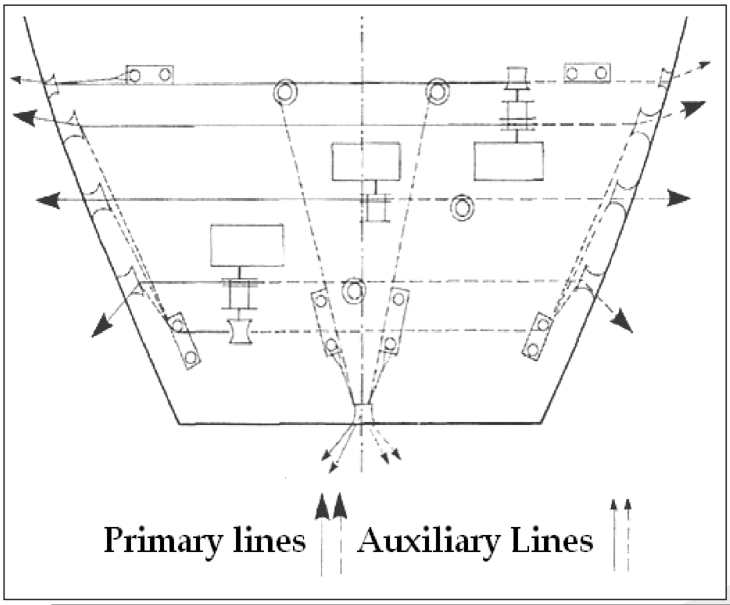
- Chain stoppers are used for stoppering the wire ropes. The chain stopper consists of open link chain of length (about 1.7 meters), with a rope tail spliced to the end link. The chain is shackled to the base of the bitts or to a deck ring bolt of convenient position. A chain stopper should be shackled as near as possible in line with the span downhaul and always to an eye plate, not passed round on a bight which would induce bending stresses similar to those in a knotted chain. The stopper is passed over the wire forming an open cow hitch, followed by the remainder of the chain, which is turned up against the lay. The turn on the chain are made against the lay of the wire, so as not to open it up and cause distortion, weakening the wire. The rope tail is also turned up in the same direction, and then held as the weight comes onto the stopper. The two half hitches of the cow are kept about 25 cms apart (as shown in below sketches). The mariner should ensure that a cow hitch is used and not a clove hitch, as the latter would be liable to jam whereas the cow hitch is easily is easily pulled loose when no longer required.

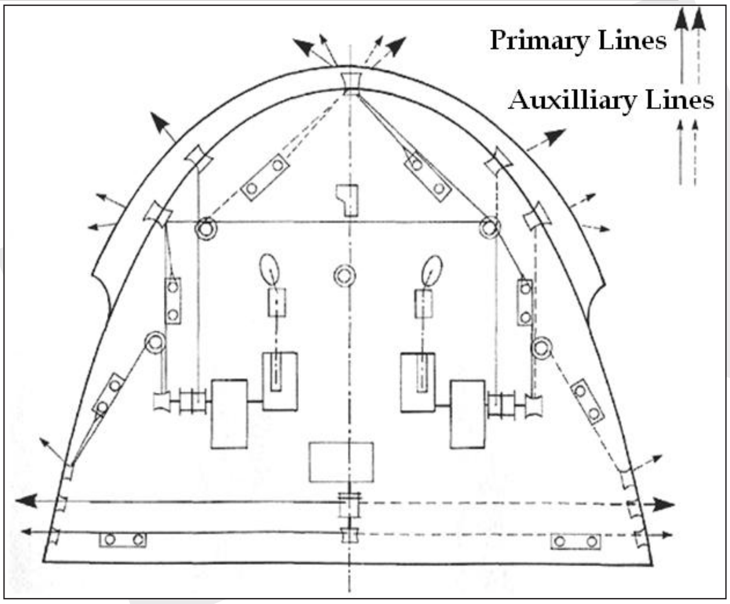


Chain Stopper for Wire Rope

5) Lead of ropes

- The moorings shall be lead in appropriate directions as required for their purpose. Such as, spring lines shall lead parallel to the ship’s length as far as possible, whereas the breast lines shall possibly be lead at 90 degrees to the length. Further, the lead and layout on deck also affects the strength of the rope. Acute angles around rollers or fairleads should be avoided as the friction between the wire and fairlead can result in a significantly higher load being carried in the line between the ship and shore bollard than that between the fairlead and winch. Reference shall be made to vessel’s mooring plan to obtain the best lead for the rope from each winch. Reference shall be made to safe procedures for handling moorings discussed under task A9.2.1 – A9.2.5.





Apply Your Knowledge

1. With reference to the mooring plan of the vessel, discuss the recommended layout of moorings.
2. Check the load settings for the winches on board your vessel at forward and aft stations.

Function: Navigation

Competence: Maneuver the ship

Task number: A9.2

Sub-task Reference number: A9.2.9, A9.2.10, A9.2.11, A9.2.12, A9.2.13

Topic: Anchoring and mooring procedures

Task Heading

- Assist the crew with removing anchor lashings and other anchor related tasks, including:
  - Preparation of anchors and letting go
  - Walking back anchor in a controlled manner (deep water anchoring)
  - Weighing of anchor, inspecting for damage and fouling.
- Accompany an officer on deck for anchoring operation. Recognize the significance and method of reporting to bridge the lead of the anchor chain.
- Use bow stopper and anchor brakes as directed by officer in charge during anchor stations.
- Assist with securing of anchors for sea. Recognize the importance of three point contact at the securing position.
- Demonstrate understanding of the procedure for releasing the bitter end of anchor chains.

Objectives

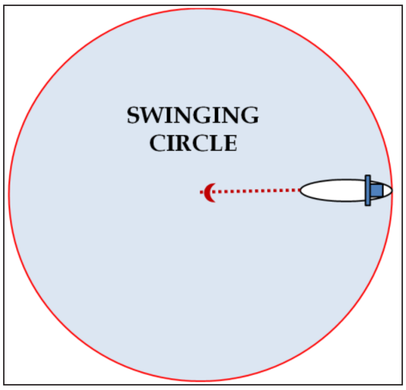
- Understand procedures of anchoring, weighing anchor and securing anchor for sea passage along with associated considerations and safety precautions.

Please read this task in conjunction with task A9.2.14

Index

Description

1) Anchoring



Vessel may be required to anchor for various reasons, some of which could be:

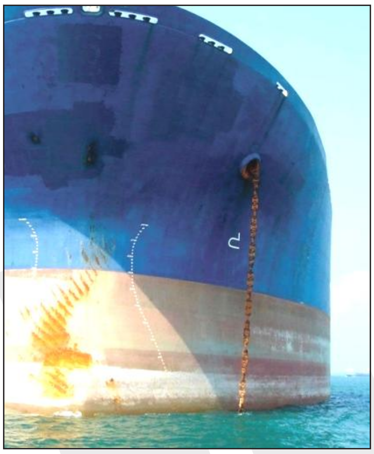
- Waiting for berth to be free
- Waiting for the transit channel convoy timings
- Waiting for tide timings
- Waiting cargo readiness at berth
- Cargo/ bunkering/ surveys/ repair operations planned at anchorage etc.

The anchoring plan for the vessel shall be prepared keeping in mind points discussed below. It shall be noted that the vessel's anchoring equipment is essentially intended for the temporary mooring in a sheltered or protected area or within a harbour when the vessel is awaiting berth, tide, etc.

- **Points to consider when making an anchoring plan**
  - Expected duration of stay at anchorage
  - Draft of vessel and depth of water in the anchorage area
  - Nature of bottom
  - Expected weather conditions and rate of current/ tidal streams
  - Proximity to shore and hazards
  - Traffic density at anchorage and availability of sea room
  - Nature of operations to be undertaken and designated anchorages

Status of engines: If engines are planned to be immobilized for repairs, the anchorage should be well sheltered.

2) Anchoring terms and expressions



- Short stay
  When the cable is taut and leading down into the water close to the vertical
- Long stay
  When the cable is taut and leading down to the water close to the horizontal
- Up and down
  When the cable is leading vertically into the water
- Growing
  Used to describe the way the cable is leading from the hawse pipe for example the cable is growing abeam when it leads abeam
- Come to, Brought up, got her cable
  Used after anchoring, when the ship starts riding to her anchor and cable and the anchor is holding
- Snub cable
  Use the brake on the windlass to stop the cable running out
- Surge cable
  Not using the brake or the windlass motor and thus allow the cable to run out freely
- Render cable
  When the brake is applied such that as weight comes on the cable it is able to run out slowly
- Veer cable, Walk back
  To pay out cable under power using with the windlass motor
- Nipped cable
  When the cable direction changes sharply due to an obstruction such as the stem or hawse-pipe

- Clearing anchors
  To remove the anchor lashings and securing arrangement and keep the anchors ready for use
- Shortening-in
  When a ship at anchor heaves in some of the cable
- A'cockbill
  When the anchor has been lowered clear of the hawse pipe and is hanging vertically above water
- Scope
  Scope of the cable is the ratio between the length of the cable outside the hawse pipe and the depth of water

- Foul anchor
  When an anchor is caught in an underwater cable or which has come up to the surface with some debris like wires, hawsers or fishing net or which is fouled by its own cable
- Clear hawse
  When both the anchors are out and the cables are clear of each other
- Open hawse
  When both anchors are out and the cables and are leading broad out on their own respective bows

- Foul hawse
  When both the anchors are out and the cables are entwined or crossed. If a ship has both the anchors out and she swings 180°, she is said to have a foul hawse and the cables are said to have a cross in them. An elbow in the cable is caused if the ship swings a further 180° in the same direction; another 180° swing in the same direction causes what is known as an elbow and cross. If the ship swings a further 180° in the same direction that is two turns in all then the cable is said to have a round turn.

- Windrode
  When a ship is riding head to wind
- Tiderode
  When a ship is riding head to tide
- Range cable
  To remove the cable from the chain locker and lay it out for example on the ship's deck, a jetty, a barge, dry-dock etc.
- Weighing anchor
  The operation of heaving in the cable until the anchor is off the bottom and heaved up clear of the water
- Anchor aweigh
  Used during weighing anchor immediately after the anchor is broken out of the bottom and is just clear of the bottom

3) Preparing anchor for letting go

- The anchors should be cleared ready for letting go as soon as ship enters congested waters or in areas with high traffic density/ restricted visibility in anchoring depths.
- Anchor lashings are removed. Any cementing on spurling pipes or plates on spurling and hawse pipes are removed.
- The windlass is put in gear, the brakes opened and the anchors are a'cockbilled. The brake is then tightened. If the anchor is to be let go on the brake, the windlass gear is disengaged.

- After a long voyage especially when the ship has experienced heavy rolling, it is prudent to walk back the cable to about half a shackle on deck and then again heave in before keeping it ready for letting go outside the hawse pipe. This will ensure that the first shackle is free to run out and not stuck due to shifting of the cable chain in the chain locker during rolling. This should be done only when the ship has no headway and not rolling.
- The windlasses should be tried out prior arrival at the anchorage as specified in ship's SMS procedures.
- The warming up steam for steam operated windlasses should be opened up well in time prior use.

4) Letting go anchor/ walk back

- 'Let Go Anchor' means anchor held by the brake only (windlass gear disengaged) is allowed to run out freely by releasing the brake.
- 'Walk Back Anchor' means anchor is lowered gradually using the windlass in gear.
- An anchor should never be let go directly from the hawse pipe except in cases of emergency.
- Generally in depths of over 50 meters, the anchor should be walked back usually up to about 4 to 6 meters above the sea bed before keeping it ready for letting go on brake.

> When the anchor and cable runs out mud, rust particles and other debris may fly out. Therefore personnel on the forecastle should wear suitable protective aids. There have been instances where the cable has snapped while anchoring. Therefore no personnel should stand forward of the

- On larger ships like tankers and bulk carriers, the anchor should generally be walked back under power and not let go on the brake considering the weight of anchor and cable.
- On receiving the order from the bridge, the anchor is 'let go' or walked back' as required. For the anchor to hold effectively, the anchor and the anchor cable shall be lying horizontal on the sea bed for a substantial length providing a horizontal pull, making a catenary while going upwards towards hawse pipe.

> In ports where the anchor is likely to be used by pilot for anchoring or berthing, the anchoring plan shall be discussed with the pilot in detail.

- When the anchor is 'let go' the brake is opened and anchor is allowed to fall freely. Gradually the brake is tightened to snub the cable as cable length equal to twice the depth of the water is run out. The cable should not be checked too soon or allowed to run out so much that it piles up at the bottom. The brake is subsequently slackened again and the cable is then allowed to render. If the cable is allowed to pile up on the anchor there is a possibility of the anchor getting fouled. Care should be taken to avoid any undue stresses especially jerks affecting the cable.
- When the anchor is walked back, depending upon the depth of water, the navigation bridge advises the number of shackles to lower in water so the anchor is held few meters above sea bed and then 'let go' as discussed above. While the anchor is lowered in water, it shall be ensured that the ship has no head way.
- In deep water anchoring is done throughout by lowering the anchor with windlass in gear. The cable is paid out with ship moving astern with a little sternway. Company SMS anchoring procedures shall be followed while anchoring in deep waters.
- The officer-in-charge on the forecastle should make regular reports to the bridge which should include the following. The intention is to advise navigation bridge of the current situation so that the engines and/or helm can be used for laying the anchor on the sea bed in the desired manner.
  - The number of shackle as it runs out or is walked back
  - Whether the cable is at long stay, short stay or up and down

- The direction in which the cable is growing
- The strain or weight on the cable

- The cable is then secured by tightening the windlass brake, putting in the bow stopper and gear disengaged. Doing this ensures that the windlass is protected from any excessive stress while the ship is at anchor. When securing the anchor it is advantageous to position the joining shackle between the bow stopper and the windlass gypsy so that in case of an emergency the cable can be broken at this shackle. This also helps in clearing a foul hawse in case two anchors have been used.

- After the cable is secured it is checked over side if the anchor is holding. This becomes evident when the ship springs towards the anchor as a result of the increasing tension of the cable, that is, the cable will initially tend to grow to long stay and then slowly slack down. The ship is then said to be ‘brought up’ and the same is reported to the bridge.

- During daylight hours the anchor ball should be hoisted. At night the anchor lights will have to be switched on.

- The windlass brake should be re-checked tight. The windlass power should be switched off. Hawse pipe cover shall be positioned in order to block the pirates boarding through hawse pipe along anchor cable.

5) Weighing the anchor

- The anchor windlass is typically designed to be capable of weighing the anchor in 100 meters depth. The windlass should be tested at least two hours prior use and kept ready. In the case of steam operated windlasses, the warm up steam should be opened up at least two hours prior use.

- The officer in charge of the operation should establish communications with the bridge. Navigation bridge shall be requested to start the anchor wash after ensuring that the relevant valves are open. The windlass brake shall be checked tight and the windlass then put in gear. The cable securing arrangement such as the bow stopper bar should be cleared. When the order to start heaving is received, the brake shall be released and heaving commenced.

- The officer in-charge of operation should report the following regularly to the navigation bridge. The intention is again to use engines and helm to avoid excessive straining of the windlass machinery.
  - When each shackle comes inboard.
  - Whether the cable is at long stay, short stay or up and down.
  - How the cable is growing.
  - The strain or weight on the cable.

- While heaving, if the cable gets nipped badly the windlass brake should be tightened and the same reported to bridge. Heaving in should be resumed only after the ship has swung such that the cable is clear.

- Ensure that the cable is washed well before entering the chain locker. If required hand held hoses can be rigged to supplement the anchor wash.

- Navigation bridge shall be informed when the anchor is off the ground. This is identified by the cable leading up and down and the windlass experiencing the increased weight. “Anchor aweigh and clear” shall be reported when the anchor is seen clear of water and any foul.

- If the anchor is fouled at the bottom and not coming up, the windlass brake is tightened and the bow stopper guillotine bar is put in place. Then engines should then be used carefully to break the anchor off the ground.
- If the anchor is fouled with the bottom mud or clay, the anchor shall be streamed in the water for a short distance to clean it. The navigation bridge shall be kept informed of the same.
- After the anchor is cleaned, it shall be housed in the hawse pipe in consultation with the bridge.
- While heaving in, the cable should be checked for any damages like cracks and missing studs etc. The anchor should be checked for any damages like fatigue cracks, bent shank or flukes before housing in the hawse pipe.

6) Securing the anchor for sea

- The anchor should be heaved right into the hawse pipe. Ensure that the flukes are resting on the shipside on the rest pads, if provided. Once properly housed, the anchor shall be touching the ship's hull at the crown and the flukes. This ensures the anchor is secured and does not move while the ship moves in the seaway causing damage to ship's hull. If the anchor can move in the hawse pipe, the anchor flukes may pierce the bow shell.
- The windlass brakes are to be tightened as per the recommendation of makers. Please note extra tightening and insufficient tightening are both incorrect.
- Windlass brakes and lashing arrangement are the primary and secondary means respectively, of securing anchors at sea. Wire or chain lashings with turnbuckles are used. The anchors should be secured in such a way that the anchors cannot work loose in heavy seas.
- The bow stopper bar is put in place and the securing pin engaged to prevent the bar from jumping off.
- Chain locker doors / man holes must be secured tightly to ensure that even if chain locker gets filled with water, it does not enter the fore peak stores.

- The spurling pipe opening on deck is covered using burlap and cemented to prevent water entering the chain locker.
- The anchors should be secured only on the orders of the master. The anchors will normally be secured only after the ship is clear of busy shipping lanes and on entering deep waters.
- During the voyage the anchor lashings should be checked regularly and tightened as necessary especially when bad weather is expected or experienced.

7) Precautions relating to anchoring operations

- Personal protection
  Personal involved in anchoring operation shall be properly dressed and equipped. This will include boiler suit, safety helmet, safety shoes, hand gloves, safety goggles, rain coat, warm clothing, hand held torch as applicable. Personal shall be competent and

experienced in anchoring operation and shall be aware of the hazards associated and relevant safety precautions. The persons shall not lean over the bulwark to see the anchor. Rather designated safe locations for the purpose shall be used. Personnel involved in anchoring operations shall be positioned suitably protected.

- Communication
  Anchoring operation is conducted in close coordination with the navigation bridge. The navigation bridge does not have a view of the anchor and hence it is the responsibility of the anchoring team to continuously update the navigation bridge of the relevant happenings.

8) Releasing the bitter end

- The anchor chain may need to be released from bitter end in cases where the vessel has to leave the anchorage in case of emergency, whereby the time elapsed in heaving up anchor may put the safety of vessel at risk.
- In such cases the anchor chain is released from the bitter end. A quick release mechanism is provided for the purpose. Usually it comprises of a pin and hammer assembly whereby the locking pin for the bitter end is released by hammering it.
- The anchor cable released from the bitter end shall as far as possible be led out in a control manner using windlass. In case the chain slips unrestricted, it is likely to snap back on the forecastle deck with a huge impact before passing through hawse pipe. Due safety precautions shall be taken in such cases.
- Time and safety permitting, the bitter end is attached to a marker float with the help of a line, which will float on the water surface. This facilitates locating the anchor once conditions improve.

Apply Your Knowledge

1. You are on anchor stations. Observe and write down the procedure followed for anchoring your ship, right from preparing the anchor for letting go to the time she is brought up. Answer briefly in bullet points.
2. Write down the meaning of the anchor terminology used during communication between the bridge and officer-in-charge at anchor stations. When is this term used?

Anchoring Term	Meaning of the term and when it is used
Leading Abaft the beam	
Leading 2 o'clock	

Anchoring Term	Meaning of the term and when it is used
Up and down	
Short stay	
Long stay	
Heavy weight	
Dragging	
Cock-a-bill	
4 shackles on deck	

IMU

Anchoring Term	**Meaning of the term and when it is used**
Slight weight	
Let go	
Release bitter end	
Screw her up	
Apply bow stopper	
Brought up to 7 shackles in the water	
Anchor aweigh	

I M U

Anchoring Term	Meaning of the term and when it is used
Anchor off the bottom	
Hoist the daylight anchor signal	
Engage gear	
Pay out to 5 on deck	
Snub cable	
Riding to her anchor	

IMU

Semester 4

Function 2: Cargo Handling and Stowage

Function: Cargo Handling and Stowage

Competence: Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

Task number: B1.1

Sub task Reference number: B1.1.6

Topic: Cargo hold preparation

Task Heading

- Open a bilge non-return valve under supervision and assist overhaul and testing.

Objectives

- Importance of non-return valves on bilge line
- Construction of bilge non-return valve
- Overhauling method of a non-return valve
- Testing procedure of a non-return valve

Index

1) Introduction
2) Bilge wells, mud boxes and strum box
3) Non-return valves
4) Overhauling
5) Testing

Description

1. Introduction

It is a basic requirement to have two non-return valves in series installed between sea or ballast system and bilge suctions in drainage of compartments and tanks to prevent the unintentional ingress of water into compartments or between compartments.

2. Bilge wells, mud boxes and strum box

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, which is also commonly known as 'rose 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.

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.

Strum boxes should be so constructed that they can be cleared without breaking any joint of the suction pipe.

3. Non-return valves

Non-return valves are fitted in the hold bilge pumping systems to ensure that water pumped out from the hold bilges to over-side or into a holding tank cannot flow back via the bilge line into the hold bilge wells and then into the cargo hold. If cargo debris is trapped in any of the non return valves it will reduce the pumping efficiency of all the other hold bilges.

Out of these 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 down 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 should be checked and inspected for proper functioning.

The non-return flap valve in the bilge well should be overhauled at the flange and it has to be ensured that the flap is free, and there is no blockage due to any cargo residue or it is not stuck in open position. It is prudent seamanship for all non return valves on the bilge line to be overhauled on a regular basis. The overhauling of these non-return valves, both, the flap types and the screw down types should be included in the ship's planned maintenance schedule (PMS).

4. Overhauling

Extreme care should be carried out when overhauling these valves. If the non-return flap valve near the bilge suction is been overhauled, the following procedure should be carried out:

- If carrying out the overhauling of the valve for the first time, then it will be prudent to identify the type of non-return valve from the ship's drawing plans, and carry a copy of this page along with you.
- Ensure proper tools like double-ended ring / ratchet spanner (for the size of flap's cover nuts), ball-peen hammer, hand scraper, hand wire brush, chisel (incase the flap is found to be jammed due to rust or otherwise), spare bucket, spare gasket (in case the old one is found to be in bad condition), rags, grease are ready at the site prior overhauling.
- Before commencing to overhaul the valve it should be confirmed from the engine room that all valves on the hold bilge line are effectively shut, to prevent any accidental water ingress from fire and general service pump, ballast and eductor pump, etc.
- Valves should be closed, with measures in place to ensure that they stay closed (**visible signs** should be placed in the engine room, at the bilge line / fire and general service pump, ballast and eductor pump, cargo control room, engine control room and navigational bridge to ensure no one accidentally opens the valves or starts the pumps. Ensure proper communication is held with crew personnel on main deck, in case something is needed.
- Use the ring spanner to open the cover nuts.(**DO NOT** use open-ended or adjustable spanners to open any kind of nuts, as they can damage the hexagonal shape thus making opening and closing of the nuts very tedious, time consuming and at times can result the nuts to be beyond repair thus using oxy-acetylene gas to cut them as last measure)
- Loosen the cover using the hand scrapper or in case needed **gently** use the hammer only on the cover (remember the valves are made up of alloy and any unnecessary brute force used, can cause the valve to crack).
- Remember that there will be some water remaining in the bilge line, which can enter again in the cargo hold bilge space, if the non-return valve is removed for inspection.
- Remove the flap cover and inspect if the non-return flap inside the valve is free of any blockage of debris / cargo / rust.
- Check for wear, deformation, dents or damage to any of the structure or fittings.
- Clean the internal part of the valve and close the flap.
- Tighten the flap cover using the spanner and cover nuts (remember to ensure the cover sits properly and the nuts are not tighten more than what is required, which may damage the packing.
- Confirm to the stand by deck personnel to inform the engine room, that the work is over and you would require the bilge lines to be blown back to confirm the effectiveness of the valves.

5. Testing

- The easiest way to test the non return valve is to stop the pump (or eductor) and allow water to flood back into the bilge line up to the non return valve.
- The bilge line can be easily filled up by gravity and if there is no water ingress observed from the non-return valve overhauled in the bilge end, the non-return valve can be said to be working effectively. The bilge line and the non-return valve can also be pressure tested in order to check the above.
- Following the testing of bilge non-return valves an entry should be made in the deck log and in the PMS.
  Remember - The non-return valve fitted on the bilge line near the suction must be tested prior to every loading and it is recommended that the non-return screw down valve in the engine room must be tested as per the ship's PMS.

Apply Your Knowledge

1. List the procedure for testing of a bilge non-return valve.

IMU

Function: Cargo Handling and Stowage

Competence: Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

Task number: B1.2

Sub task Reference number: B1.2.1, B1.2.2, B1.2.3.1, B1.2.3.2

Topic: Cargo gear

Task Heading

- Assist the crew with the rigging and operation of cranes and derricks
- Assist with routine maintenance and inspection of cranes and derricks
- Assist with:
  - Topping and lowering cranes and derricks
  - Overhauling blocks and shackles

Objectives

- Understand different types of derricks, derrick rigs, use of cranes and maintenance procedures for derricks, cranes, clocks and shackles

Please read this task in conjunction with task B1.2.6

Index

1. Derricks
2. Parts of a derrick
3. Different types of derricks
4. Different types of derrick rigs
5. Safe working practices with derricks
6. Maintenance of derrick systems
7. Deck cranes
8. Safe working practices with cranes and maintenance procedures
9. Blocks
10. Shackles and safety pins

Description

1) Derricks

Derricks are one of the earliest of the cargo handling gear used on ships. There are various types of derricks used on ships. The rigging of all these derricks for its operational use, which includes setting up the ancillary parts of the derricks, will differ from different types of derricks.

2) Parts of a derrick

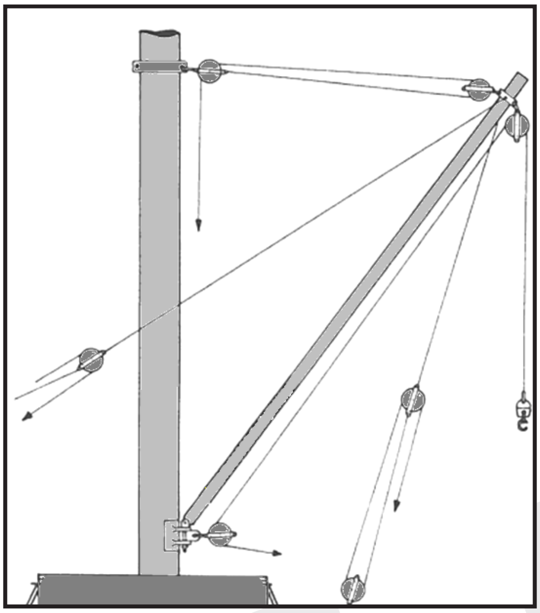
Cargo boom	A spar extending from a mast or a king post, used as a derrick arm to handle cargo. It is a cylindrical spar made of wood or steel by which cargo is loaded and discharged. It is supported by masts or king posts.
Cargo runner	Term used to describe the cargo lifting wire used on a derrick.
Topping lift	The rig that supports the cargo boom at any desired angle from the deck and the tackle that raises and lowers the boom. There could be a Single topping lift or a multiple topping lifts used for the derrick.
A span topping lift	It is a stationary topping lift shackled into the head of the boom and into the head of a king post. The boom remains at one certain angle at all times
Guys	The lines or tackle used to steady or swing cargo booms are known as guys.
Head of a boom	It is the upper end of the boom.
Heel of a boom	It is the lower end of the boom.
Bail	It is a triangular piece of steel or boiler plate used in connection with the single topping lift.

Side whip or side runner	It is the runner on the boom positioned over the side of the ship.
Hatch whip or hatch runner	It is the runner on the boom positioned over the hatch.
Jumbo boom	It is a heavy lift boom capable of handling weights from 5 to 50 tons or more.
Pedestal	It is the fitting which takes the gooseneck of the jumbo boom.
Tabernacle	It is a watertight structure built around masts or between king posts, in which gear may be stowed or winches are housed.
Preventer	Any piece of gear rigged in addition to the regular gear to prevent it from carrying away; The best known is the preventer guy which is simply a single wire shackled into the head of the boom and led down to the deck and made fast.
Stopper	It is a piece of line or chain used to stop off a hauling part while it is being belayed (made fast).
Gooseneck	the bearing and swivel fitment, found at the heel of a derrick which allows the derrick to slew from port to starboard, and luff up and down when in operation.
Hounds Band	A lugged steel band that straps around a 'mast' used to shackle on shrouds and stays. It is also employed to secure 'Preventer Backstays' when a heavy derrick is being deployed in order to provide additional strength to the mast structure when making the heavy lift.
King posts	Also called Samson posts, are Vertical supports, usually made of steel, one on each side of the centerline of the ship used to support booms.
Luffing	movement of a crane jib or derrick boom up or down
Masts	Masts are the supports for cargo booms, and also signal lights, antennas, and crow's nests.
Shrouds	These are used to provide athwartship support for the mast or king posts. Two or more shrouds are used on either side of a mast or king post and are secured to the deck or bulwark in a fore and aft direction to provide maximum support.
Snatch block	This is a single sheave block, often employed to change the direction of lead, of a wire or rope. The block has a hinged clamp situated over the 'swallow' which allows the bight of a wire or rope to be set into the block without having to pull the end through.
Spider band	A steel lugged strap found around the head of a derrick which the rigging, such as the topping lift and guys are shackled onto. The equivalent on a mast structure is known as a 'Hounds Band'.
Standing Rigging	Term used to describe fixed steel wire rope supports.
Stays and backstays	These are heavy wire ropes, found at the mast where the jumbo boom is located.
Bull rope	Wire rope used on a single topping lift to top and lower the boom
Trunnion	An arrangement similar to the 'gooseneck' of a small derrick, normally found on intermediate size derricks of 40 tonnes or over. They are usually manufactured in cast steel and allow freedom of movement from the lower heel position of the derrick.
Tumbler	a securing swivel connection found attached to the 'Samson Post' to support the topping lift blocks of the span tackle
Union Plate	A triangular steel plate set with three eyelets used in 'Union Rig' to join the cargo runners and hook arrangement. It can also be used with a single span, topping lift derrick to couple the downhaul with the chain preventer and bull wire, sometimes referred to as 'Monkey Face Plate.

3) Different types of derricks

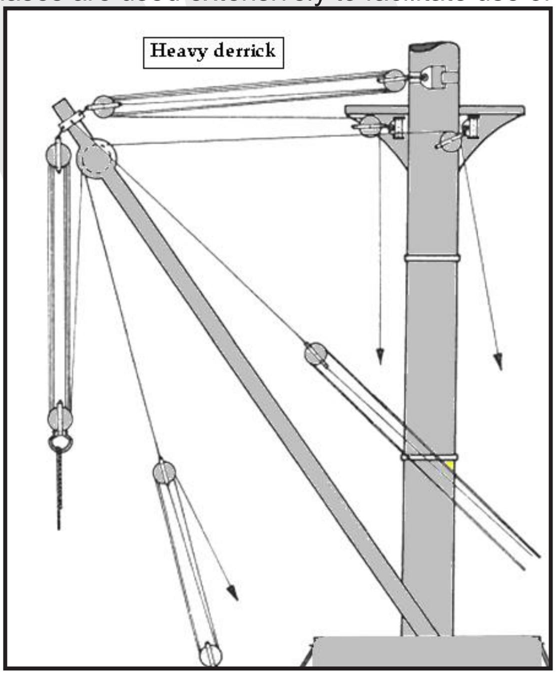
➢ **Single swinging derricks**

The conventional derrick was initially evolved as a single hoist operation for the loading and discharging of weights. When cargo is handled using one derrick only, the rig is known as a swinging derrick. The amount by which the derrick can be swung out of the centre-line is limited, because the guy must not make too small an angle at the derrick head. If the angle is too small, then the guy loses control.



- **Heavy lift derrick**

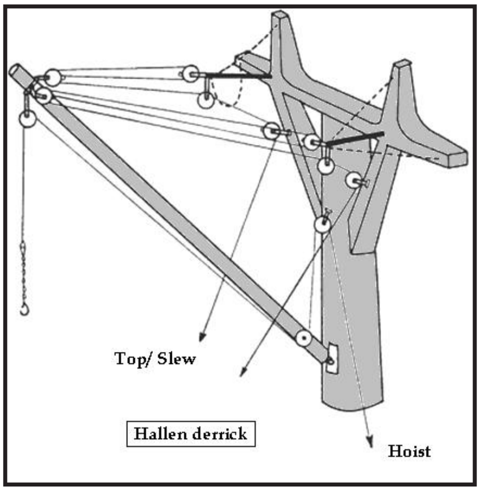
A single swinging derrick with a higher SWL; the guys, blocks, boom and other fittings are of related higher SWL. Purchases are used extensively to facilitate use of wires for higher loads.



- **Specialized derrick rigs**
- **Hallen derrick**

This is a single swinging derrick comparatively faster in operation and can work against a list of up to 15°. A 'D' frame is used to segregate the leads of the combined slewing and topping lift guys. Use of the outriggers from a 'Y' mast structure provides clear leads even when the derrick is working at 90° to the ships fore and aft line. They are usually manufactured in the 25–40 tonne SWL range and, when engaged, operate under a single-man control.

Joystick control for luffing and slewing is achieved by the port and starboard slewing guys being incorporated into the topping lift arrangement. A second hoist control can be operated simultaneously with the derrick movement.



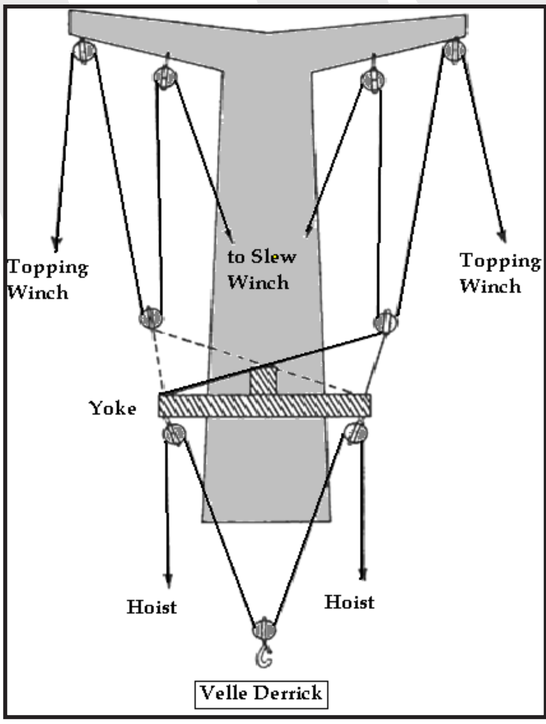
Hallen derrick

- ❖ **Velle derrick**

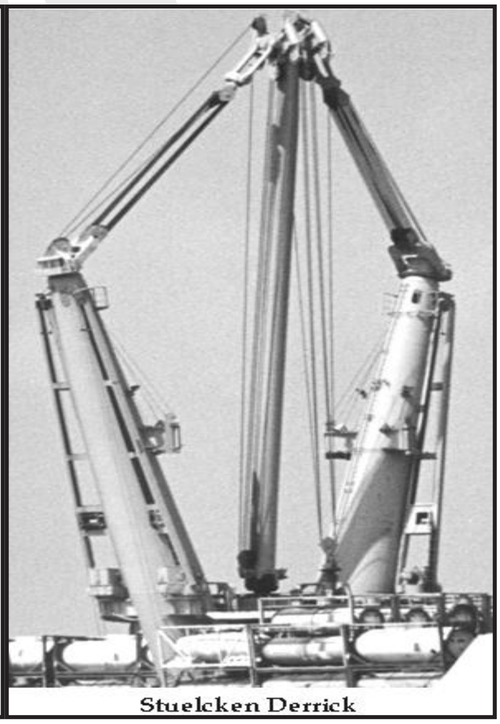
In this design the leads for the topping lift and slewing arrangement are spread by a cross ‘T’ piece at the head of the derrick. A widespread structured mast is also a feature of this rig. The design facilitates a single-man operation, with clear decks being achieved while in operation. Generally, the ‘Velle’ is manufactured as a heavier rig and variations of the design with a pivot cross piece at the derrick head are used with multi-sheave purchases to accept the heavy type load.

- ❖ **Stuelcken derrick**

This is a heavy lift derrick of SWL around 275 tonnes or more. A Stuelcken derrick can be easily brought into operation, far quickly than a normal heavy lift derrick. It provides easy stowage and operation using four winches. The derrick boom is mounted between two V shaped booms and hence it can operate on either side, serving hatches forward and aft of it.



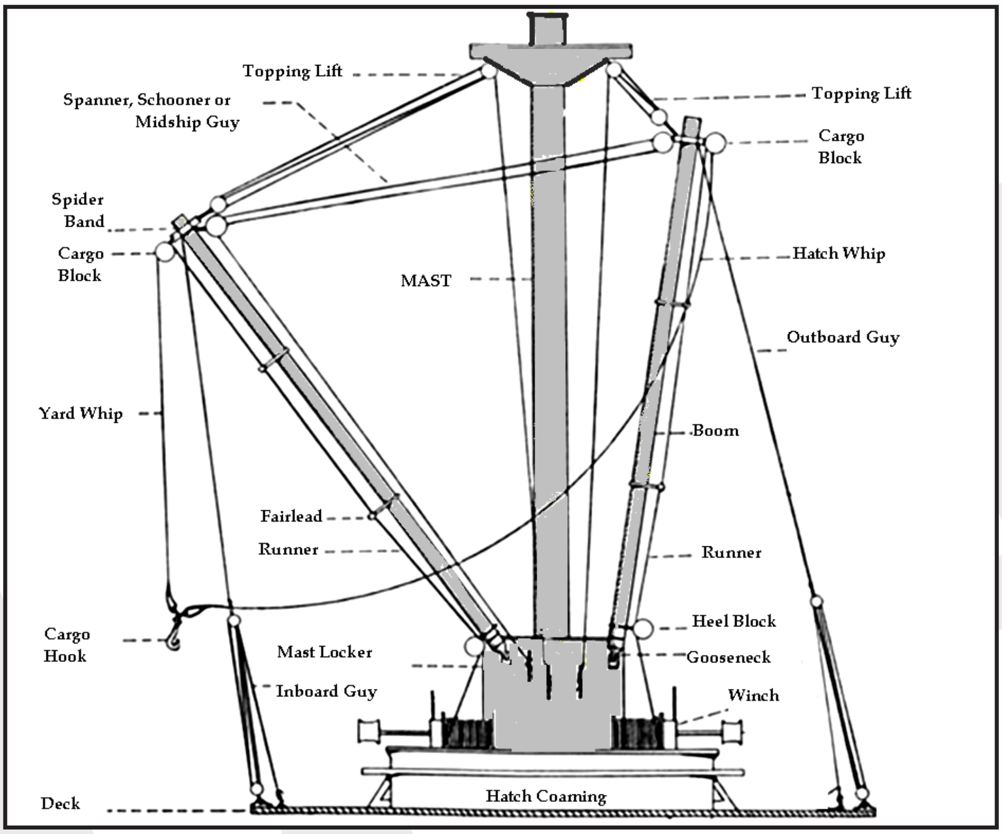
Velle Derrick


Stuelcken Derrick

4) Different types of derrick rigs

➢ Union Purchase rigging

❖ The union purchase method of rigging derricks is most common with conventional derrick rigs. In this operation, one of two derricks plumbs the hatch and the other derrick plumbs over shipside. The two runner falls of the two derricks are joined together at the cargo 'Union Hook'. The load is lifted by the fall which plumbs the load till it is above the height of the bulwark or ship's rail, or hatch coaming. The load is then gradually transferred to the fall from the second derrick. Athwartship movement of cargo is achieved by heaving on one derrick runner and slacking on the other.



➢ Safety precautions when working with Union Purchase rig

- ❖ Working angle between cargo runners should not exceed 90° to avoid excessive tension
- ❖ SWL shall be clearly marked on the derrick when rigged for union purchase. Else, the SWL should not be more than 1/3 of single derrick
- ❖ Cargo sling should be kept as short as possible to clear the hatch coaming
- ❖ Derrick should be topped as high as possible
- ❖ Preventer guys of adequate strength should be rigged on the outboard side of each derrick, and secured to the deck with similar tension with slewing guys but to different eyes.
- ❖ Derricks should be topped as high as practicable consistent with safe working and apart to the extent necessary.
- ❖ Dangerous tensions may develop in the rig if the winch operators do not wind in and pay out in step.
- ❖ Each guy should be secured to individual and adequate deck or other fastenings.
- ❖ An adequate preventer guy should always be rigged on the outboard side of each derrick when used in union purchase.
- ❖ The preventer guy should be looped over the head of the derrick, and as close to and parallel with the outboard guy as available fittings permit.

- ❖ Narrow angles between derricks and outboard guys and between outboard guys and the vertical should be avoided.
- ❖ In general, the inboard derrick guys and preventer should be secured as nearly as possible at an angle of 90° to the derrick

➢ **Yo-Yo gear**

This is not a much preferred option. Two derrick heads are placed close together and their runners are combined by means of a block or a tackle. The system is used where it is necessary to lift weight in excess of the SWL of the derrick. The operation is exceptional and critical and requires thorough risk assessment prior the operation.

➢ **Wing-lead derrick**

Using the guys and the cargo runner, the derrick is swung to the desired position. It is a variation on the single swinging derrick. The cargo runner is passed through a head block to a block on the ship-side, thence to the winch via a heel block on the derrick. This rig is rarely used.

➢ **Backweight or dead-man rig**

In this rig, a dead weight is used to swing the derrick by attaching the same to the head of the derrick by means of a lazy guy.

➢ **Liverpool rig**

Here the derrick remains plumbed over-side. A travelling block is attached to the cargo runner which is connected to a bull rope. When the load is heaved clear of the shipside and the hatch coaming, the bull rope is hove inboard and the cargo can be discharged or loaded into the hold. The derrick is not swung in the process.

5) Safe working practices with derricks

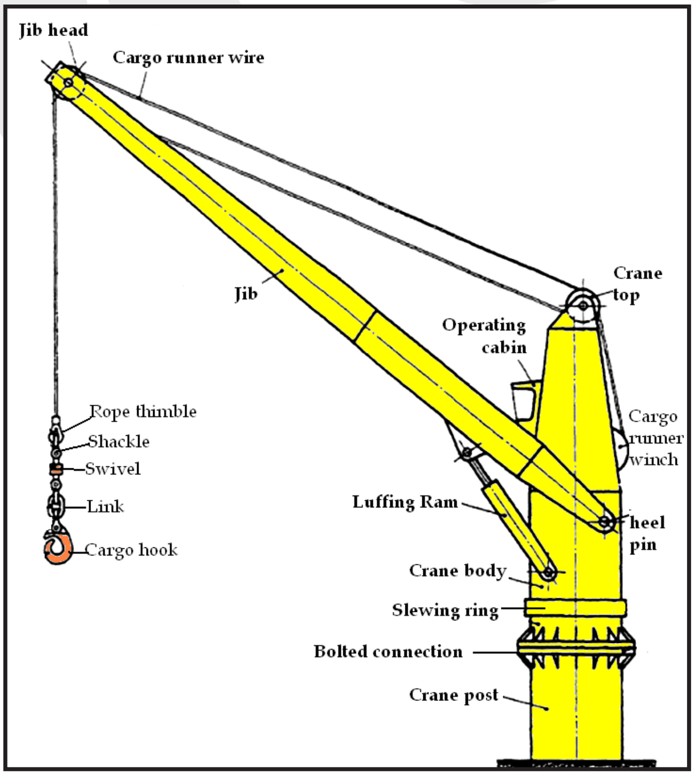
- ➢ Ships' derricks should be properly rigged. Derrick rigging should be checked and maintained with plan.
- ➢ Before raising, lowering and adjusting a derrick, the hauling part of the topping life should be flaked down the deck clear of the operational area, all persons standing clear. Someone should be available to assist the person controlling the wire on the drum and keeping the wire clear of turns and in making fast to the bitts or cleats. Where the hauling part of a topping lift purchase is led to a derrick span winch, the bull-wire should be handled in the same way.
- ➢ When a single span derrick is being raised, lowered or adjusted, the hauling part of the topping lift or bull-wire (i.e. winch end whip) should be adequately secured to the drum end. Where topping lifts are secured to bitts, 3 complete turns should be taken before the 4 cross turns on top. A light lashing shall be placed to prevent spring off of the wire.
- ➢ The derrick head should be lowered to the crutch or to deck level for safety whenever the rig is to be changed.
- ➢ The pawl of winch requires to be lifted to allow the derrick to be lowered. This shall be done with extreme care.
- ➢ The winch speed should be in consistent with the safe handling of the guys. Winch driver should have the full awareness regarding the load and where required take instructions from a single controller with a clear view of operation.
- ➢ Cargo runners should be secured to winch barrels by U bolts and minimum 3 turns remaining on the barrel when fully extended.
- ➢ The runner should be used direct from the heel block via snatch blocks when dragging heavy cargo from tween deck. Where rollers are fitted to runner guides, they should rotate freely.
- ➢ Runner guides should be checked in position fitted to all derricks so that when the runner is slack, the bight is not a hazard to persons walking along the decks.
- ➢ A heel block should be secured additionally by means of a chain or wire so that the block will be pulled into position under load but does not drop when the load is released.
- ➢ All persons on deck in the vicinity should be warned before a derrick is raised or lowered, so that no person stands in danger from, bights of wire and other ropes.

- When steam winches are being operated, winch drivers must ensure that the winches and steam pipes are drained of water before work commences and after any period during which the winches have remained idle.
- Makeshift extensions to winch control, particularly for the purpose of operating two winches by one man, should not be permitted.
- Inexperienced persons should not operate winches unless under the direct supervision of a competent driver.
- Heavy lift operations shall be carried out as discussed under task B1.3.9.

6) Maintenance of derrick systems

- Wires, blocks, sheaves, heel pins and other moving parts are greased in accordance with shipboard PMS.
- Testing is carried out annually / quadrennial (four yearly).
- All test certificates for new equipment like wires, shackles, sheaves, ropes, blocks etc maintained on board.
- While inspecting blocks / sheaves, following are checked
  - Misalignment of sheaves
  - Heavily scored sheaves
  - Incorrect sheave groove to wire diameter ratio
  - Frozen guide rollers.
  - Inadequate internal lubrication
- While inspecting wires, following are checked
  - Wire fatigue
  - Kinking flattening
  - Inadequate internal / external lubrication.
  - Broken/ brittle strands.
- Limit switches are tested as provided.

7) Deck cranes



- The cranes are the simplest to use of amongst all shipboard lifting gear. Cranes can be either electric or electro-hydraulic operated. The hydraulic crane offers compact motors, which have high reliability, minimum need for maintenance and security against overloading. Each electric motor operates four independent pumps which operate each motion of the cranes i.e. topping, lowering of the Crane jib and hoisting / lowering of the runner wire. The rigging of a crane is permanently set, in self contained housing and it leaves the deck entirely clear of guys and other riggings. The crane housing provides protection from the weather for the wires and machinery and much of the servicing can be done from within the crane cabin or the pedestal. The winding of the wire rope on the drum is guided by geared lead mechanism. The hoist and topping lift wires are accommodated on winch barrels found in the base of the crane beneath the cabin position. Limit switches are provided acting as safety cutouts to operate the crane with in the parameters specified.

- Most cranes operate within limits of slew, and with height-luffing limitations. Virtually all cranes are manufactured to operate through a complete circular arc. Limit switches are usually set with shipboard cranes to avoid the jib fouling with associated structures. Safe operational arcs are normally depicted on the ships rigging plan and limit switches are set accordingly.
- Cranes are generally operated by means of two joy sticks provided in the crane cabin. One joy stick is used for hoisting, lowering and slewing of the crane jib while the other is used for hoisting and lowering of the runner wire.

- Some ships may be provided with **Twin Cranes** also known as **Gemini Cranes,** where the two cranes are mounted on the same pedestal. They can be operated as separate individual cranes or as a combination where by they can be used for lifting heavy loads.

8) Safe working practices with cranes and maintenance procedures

Derricks, cranes, blocks and shackles are part of lifting gear and their records are maintained in the chain register. Task B1.2.6 shall be read in conjunction for details on

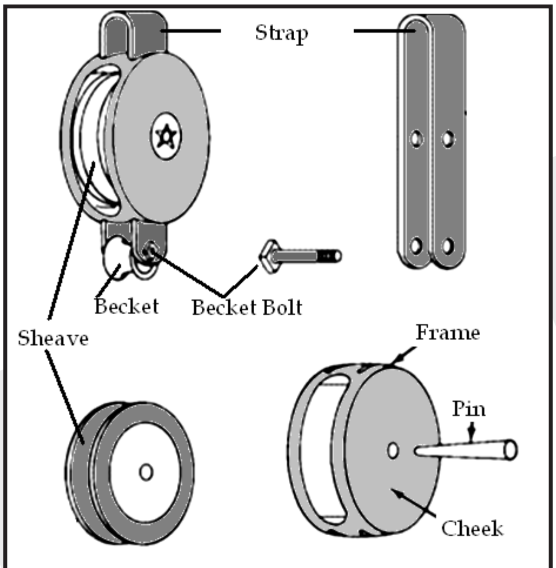
- Manufacturer's instructions should be followed for proper operation and inspection. All equipment is in good condition and there is no sign of excessive wear and tear.
- Unnecessary acceleration, retardation, sudden and rapid restriction, increases the normal stresses provided by a load upon the crane negatively affect its mechanism.
- Before rigging the crane, the locking pin for the jib on the crutch should be removed, the cargo block should be clear of its lashing and all obstruction and personnel.
- Proper understanding of crane signals is of utmost importance and the person signalling should always be in view of the operator in the crane cabin.
- All limit switches, cut-outs and emergency stops shall be tried out prior handing over the cranes to stevedores. Audio-visual alarms for these cranes shall be checked working to indicate movement on the track way.

- The crane operation shall be monitored carefully. Any malfunctioning or slipping winch brakes shall be carefully noted and rectified.
- The hydraulic system shall be checked for oil levels and replenished as specified in manufacturer's instructions.
- Crane cabin windows should be clean providing a proper view to the crane operator.
- SWL, length and size of the falls , safe working load of all fittings, boom limiting angles both for slewing (if applicable) and for hoisting should be recorded on the chain register. SWL and the slewing angle shall be prominently marked on the

cranes. Some cranes have two SWL for different angles of jib clearly marked on the crane. Generally the reach in meters is marked.

- If any faults are noted in the ship's cargo handling equipment, the equipment should be removed from operation. All such break downs should be recorded in the ships log book or any other log book meant for this purpose.
- Access to a crane should be always by the proper means provided. Cranes should be stationary while accessing.
- The load testing is carried out in accordance with the PMS.
- All moving parts should be regularly greased specially at the sheaves and Jib base gearing for smooth functioning. Crane falls should be regularly greased or coated with special wire rope primer.

9) Blocks



Parts of a Block

- A block consists of one or more sheaves fitted in a wood or metal frame. Each block has one or more straps of steel or rope that strengthen the block and supports the sheave pin. By inserting a hook or shackle in the strap, the block itself may be suspended or a load applied to the block. If the block has a becket to which the fall is spliced, the becket is also secured to the strap. The three types of cargo blocks most frequently seen on ships are the diamond, oval, and roller bearing.
- **Maintenance and overhaul of blocks**

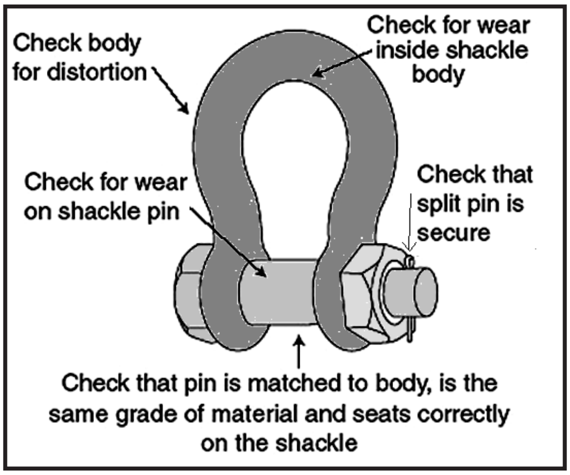
❖ Blocks should be disassembled periodically and inspected and lubricated. A mixture of white lead and tallow, or graphite and grease, should be used for wooden blocks.

- The frame of the block shall be inspected for any cracks or splits and for any signs of the sheave wearing on the frame. Any worn spots on the inside of the frame shall be checked. The pin is checked to see if it is bent. The hooks or shackles are checked for any sign of distortion. A bent pin or a distorted hook or shackle is no longer safe.
- A wooden block shall not be painted because a coat of paint could hide a split. Clear shellac or varnish or several coats of linseed oil shall instead be used.
- Metal in constant use is subject to fatigue. Blocks shall be carefully inspected in running rigging for any signs of distortion or wear. Any suspected wooden blocks shall be replaced.
- Metal blocks are used in cargo handling rigs. These should be disassembled frequently and inspected for wear. However, if they are kept well lubricated those used only occasionally seldom need to be disassembled. Greasing points are provided for the purpose. The general condition of sheave, block cheeks and pin shall be checked for any corrosion. These shall be kept well maintained. The outer surfaces shall be painted suitably. The swivels where fitted shall be greased and free to rotate.

10) Shackles and safety pins

While using shackles the following shall be checked.

- SWL markings shall be clearly legible. The shackle used in the system shall be of the required SWL same as the one for the system.
- The threads of the pin and the shackle body are in good order and function correctly. The body and pin are not damaged in any way and are free from distortion, nicks, gouges, cracks and excessive wear and corrosion. (maximum wear shall not exceed 8%).
- The pins should be straight.
- Screw pins shall be checked fully screwed in all the way.
- Nuts on safety pins shall be snug against the eye of the shackle and cotter pins inserted before the shackle is used.
- Widths between the eyes should not be greater than as they were originally. Excessive widths indicate that the shackle had been strained and should not be used.



Apply Your Knowledge

1. Discuss the precautions to be observed during the operation of cranes and derricks.

Function: Cargo Handling and Stowage

Competence: Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

Task number: B1.2

Sub task Reference number: B1.2.4, B1.2.5

Topic: Cargo gear

Task Heading

- Supervise the operation of cargo gear when in use by stevedores.
- Assist in testing of all the crane limits.

Objectives

- Understand precautions and safety checks on derrick system and cranes when in use by stevedores, procedures for testing of crane limits

Please read this task in conjunction with tasks B1.2.7 and B1.3.9

Index

1. Lifting operations
2. Testing of crane limit switches

Description

1. Lifting operations

- The responsibility of safe conduct of cargo operations lies with the vessel. Minute errors/ negligence are likely to result in causing damage to cargo, vessel, lifting gear and above all, serious personal injuries. To ensure the safety of crew and shore workers, each lifting operation must be carried out in a safe manner. It shall be properly planned and supervised appropriately. During cargo operations, the ship's cargo gear is likely to be used by the shore stevedores. The stevedores are usually qualified and experienced in such tasks. However, it is prudent that the stevedores are advised on the safe procedures, limitations and warning alarms of the specific instruments. Furthermore safe and correct operation shall be ensured by proper supervision. Additional safety precautions that shall be taken while cargo operations are in progress are as follow:
- Weather conditions can significantly affect the lifting operations. It is recommended to suspend lifting operations before conditions deteriorate to the extent that lifting becomes dangerous.
- Weights shall be lowered, heaved, and swung at moderate speeds to avoid causing undue accelerations and jerks on the lifting gear.
- A powered appliance should always have a person at the controls while it is in operation. The operator of the lifting appliance shall have a clear view of the whole of the path of travel of any load carried by that appliance. Where such a view is not available, a signaler shall be employed.

The OOW has the authority to stop any operation whenever it is found not-conforming to safe work procedures; or the safety or personnel, ship, cargo or

- ❖ Loads should not be lifted over a person or any access way, and personnel should avoid passing under a load which is being lifted. The signalmen shall be positioned in a clear safe position from where he can have a clear look and is directly in sight with the crane/ derrick/ winch operator. The winch-men shall be positioned clear of the snap back zones of wires under stress. Others not directly engaged in the operation should be kept clear of such areas.
- ❖ All loads should be properly slung and properly attached to lifting gear, and all gear properly attached to appliances. The slings shall be correctly positioned and ensured not allowed slipping off.
- ❖ The use of lifting appliances to drag heavy loads with the fall at an angle to the vertical is NOT advisable because of the friction and other factors involved and should only take place in exceptional circumstances where the angle is small, there is ample margin between the loads handled and the safe working load of the appliance, and particular care is taken. In all other cases winches should be used instead.

While portable loading gear such as fork lifts, pay-loaders etc are placed aboard, the weight of the gear, the condition of lifting points, and SWL of cranes and slings shall be cross checked. The operator shall NOT be residing in the forklift

- ❖ It shall be remembered that the rigs of union purchase significantly reduces the SWL. Two cranes/ derricks shall preferably not be used to lift a single weight simultaneously. Such an operation is extremely dangerous and requires complete risk assessment and thorough planning and supervision.

- ❖ It shall be ensured that the wire guards and other appropriate protective devices are correctly positioned and are in sound condition.
- ❖ All gear shall be marked with its safe working load prominently.
- ❖ Before any attempt is made to free equipment that has become jammed under load, every effort should first be made to take off the load safely. Precautions should be taken to guard against sudden or unexpected freeing.
- ❖ Make-shift extensions should not be fitted to controls or any unauthorized alterations made to them. Foot-operated controls should have slip resistant surfaces. Limit switches shall never be isolated.
- ❖ Precautions relating to heavy lift operations are covered under tasks B1.2.7 and B1.3.9 which shall be read in conjunction to this task.

2. Testing of crane limit switches

For a crane, there are generally five limit switches and one slack wire detector. The limit switches are provided to ensure that the cranes run within safe limits.

➢ **Runner hoist limit switch**

This is located at the jib head and trips the crane power when the hoist block touches the limit lever. This safeguard against the runner block being hoisted too far and hitting the jib head sheaves.

- **Jib topping upper and lower limit**

  All cranes/ derricks manufacturer specify the angle range (or the radii) over which the SWL applies. Hence to limit the jibs movement between the upper and lower angular limit, limit switches are provided. Both the limit switches are placed around the base of the jib, the upper limit switch above and the lower limit switch below, their position carefully adjusted such that the jib touches the limit lever when the angular limit is reached.

- **Jib slewing port and starboard limit**

  At most times when there is a single pedestal crane between two hatches, the crane would have a 360º free rotation. In such a case there would be no slew limit switches. But when there are obstructions, for e.g. another crane, mast or superstructure then slew limit switches are used and placed such that they activate just before the jib could touch the obstruction. The feature is common on twin cranes.

- **Slack wire detector**

  It is placed either forward of the hoist drum or at the jib head. It activates when the tension on the runner wire reduces below a certain limit. This could happen when the cargo block has reached the tank top or the wharf and further lowering will cause the block to rest on it. It could also take place if the block gets snagged somewhere. In such cases if the runner wire becomes slack the slack wire detector activates cutting off the power. This is to safeguard against sudden release of a snagged block and to prevent a slack wire from jumping the sheave when tension is again taken up.

- All these limits switches are set and checked at the time of installation and periodically during surveys. The operation shall be conducted with proper formal risk assessment. The testing of limit switches is done under close monitoring, without having any load on the fall. Experienced and skilled crane operators shall be involved in the operating the cranes during tests under monitoring of competent officers.

Apply Your Knowledge

1. Stevedores are required to use ship's gear for discharging cargo. List all the safety limits that need to be tested prior handing over the cargo gear to the stevedores.
2. Discuss the circumstances when the limit switches are required to be by-passed during routine operation on board.

Function: Cargo Handling and Stowage

Competence: Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

Task number: B1.3

Sub task Reference number: B1.3.6

Topic: Cargo operations

Task Heading

- Assist in maintaining the vessel in an upright condition using heeling tanks during loading and discharging, if applicable.

Objectives

- Understand the importance and functioning of anti-heeling system provided on board vessels.

Index

1) Introduction
2) Anti-heeling system

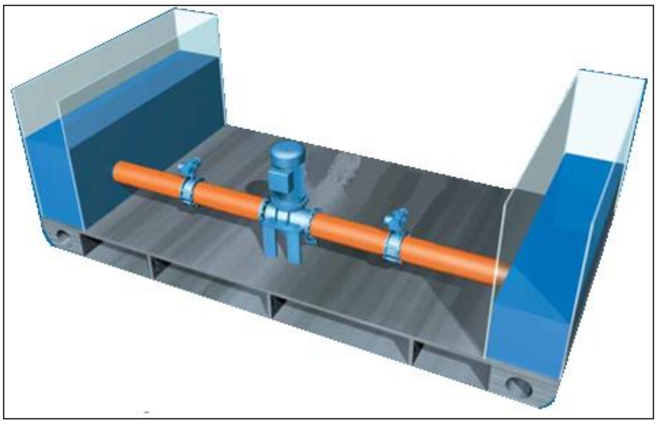
Description

1) Introduction

- Inclining of the vessel in transverse direction caused due to uneven distribution of weights about the fore and aft centerline of the vessel is called 'List'. List gets corrected only when the moments on either side of the fore and aft centerline are equated. When a vessel inclines transversely, due to external forces such as wind or waves, it is termed as 'Heel'. Heel gets corrected as soon as the external forces are removed.
- Listing of vessel is common during cargo operations. Where heavy units are loaded as individual pieces, such as on container ships, list is caused instantaneously. Such vessels are provided with anti-heeling systems.

2) Anti-heeling system

- The anti-heeling system is designed to automatically detect the angle of list/ heel of the ship and compensate the same by rapidly creating a righting moment by transferring water from one side of the vessel to the other. This allows the vessels to continue loading and unloading operation without any interruptions in between for list correction.
- The anti-heeling system usually operates with a pair of ballast tanks located one on either side which are connected through pipelines at the bottom and an air vent pipe at the top. The tanks are located usually on the side extremities in order to create large moments about the centerline. As the transverse distance between the tanks increases, the amount of water that must be transferred to obtain the necessary heeling moment decreases. The lines are fitted with automatic valves and a pump that can pump water in either



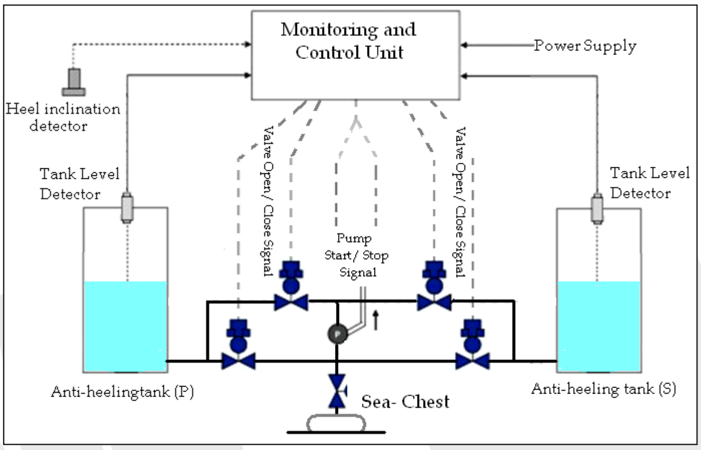
direction, from port to starboard and vice versa. When the ship heels to any side, the heeling sensor sends the signal to the master control panel for change of ships angle with respect to the ship's upright position. This triggers the valves and pump to operate allowing flow of water in the desired direction till the list is corrected. Level control switches are also installed in the tanks involved with the anti-heeling system to avoid low level or over filling and hence over pressurizing of the tanks.

- The systems have been developed to rapidly transfer large quantities of water. The nominal transfer rate of ballast water from one ballast tank to the other on the opposite side depends on the line diameter connecting the two tanks, tank height and the capacity of the ballast pump.

- There are two types of anti-heeling system used on board ships:

a) Pump system
b) Air blower system

a) Pump system



- The pump system consists of electrical motor driven water pump, a set of lines, automatic valves, a heel/list detector and a monitoring and control unit. The heel/ list detector detects the inclination of the vessel against the preset value and sends a signal to the monitoring and control unit. The control unit sends signals to open the desired valves and start the transfer pump to allow flow of water in the desired direction. The system operates till the list is brought down to the less than set limit and then the valves close and pump stops.

- The pump could be of centrifugal or axial flow pump of a reversible or non-reversible type. The pump is controlled by the control unit. However, a control panel is provided to operate the same manually as well. The valves are butterfly valves fitted with hydraulically or pneumatically operated actuators. The monitoring and control unit contains a programmable logic controller for operating the system. The tank level detectors sense the liquid level and send signal to control unit to avoid over-pressurizing of the tanks. Further, a flow switch is used in the line to guard the dry running of the pump. The line system is further connected to the sea chest to fill up the tanks through a manually operated valve.

b) **Air blower system**

- This type of anti-heeling system makes use of compressed air blower admitted to the top of either tank, to force the liquid from one tank to another. The valve group contains standard butterfly valves with fast acting pneumatic or hydraulic actuators. The blower works continuously to realize a fast heeling compensation during loading and unloading conditions. If required the heeling capacity can be modified by using two or more independent blower systems.

- Starter panel is provided for each blower unit. The control system can include a high resolution pendulum sensor for measuring of ships heel angle as basis for precise heeling compensation. The tank sensor system usually consists of two pressure sensors for monitoring of tank pressure at bottom and top of tank and also for measuring of actual water level. A level switch is used to avoid overfilling and overflow of tank during operation.

Apply Your Knowledge

1. Discuss the automatic and manual functioning of anti-heeling system if provided on board your vessel.

IMU

Function: Cargo Handling and Stowage

Competence: Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

Task number: B1.3

Sub task Reference number: B1.3.7

Topic: Cargo operations

Task Heading

- Calculate the quantity of cargo loaded, stability and loading stresses using loadicators, stress indicators, etc. Calculate arrival drafts using trim tables.

Objectives

- Understand the use of stability booklet and loadicators

Index

1. Loadicator
2. Trim and stability book
3. Loading the vessel
   a) Estimating maximum amount of cargo a vessel is allowed to load
   b) Calculating/ adjusting trim

Description

1) Loadicator

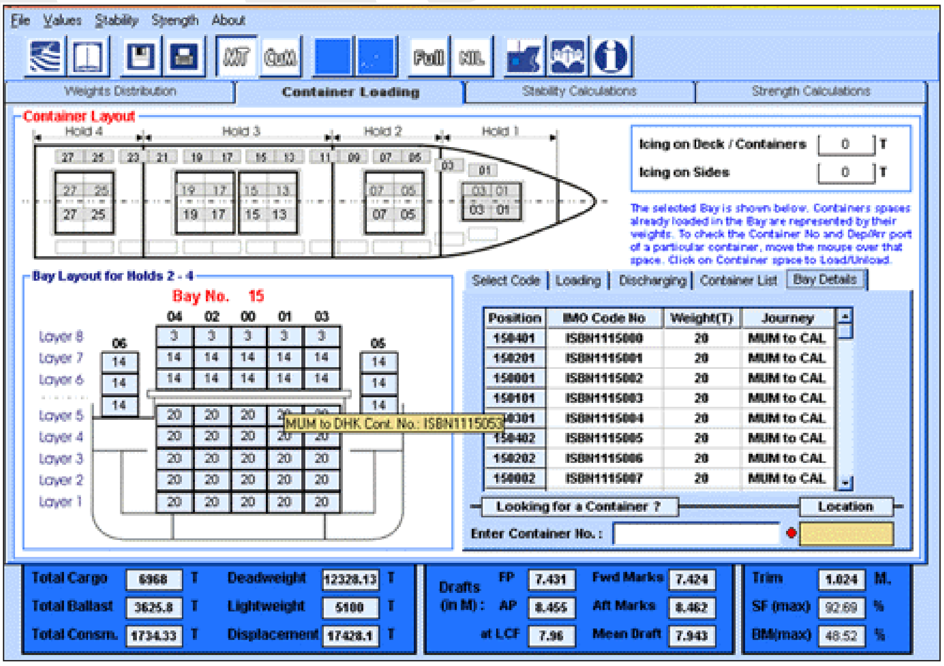
- Loadicator (Loading instruments / stress indicators) is an instrument provided to check the stability and stress condition of the vessel for a given load condition of the vessel.

> The loading computer system is not a substitute for the approved loading manual or the stability booklet and it is used as a supplement to these approved documents to facilitate strength and stability calculations. The loading computer system is ship specific equipment and the results of the calculations are applicable only to the ship for which it has been approved.

- The loading computer program is operated from a dedicated PC either in the cargo control room (CCR), or in the ship's office. These shall not to be used for any other purposes. A second copy of this program may be kept on another computer for checking purposes.
- The loading instrument software presents relevant parameters of each loading condition such as deadweight, light ship data, displacement and centre of gravity, draughts at the forward and aft perpendiculars and at midship, trim, metacentric height, free surface correction on the righting lever (GZ), shear forces and bending moments for sea going and harbour conditions etc. It further provides a clear warning is given if any of the strength, stability or general loading limitations is not complied with. The calculated forces and moments are displayed in both graphical and tabular format, including the percentage of permissible values. Various parameters and screens can be printed, for record purposes.

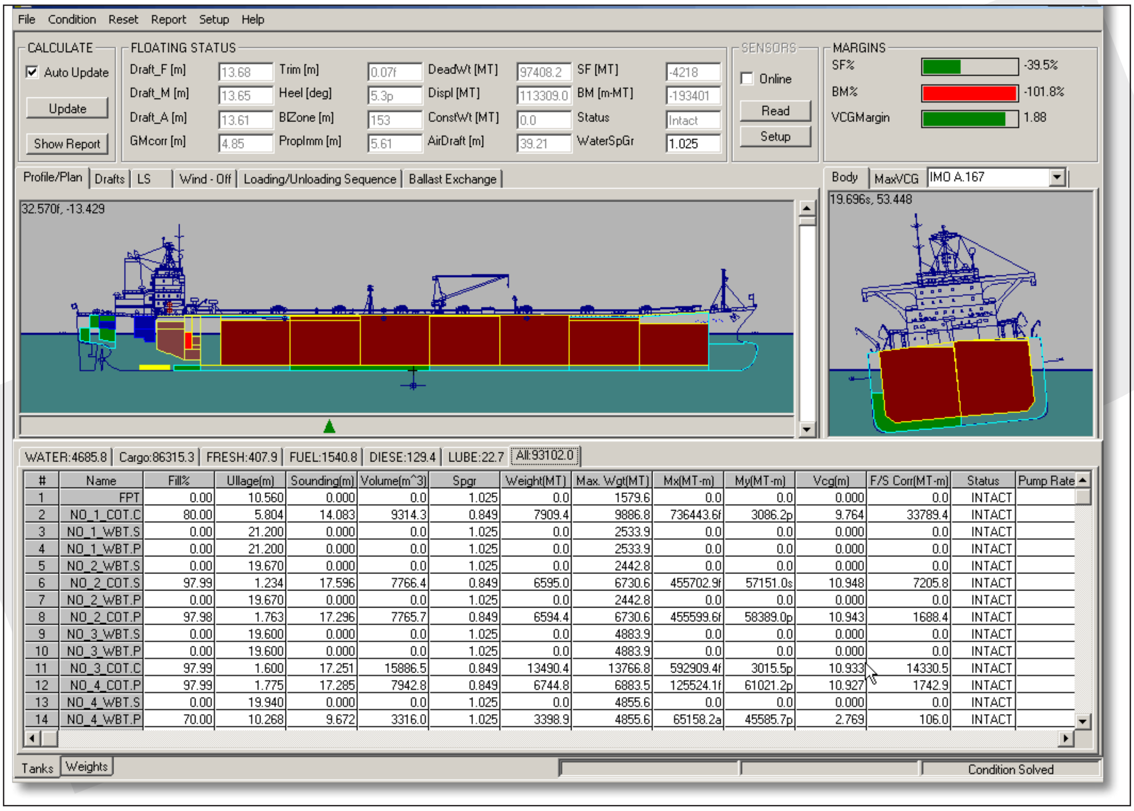
> Every loading (deballasting) / unloading (ballasting) sequence is planned using the loadicators to ensure the shearing forces and bending moments throughout the ship's length are kept within limits. Loadicators prove to be a vital aid since they are beneficial to the ship's officers planning or monitoring loading / unloading in illustrating immediate problems thus giving enough time for corrective action if required.

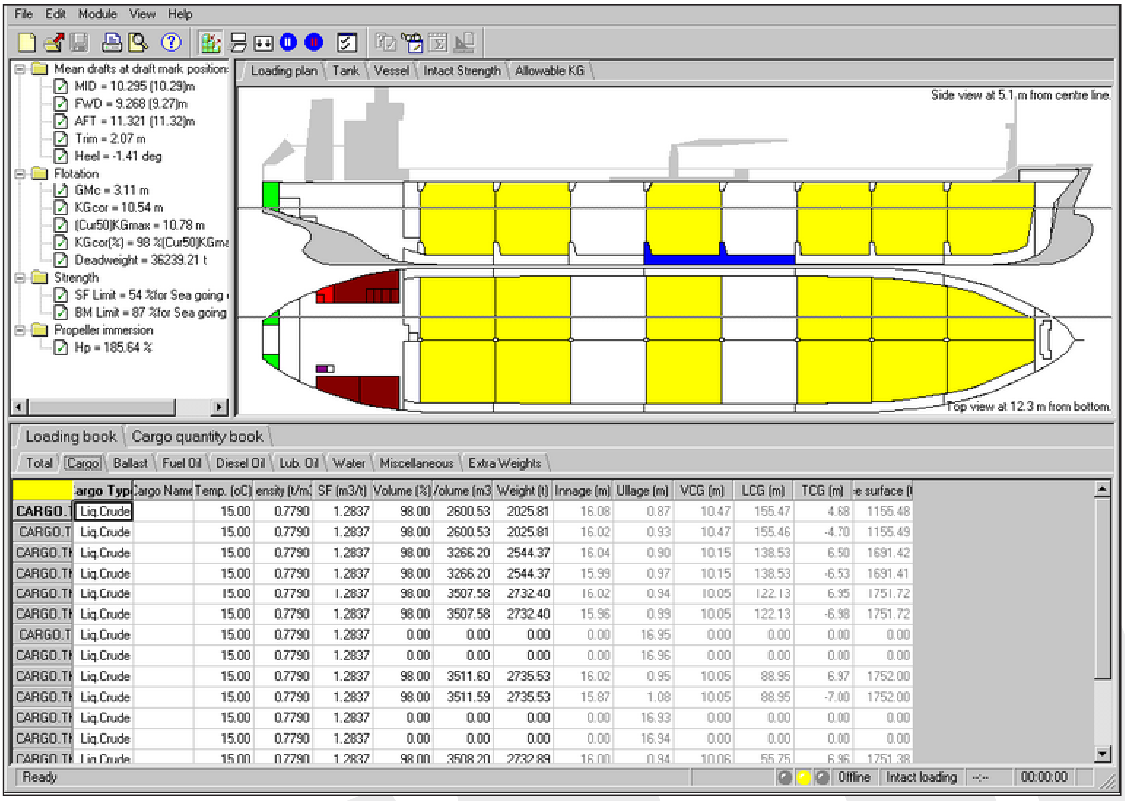
- The test calculations of the loadicator are carried out after installation in the presence of a classification society surveyor. Normally, the test conditions are permanently stored in the computer.
- The accuracy of the onboard computer for stability calculations is checked at each annual survey by applying at least one approved test condition. If a society surveyor is not present for the computer check, a copy of the test condition results obtained by the computer check is to be retained on board as documentation of satisfactory testing for the surveyor's verification.
- Every loadicator is provided by a uniquely identified ship specific operation manual. This operation manual is written in a concise and unambiguous manner using illustrations and flowcharts for clear explanation. The operation manual contains a general description of the program denoting identification of the program and its version number stated. It further has a copy of the certificate of approval, or equivalent, signifying approval of the calculation program, details of the hardware specification needed to run the loading program, a description of error messages and warnings likely to be encountered etc.
- Loadicators on board bulk carriers generally include features such as ballasting sequence, loading / unloading sequence, automatically ballast control (in some programs only), longitudinal stress , shear forces and bending moments curves, SF and BM margin to maximum allowable for seagoing and harbor condition, deflection (hogging and sagging), adjacent/ block loading/ permissible tank to strength warning, SF correction at bulkheads, permissible tank top / net tank top strength warning loading, grain stability calculations according to grain code, flooded strength calculation etc.
- The loading computer program of a container ship could have two options for loading containers, manual or automatic. Users can simply use drag and drop procedure to load manually. Loading instruments are involved during the planning of cargo stowage. They permit known weights aboard the vessel to be pre-programmed and the centre of gravity of each unit, with its respective stowage space to confirm the stability requirements. The features a loading computer of a container ship include Cargo handling functions for loading port / discharging port, shifting of container control, segregation check, container sorting, container status, graphical view for stowage plan, bay section, plan/ profile, deck strength and stack weight warning for containers, preparation of bay plans with user defined parameter, assigning container properties, read / write from Baplie file and container details from excel file, lashing and torsion calculations.



- The loading computers of a RO – RO ship are quite similar to container ships. The automated stowage planning can allow the users to customize automatic loading.Improved legislations require Ro-Ro vessels to have a direct link to the shore-side administration. The modern loading instruments permit known weights aboard the vessel to be pre-programmed and the centre of gravity of each unit, with its respective stowage space. This can be entered by shore planners (who have the same loading instruments of the specific ship) to provide the ships overall metacentric height (GM), very quickly. The ship's officer is then given this data to be checked on their designated loading instruments, to confirm the stability requirements.

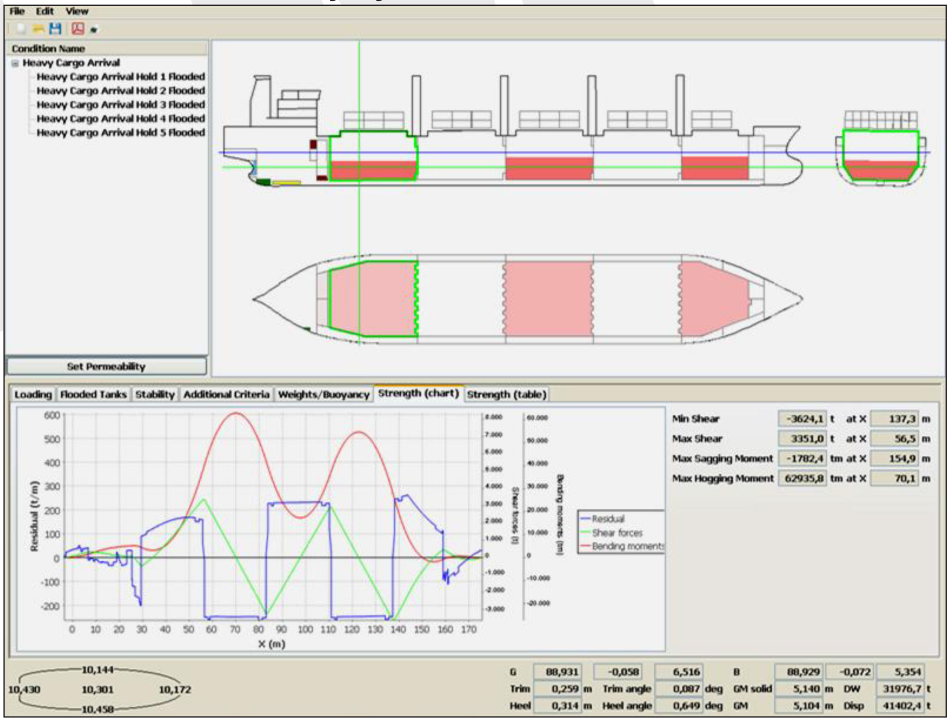
- The loading programs used on tankers have graphical loading / discharging sequence simulation and predictions. These also perform complete oil calculation according to ASTM. Some programs allow the user to input basic properties of crude oil and generalized petroleum products such as API gravity or density at the standard API, ISO or random temperature. Some programs also include intact and direct damage calculation of damage stability, which has to be type approved as per the requirements of Marpol / IMO IGC code for tankers.

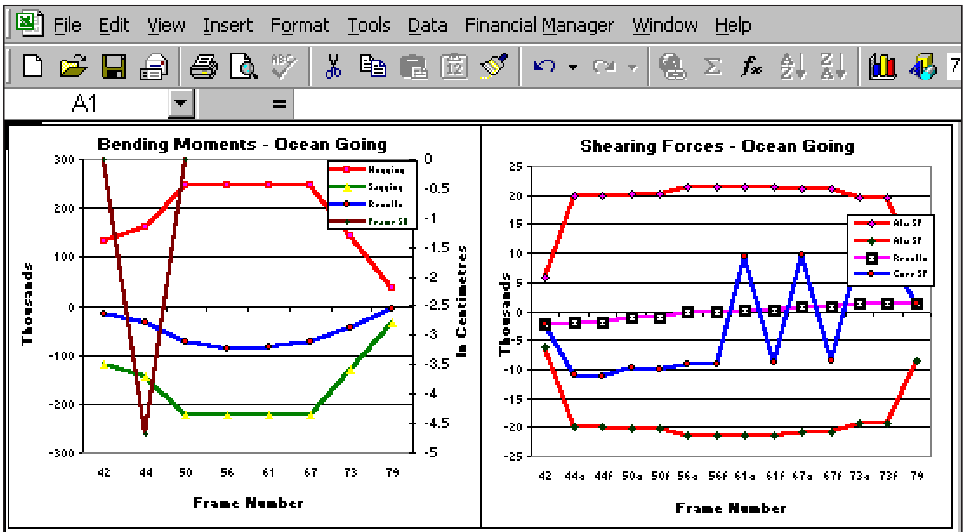




➢ On board LPG/LNG ships, the loading programs have additional features such as liquefied fraction, vapour fraction and summary calculations, extended ullage report along with gas cargo summary and gas cargo report, cargo quantity calculations and various corrections to cargo volume etc.

Stability layout on some loadicators





Ocean Going

Print Stress

Calc. Point	Bending Moments			
	Hogging	Sagging	Results	%age
42	131733	-117997	-16338	13.85
44	162114	-145209	-33304.5	22.94
50	247000	-221244	-72603.9	32.82
56	247000	-221244	-86684.3	39.18
61	247000	-221244	-84776.7	38.32
67	247000	-221244	-71409.3	32.28
73	143023	-128109	-43730	34.13
79	38398	-34394	-6358.23	18.49

Calc. Point	Shearing Force				
	Alw SF	Alw SF	Results	Corr SF	%age
42	5986	-6181	-2180.28	-2180.28	35.27
44a	19813	-20053	-1849.27	-10878.5	54.25
44f	19813	-20053	-1849.27	-11081.4	55.26
50a	20115	-20280	-917.389	-9735.86	48.01
50f	20115	-20280	-917.389	-9998.91	49.30
56a	21501	-21501	-72.3197	-9041.42	42.05
56f	21501	-21501	-72.3197	-9179.74	42.69
61a	21501	-21501	225.608	9333.027	43.41
61f	21501	-21501	225.608	-8917.63	41.48
67a	21108	-20850	673.4736	9816.714	46.51
67f	21108	-20850	673.4736	-8472.34	40.63
73a	19698	-19441	1206.819	10352.63	52.56
73f	19698	-19441	1206.819	10477.68	53.19
79	8672	-8597	1382.965	1382.965	15.95

Hull Stress Monitoring System (HSMS)

Hull Stress Monitoring System is a navigation safety instrument which continuously monitors real-time hull stress using deck-mounted strain gauges, Long Based Strain Gauge (LBSG), accelerometer and clinometer during a voyage or loading/unloading operation and giving alarm as necessary. Based on the information provided, the ship master can alter the course or reduce the speed and the loading procedures can be improved.

2) Trim and stability book

- A trim and stability booklet is provided by the ship builder, which is presented to the ship-owner on nearing completion of a new ship. This book is used by the ship's officers for planning every loading / unloading operation.
- The following technical data is contained in this book-

- General particulars of the ship and general arrangement plan
- Inclining experiment report and its results.
- Capacity, VCG, LCG particulars for all holds, compartments, tanks etc.
- Cross curves of stability. These may be GZ curves or KN curves.
- Deadweight scale data. May be in diagram form or in tabular form.
- Hydrostatic curves. May be in graphical form or in tabular form.
- Example conditions of loading

Sample format of hydrostatic particulars of a ship

HYDROSTATIC PARTICULARS (in Salt Water) (S.G 1.025)

A.B. = Above Keel
A.P. = Aft. Perpendicular

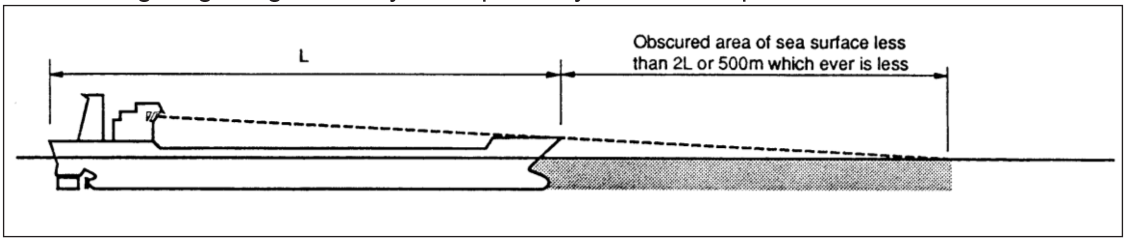
DRAUGHT (Bottom of Keel) (Metres)	DISPLACEMENT Tonnes (i.e. 1000 kilograms)	T.P.C (Tonnes per Cm. Immersion)	M.C.T.C. (Moment to Change Trim One Cm.)	L.C.B. FWD. OF A.P. (Metres)	L.C.F. FWD. OF A.P (Metres)	V.C.B. A.B. (Metres)	K.M. (T) TRANSVERSE METACENTRE A.B. (Metres)	K.M. (L) LONGL. METACENTRE A.B. (Metres)
1.000								
.200								
.400								
.600								
.800								
2.000								
.200								
etc.								

NOTE: The hydrostatic particulars given above have been developed with the vessel floating on waterlines which are *level or inclined to the keel
*(Delete whichever is not applicable)

3) Loading the vessel

The points to consider while planning the loading of the vessel are as follows:

- Maximum draught midship, not to exceed the loadline mark
- Minimum draught forward, due to strength considerations (slamming) (essential when planning a ballast exchange at sea also)
- Draughts aft, midship and forward to be within the designated reinforced ice belt, relevant for vessels with ICE class, when operating in ice infested waters
- Minimum metacentric height (GM)/ Maximum vertical centre of gravity (VCG) to satisfy requirements for stability
- Maximum metacentric height (GM) to limit sloshing in tanks
- Maximum trim
- Lateral load limitation due to strength considerations
- Cargo tank filling degree as a function of cargo density due to strength and/or stability considerations
- Limits to distributed loads on deck to be limited by the strength for which the deck is approved.
- Navigating bridge visibility as required by SOLAS chapter V



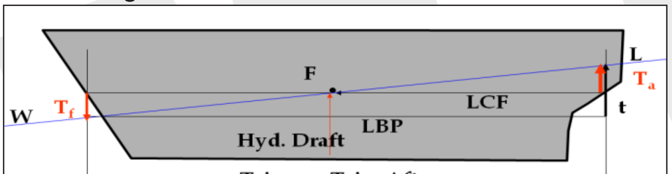
- Propeller immersion in percentage
- Block loading criteria violation and maximum load density violation For bulk carriers
- In general, for the arrival conditions, a ship should arrive at the end of the voyage (with cargo and/or passengers as per loaded departure conditions) with at least 10% stores and fuel remaining. For passenger ships, a mass of 75 kg should be assured for each passenger; but may be reduced to not less than 60 kg where this can be justified.

a) Estimating maximum amount of cargo a vessel is allowed to load

- The maximum permitted draft of the vessel is checked with reference to applicable loadline zones. The draft in the load port, discharge port or the on the sea passage shall not exceed the draft permitted by the loadline zones applicable to the area. The minimum of the permitted drafts is selected for loading at the load port.
- The permitted displacement for the selected draft is checked for hydrostatic tables.
- The lightship displacement, along with ballast planned to be carried on passage, stores and constants, and the consumables (fuel + fresh water) is deducted from the permitted displacement to estimate the maximum amount of cargo that can be loaded.
- A vessel loading in fresh water port or port where density of water is less than sea water can submerge the applicable load-lines by an excess equal to the fresh water allowance/ dock water allowance respectively.
- In practice, a draft survey is carried out upon arrival of the vessel to calculate the current displacement of the vessel and constant unknown weights present onboard. An estimate of the cargo to be loaded is done as above. Prior completion of loading a suitable quantity of cargo is kept spare for trimming the vessel as desired. The loading is finished completing to the permitted draft in the respective loadline zone as applicable. A draft survey is again carried out after completion and the quantity of cargo loaded is calculated after deducting the lightship, ballast, fuel, fresh water, and other constants on board.

b) Calculating/ adjusting trim

- The difference between the forward and aft drafts of the vessel is called the trim of the vessel. It can be calculated using the hydrostatic particulars of the vessel, with reference to the distribution of weights onboard.

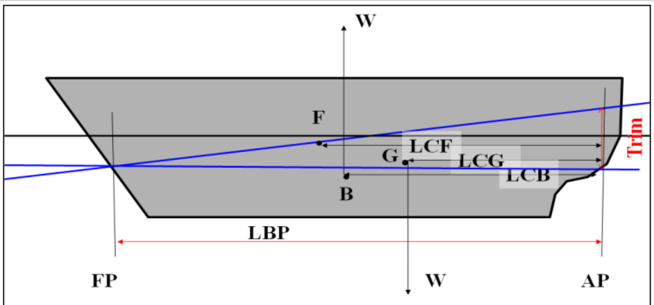


$$\frac{\text{Trim}}{\text{LBP}} = \frac{\text{Trim Aft}}{\text{LCF}}$$

$$\text{Trim Aft} = \frac{\text{Trim x LCF}}{\text{LBP}}$$

$$\frac{\text{Trim}}{\text{LBP}} = \frac{\text{Trim For'd}}{\text{(LBP – LCF)}}$$

$$\text{Trim For'd} = \frac{\text{Trim x (LBP – LCF)}}{\text{LBP}}$$



$$\text{Trimming Moment} = \text{W. (LCG} \sim \text{LCB)}$$

$$\text{Change in trim (cms)} = \frac{\text{Trimming Moment}}{\text{MCTC}}$$

- Alternatively smaller calculations can be performed to estimate the change in trim using trim tables for the vessel, which are provided in the stability booklet. Trim tables provide pre-calculated results for change in drafts forward and aft, when a standard weight of

100/ 500 tonnes is added in a given cargo / ballast space, vessel floating at a given mean draft in SW.

```
============
 TRIM TABLE:    CHANGE OF DRAFT DUE TO    100. MT IN EACH HOLD AND TANK
============

SHIP NAME : 4500TEU CLASS CONTAINER CARRIER                    S.G =     1.025 MT/M**3
```

COMPTMENT NAME	DRAFT	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00
	DISPL	19723.	25704.	31934.	38394.	45079.	52010.	59182.	66615.	74332.	82336.
NO.5 D.B.W.B.T.(P)	FOR'D	-0.024	-0.022	-0.020	-0.017	-0.015	-0.013	-0.010	-0.008	-0.006	-0.004
	AFT'D	0.057	0.054	0.050	0.047	0.043	0.039	0.036	0.031	0.028	0.025
NO.6 S.W.B.T.(P)	FOR'D	-0.071	-0.064	-0.059	-0.054	-0.049	-0.045	-0.040	-0.036	-0.031	-0.027
	AFT'D	0.102	0.095	0.088	0.082	0.075	0.069	0.062	0.055	0.049	0.044
A.P.T.(C)	FOR'D	-0.080	-0.073	-0.067	-0.061	-0.056	-0.051	-0.046	-0.041	-0.036	-0.032
	AFT'D	0.111	0.103	0.096	0.089	0.082	0.075	0.068	0.060	0.054	0.048
NO.3 S.F.O.T.(P)	FOR'D	0.033	0.030	0.028	0.027	0.027	0.026	0.026	0.026	0.026	0.025
	AFT'D	0.002	0.003	0.003	0.004	0.003	0.003	0.003	0.002	0.002	0.002
NO.4 D.B.F.O.T.(C)	FOR'D	0.001	0.002	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
	AFT'D	0.032	0.031	0.029	0.027	0.025	0.023	0.021	0.018	0.016	0.015
NO.5 D.B.F.O.T.(C)	FOR'D	-0.026	-0.023	-0.021	-0.019	-0.016	-0.014	-0.011	-0.009	-0.007	-0.005
	AFT'D	0.058	0.055	0.051	0.048	0.044	0.040	0.036	0.032	0.029	0.026

Apply Your Knowledge

1. Use the loading instrument provided on your ship under supervision.
2. Your vessel has just departed the load port. Calculate expected drafts on arrival at the discharge port. Make use of trim tables for voyage changes with respect to fuel, fresh water and ballast.

Function: Cargo Handling and Stowage

Competence: Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

Task number: B1.3

Sub task Reference number: B1.3.8

Topic: Cargo operations

Task Heading

- Assist in establishing and maintaining effective communications on board and with shore personnel during loading and unloading

Objectives

- Understand the importance of establishing and maintaining effective communications on board and with shore personnel during loading and unloading

Index

1) Ship-shore communications

Description

1) Ship-shore communications

- While the vessel is loading or discharging cargo the additional hazards which require close monitoring are, the stresses experienced by the vessel and hazards associated with cargo (including fire, pollution, dangerous cargo hazards etc.). The stresses are controlled by planning the cargo operations in the form of loading/ discharging plan and synchronizing the same with ballast operations. However, there could be incidents where the ballast operations run out of synchronization and the cargo operations may require to be stopped in between, particularly on large bulk carriers/ tankers where the cargo is loaded at high rates. Liquid cargoes such as oil, chemicals etc. pose pollution hazards when spilled. The risk increases during changeover of tanks on board/ ashore and during topping off tanks. Container vessels, ro-ro vessels and other cargo vessels involve cargo operations where the cargo units may require lashing of individual units in a specific manner.
- In all circumstances discussed above and many more, the cargo operations require coordination with shore and hence communications play a vital role.
- The arrangements for ship-shore communications are confirmed when completing the ship-shore safety checklist, giving all necessary details for both ship and terminal including language and terminology to be used, location of telephones and terminal offices, normal communications procedures and telephone numbers, designated VHF Channels, personnel responsible for terminal cargo operations, Ship's officer responsible during cargo operations, notice periods and notifying procedures for reducing the loading rates and finishing loading, emergency communications procedures, channels, signals and telephone numbers, agreed procedure to STOP cargo operations in case of emergency, including emergency signals, emergency signals to indicate emergency on board / at terminal etc.
- The operations are further continuously monitored to ensure that the plans are followed and any deviations are identified at the earliest. Ship's officers and crew are assigned responsibilities to monitor and report the same to the cargo control room on board. Communications between the deck watch and the cargo control room are maintained using portable VHF/ UHF transceivers. The channel used is selected not interfering with the terminal operations and other vessels in the vicinity. When using portable sets, it is likely that the unit's battery may be discharged or the sound level is not audible in the

prevailing conditions. It is recommended to test the sets at regular intervals during the watch in order to ensure that the system stays in operation.

Apply Your Knowledge

1. Listen to the ship-shore communication on board your vessel during cargo operations.

IMU

Function: Cargo Handling and Stowage

Competence: Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes

Task number: B1.3

Sub task Reference number: B1.3.9

Topic: Cargo operations

Task Heading

- Demonstrate understanding of the effects of loading heavy lifts and high density cargo on the stability of the vessel.

Objectives

- Understand the effects of loading heavy lifts on the stability of the vessel
- Understand the effects of loading high density cargo on the stability of the vessel

Index

1) Heavy lifts
   i. Information
   ii. Rigging of heavy lift derricks
   iii. Stability details
   iv. Precaution
   v. Lateral drag
   vi. Loading / discharging heavy lifts

2) High density cargo
   i. Introduction
   ii. Problems associated with high-density cargoes
   iii. Precaution prior loading high-density cargoes
   iv. List of heavy-density cargoes given in IMSBC code

Description

1) HEAVY LIFTS

If the ships are designed to transport heavy lifts and are equipped with derricks then they are likely to be fitted with either the large 'Stulken-type' derricks, or specialized 'Hallen' or 'Velle' derricks or the conventional 'Jumbo' derrick. Modern cranes are well equipped in terms of carrying these heavy lifts as a typical deck crane would have safe working loads up to 60 tonnes or over. Some ships have 'Twin Cranes' also known as 'Gemini Cranes', where the two cranes are mounted on the same pedestal. They can be operated independently as individual cranes and for lifting heavier loads they can be combined together by locking them. Special care need to be taken when using cranes in 'Gemini formation'. There is always a chance that the brake of one crane may slip resulting in the other crane becoming overloaded.

i. **INFORMATION**

What information is necessary for us to know before loading a heavy lift?

- The weight, size and construction of the loads.
- Where support points of the loads are required or are permissible.
- Maximum load of each specific support point which the design would tolerate.

- What securing points are available on the load and where are they located.
- Where can the lifting attachments are made on the load and how they are made.
- Is the speed of movement of the load is in anyway critical.
- If any additional lifting or lashing and dunnaging equipment is required and who will provide them.
- Permissible load density of the tank top or deck where the heavy lift is to be placed.
- Lashing points available on the ship in the vicinity where load is to be placed.
- Necessary lashing gear available and ready at hand.

ii. **RIGGING OF HEAVY LIFT DERRICKS**

- All gears associated with lifting such as runners, guy pendants, tackles, blocks etc. to be examined carefully.
- Lifting gears and associated equipments to be greased and renewed as necessary.
- All other riggings cleared.
- Rig wires, blocks etc. as per rigging plan.
- Rig Preventers and backstays as per the plan.
- Topping lifts in good condition and securely shackled (moused).
- Winches should be in double gear.
- Derrick unclamped from mast.
- Set tight preventer guys.
- Rig extra stays if required
- Once clamp removed, take weight on messenger and slowly lower the derrick.

iii. **STABILITY DETAIL**

Since we are considering that the loading is carried out on a conventional multi- purpose ship, and not one of a specialized “heavy lift ship” it is normal practice to calculate the maximum angle of list that will occur during the lifting period. This angle of list should be calculated and the loss of metacentric height (‘GM’) ascertained prior to commencing the lift. A junior officer can be delegated to monitor the 'inclinometer' once the lift is commenced that could give early warning if this list angle is being exceeded. (If this happens, the load will have to be landed and the stability reworked.) There should be no loss of positive stability, or kept to the minimum and any free surface effects in the ship’s tanks should be eliminated by pressing up or reduced wherever possible.

iv. **PRECAUTIONS**

In order to achieve a successful outcome an adequate GM must be establish prior to commencing the lift bearing in mind that the gravity effect of the load will act from the head of the crane / derrick once the weight is taken on the lifting gear. A large list is not advised, as the cranes are designed to work upright. When working under an angle, stresses in the construction may occur, which are not foreseen.

Also, if the vessel has a larger list, the risk exists that the cargo moves sideways when coming free from its rest (see lateral drag below). The moment the cargo is free of the deck, for the ship as a system, its centre of gravity moves immediately from the original location at rest, in this case the tank-top, to the location of suspension, in this case the top of the crane jib. When at that moment the ship has a list, this list may increase, and the situation is out of control.

The stability curve changes rapidly at the moment of lift off. It is therefore of utmost importance that before the actual hoisting starts, the ‘hook’ is vertically above the center of gravity of the parcel. When a heavy cargo weight has to be lifted from the quay, the slings are tightened first making sure the hook is vertically above the center of gravity of the weight.

Prudent preparation should include an assessment of the vessel's ballast tanks and the elimination of any excess free surface effects. Additional ballast may be usefully added low down to improve the ship's GM.

v. LATERAL DRAG

One of the main problems with a vessel landing a heavy lift and carrying the expected list will be the dangers of the lift dragging itself from the loading platform as the weight is relieved and the ship rolls back to the upright. If unprepared for, the lateral movement of the load can be violent as the ship rolls against the angle of list.

This situation and associated dangers can be eliminated by coming back on the lifting purchase and simultaneously coming back on the topping lift, so keeping the crane / derrick head in a plumb line. Adequate manpower should be available in the form of competent winch drivers and the supervising controller. Winches should be set into double secured to points on the load to allow position adjustments to be made.

vi. LOADING / DISCHARGING HEAVY LIFTS

When loading or discharging heavy-lifts, deck officers should be aware of the following precautions and procedures:

Best place to load

- Longitudinals, plate floors.
- Solid floors or transverses.
- Examples: along longitudinal center girder, lower hold abaft machinery space.
- Load density not to be exceeded.
- If loading inside the cargo hold, always choose the ‘square of the hatch’ as the loading location for ‘heavy lifts’ as dragging it out from under the wings may not be a good option.
- In the hatch, in preference to on deck because of larger GM. **If the heavy lift exceeds load density -** Spread the load over a large area so that the load density is less than the maximum load capacity of that area. Add bearer, thick dunnage and spreaders.
- Locations as per ‘cargo securing manual’ for determining lashing points on board.

Precautions prior loading

- The stability of the vessel should be adequate and the maximum angle of list should be acceptable. All free surface effects (FSE) should be eliminated by either ‘pressing up’ or ‘emptying’ tanks.
- Ensure rigging is as per rigging plan
- If a conventional ‘Jumbo’ Derrick is employed, then the rigging plan should be referred to with regard to the positioning of ‘preventer backstays’ to support any mast structure.
- A careful check on the condition of the derrick / crane and associated gear should be made before commencing the lift. SWL of all gear (including the shore gear being used) shackles, blocks and wires is checked before handling any ‘heavy lift’
- Ensure all the ship’s moorings are taut and that men are standing by to tend as necessary. Fenders should be pre-rigged and the gangway lifted clear of the quayside.
- Bearers (dunnage) area calculated taking into account the load density of the deck should be higher than the weight of the load, for example the weight of the cargo + 5% of heavy seas. Dunnage should be laid making sure that the grains are parallel to the deck
- Many a time, long beam spreaders may be required while handling large and heavy items. Bridle length of the spreader will need to be checked. In such cases it has to be ensured that sling with load can pass easily over the hatch coaming (especially keeping within the load angle limits of the cranes)
- All cargo winches affecting the load should be placed in ‘double gear’where appropriate.

- The deck area where the load is to be landed should be clear of obstructions, and heavy bearers laid to accept and spread the deck weight.
- The ship's deck capacity plans should be checked to ensure that the deck space is capable of supporting the load.
- Full use should be made of the proper lifting points on the load and only load bearing lifting points should be used for slinging the cargo
- The winch drivers and controller should be seen to be competent, and all non-essential personnel should be clear of the lifting area.
- Any ship's side rails in the way of the load should be lowered or removed and any barges secured to the ship's side should be cast off.
- Steadying lines should be secured to the load itself and to the collar of the floating block if fitted.
- All relevant heads of departments should be advised before commencing the lift.
- During operations of the derrick all personnel should keep clear of the area. A signal man should be designated and all personnel must follow his instructions. **NO ONE should be allowed to stand under the slung load.**
- Use the designated lifting points and take the weight slowly. Stop, and inspect all round once the load clears the deck, before allowing the lift to continue.

Precautions when lifting

- Inform engine room and galley.
- Inform all relevant personnel.
- Ensure fore and aft moorings are taut and tended.
- Use steadying lines (swing preventers).
- Competent winch man / crane operator.
- Communication signals understood. Standard signals as per COSWP to be used.
- Only one competent person to signal the whole operation.
- Whole operation to be supervised by a responsible officer.
- Raise gangway.
- The derrick / crane head to be plumbed over the weight.
- Take weight slowly.
- Lift the load slowly, swing in the correct position and load on the appropriate position.
- Control swing by steadying stays.
- Consider emergency action if vessel develops heavy list (more than calculated) during the operation.

Safe Handling Practice for heavy lift (jumbo) derrick in addition to above:

Jumbo derricks are basically large swinging derrick, but of higher SWL, fitted with three to six fold purchases for cargo hoists and topping lifts.

- Officer to check the lift can be carried out safely and successfully. Ensure SWL of derrick adequate. Grease if need.
- Allowance should be made for the weight lifted plus the purchase weight.
- End links, rings or shackles to ride freely from whichever point they hang.
- Strops, wire slings, eye bolts etc. to be examined that they're of adequate strength.
- While slinging, wood or other packing to be used to protect the sling from any sharp edges on the load and to prevent the sling from cutting into the land.
- Avoid shocks due to load slipping or sudden starts
- Examine all rigging by officer. Secure all preventer backstays to the supporting mast. Use correct slings on the load with beam spreaders. Secure steadying lines on the 4 corners of the load to control oscillations during lifting
- Derricks should not be operated in "depressed condition" - meaning that it should not be operated with the derrick boom very close to the horizontal. Most heavy lift derrick systems are marked with the max/min angle of operation on the derrick boom.
- As far as possible load should remain level at all times during the operation.

- Rig and test steam guys and power guys to ensure correct leads. Winches should all be in double gear
- Check the lugs on the load. Check the crate/container of the load is reinforced
- The ship may return sharply after landing the load. The offshore guy could be ease out as the load lands and lifting purchase veer smartly. Winch driver should be competent and under control of single person

Manufacturers' instructions and reference to the ship's rigging plan should always be consulted regarding the preparations of setting up the lifting gear, especially when officers are unfamiliar with the style of rig.

2) HIGH-DENSITY CARGOES

i. INTRODUCTION

In relation to dry bulk cargoes, the term high density solid bulk cargo means the cargo with stowage factor (SF) of 0.56 m^3 per ton or less as given in the "International Maritime Solid Bulk Cargo Code" (IMSBC code). Examples in dry bulk cargo category are concentrates and ores.

Nickel ore

Copper concentrate

Iron

ii. PROBLEMS ASSOCIATED WITH HIGH-DENSITY CARGOES

High density cargoes may cause structural damage to the vessel and pose stability problems from the position of stow. Could well affect bending and shear force stress effects on the hull.

Structural damage can occur through excessive bending and shear forces caused by poor distribution of and/or inadequate trimming of certain cargoes, or sailing with partly filled holds or empty holds.

iii. PRECAUTION PRIOR LOADING HIGH-DENSITY CARGOES

Before a high-density cargo is loaded or unloaded, the master and the terminal representative agree on a plan which ensures that the permissible forces and moments on the ship are not exceeded during loading or unloading, and include the sequence, quantity and rate of loading or unloading, taking into consideration the speed of loading or unloading, the number of pours and the deballasting or ballasting capability of the ship. The plan and any subsequent amendments are lodged with the appropriate authority of the port State. The master and terminal representative ensure that loading and unloading operations are conducted in accordance with the agreed plan. The chief officer while preparing the loading / unloading plan should refer to the ship's approved loading manual to determine a cargo load distribution consistent with the structural loading limits and ensure that calculations are made to determine, that the "Still Water Shearing Forces" (SWSF) and "Still Water Bending Moments" (SWBM), block loaded cargo weights and local loading limits are not exceeded for any part of the voyage. Necessarily all loading / unloading operation will have ballasting and de-ballasting operations in tandem and the chief officer, while planning these operations should ensure that correct synchronisation are carried out with cargo operations.

When loading high density cargoes there is a risk of overloading tank tops and proper precautions should be taken.A general cargo ship is normally constructed to carry cargoes in the range of 1.39 to 1.67 cubic metres per tonne when loaded to full bale and deadweight capacities. When loading a high-density solid bulk cargo, particular attention should be paid to the distribution of weights to avoid excessive stresses, the cargo should be levelled to ensure an even pressure over the tank top, taking into account that the loading conditions may be different from those found normally and that improper distribution of such cargo may be capable of stressing either the structure under the load or the entire hull. Provided that the tank top is not overloaded, the pressure on the hopper tanks should be within acceptable limits, but in any case, if the density of the cargo is sufficiently high, the surface level of the stow will be below the upper limits of the sloping sides and no problems should arise. To set out exact rules for the distribution of loading is not practicable for all ships because the structural arrangements of each vessel may vary greatly. The tank top limitations are laid down when the ship is built and provided that the structure remains within class specifications, remain unchanged throughout the life of the ship and is provided in the ship's stability information booklet or may be obtained by the use of loading calculators, if available.

PRECAUTIONS

Precautions while planning for loading the above categories of cargo:

- Ensure that the vessels are designed and strengthened for loading such cargo;
- The master / owner of the vessel must be in possession of comprehensive information on ship's stability and distribution of cargo for standard loading conditions, which must have been approved by the classification society or flag state;
- The proposed stowage plan must ensure that the permissible forces and movements are not exceeded during loading taking into consideration the rate of loading, number of pours and de-ballasting capability of the vessel.
- Check maximum allowable load per unit surface area of the tank top plating as the density of the cargoes is extremely high, the tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration should be paid to ensure that the tank top is not overstressed during the voyage and during loading by a pile of the cargo.
- Check maximum allowable load per hold;
- As far as practicable, high-density cargoes shall normally be loaded in the lower hold cargo spaces in preference to 'tween-deck cargo spaces;
- When it is necessary to carry high-density cargoes in 'tween-decks or higher cargo spaces, due consideration shall be paid to ensure that the deck area is not overstressed and that the ship's stability is not reduced below the minimum acceptable level specified in the ship's stability data;
- Because of the velocity at which some high-density solid bulk cargoes are loaded, special care may be necessary to protect cargo space fittings from damage;
- To sound bilges after the completion of loading may be effective to detect damage on cargo space fitting;
- The high density cargoes should be trimmed to ensure that the height difference between peaks and troughs does not exceed 5% of the ship's breadth and that the cargo slopes uniformly from the hatch boundaries to the bulkheads and no shearing faces remain to collapse during voyage, in particular on smaller ships, i.e., 100 m long or less;
- The loading rates for the cargo should commence slowly and increase gradually. Fast rates of loading have proven to cause serious damage by generating rapid stress values throughout the ship's length.

iv. LIST OF HEAVY-DENSITY CARGOES GIVEN IN IMSBC CODE

Mineral Concentrates (See Bulk Cargo Shipping Names below)

- Cement Copper
- Copper Concentrate
- Iron Concentrate
- Iron Concentrate (Pellet Feed, Sinter Feed)
- Iron Concentrate (Sinter Feed)
- Lead And Zinc Calcines (Mixed)
- Lead And Zinc Middlings

- Lead Concentrate
- Lead Ore Residue
- Lead Silver
- Concentrate
- Manganese
- Concentrate
- Nefelene Syenite (Mineral)
- Nickel Concentrate
- Pentahydrate Crude
- Pyrites
- Pyritic Ashes (Iron)
- Pyritic Cinders
- Silver Lead Concentrate
- Zinc And Lead Calcines (Mixed)
- Zinc And Lead Middlings
- Zinc Concentrate
- Zinc Sinter
- Zinc Sludge Loading

Apply Your Knowledge

1. Discuss the precautions to be observed whilst loading heavy lifts and/ or high density cargo on the stability of the vessel.

I M U

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: B2.1.6

Topic: Inspection of cargo spaces, hatch covers and ballast tanks

Task Heading

- Assist in reporting damage caused by stevedores.

Objectives

- Understand the importance of stevedore damage report and the requirement of early detection, detailed support evidence and procedure of getting the repairs done

Index

- Stevedore damages

Description

1) Stevedore damages

- Unsafe handling of cargo and cargo handling gear is likely to cause damage to cargo and / or the ship structure. Stevedore damage is a damage that has been caused by the stevedores during cargo handling. These damages to the vessels can prove dangerous and repairs may turn out to be very costly if left un-noticed.
- It is very important that the duty officer should be alert and watchful during cargo operations 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 registering a "Stevedore damage report".
- When a stevedore damage has occurred, the duty officer should:-
  - ❖ carry out the on-the-spot investigation with attendance of stevedores side, tender the Stevedore damage report & notice of liability to the stevedores (terminal superintendent or Manager only, not foreman) immediately after confirmation of the state of accident, and have him sign it;
  - ❖ report to the chief officer and master, as depending on some charter parties, the Master then would be required to notify the charterers within 24 hours after the occurrence of an accident.
- The categories of damages which require tender of stevedore damage report are classified as mentioned below.

❖ **Serious damage**

Damages which impair 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**
  Damages that affect seaworthiness or violate class requirements. For this a stevedore damage report must be handed over to the stevedores and an acknowledgement received. Repairs must be completed prior leaving port. All expenses will be on stevedores account. Stevedore damage reports should be substantiated with photographs.

- Cases when there is a major damage that affects seaworthiness, the owners need to be advised immediately alongwith preparation of a detailed statement. A copy of the signed stevedore damage report & notice of liability is handed over to the stevedores. The same is also sent to owners and charterers as applicable. Any damage affecting seaworthiness will need to be repaired prior the ship departs from the port and class survey done as necessary. Local P&I representatives will also be attending the investigations and repairs.

- The repairs are carried out on the expense of stevedores. In cases where the vessel is under voyage charter, the owner of the vessel recovers the costs from the stevedores. Whereas under time charter, the owners notify the charterers and get the expenses reimbursed. The time charterer, in turn, recovers the same from stevedores. What lies as being most important is notifying the stevedores in time and getting their acknowledgement for damage.

- The stevedore damage report & notice of liability is required to be tendered directly to the stevedore and the written acknowledgement taken. If the stevedores refuse to sign such an acknowledgement, same shall be endorsed on the report. Evidences of damage such as photographs and statements of witness are taken. Later these are sent to time charterer, depending on the provisions of the charter party.

- It is necessary to identify the exact nature, extent and cause of the damage. The report should be accompanied with digital photographs, again identifying the exact location of damage. After having issued the reports and collected the evidence by the digital photographs, the documentation should immediately be mailed to the owner’s technical department for further processing.

- In some cases, stevedores may repair the damaged portion on the spot to restore it to the original state before departure. Other cases, they may come up with a provision of repairing the damage in the next call of the vessel or some other convenient port.

In case of a stevedore damage

- take/secure evidence
- issue stevedore damage report & notice of liability and get acknowledgement
- inform owner's technical department and charterers if applicable
- if affecting seaworthiness or in case of cargo damage, arrange for a survey with P&I or Hull & Machinery insurance
- get the repair done before departure if affecting seaworthiness of vessel, damaged cargo (such as reefer container) may need to be offloaded
- repairs either carried out by stevedores or the costs reimbursed by stevedores

If repairs are carried out by ship then generally upon completion of repair, the stevedores/charterers shall be advised of following

- ship's name and voyage number
- date and port where damage occurred
- location and extent of damage
- details of repair work carried out
- material used, also including oxy-acetylene gas, electrodes, paints etc
- man-hours utilized (separately for repair and painting work)
- other pertinent remarks.

Apply Your Knowledge

1. Locate the stevedore damage report form prescribed by your company. Find the type of damages that will require to be rectified before the vessel departs from the port.

IMU

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: B2.1.7, B2.1.8

Topic: Inspection of cargo spaces, hatch covers and ballast tanks

Task Heading

- Demonstrate understanding of emergency operation procedure for the hatch covers.
- Inspect the draining arrangement for hatch covers.

Objectives

- Understand emergency operation procedure for the hatch covers
- Understand draining arrangements for hatch covers and importance of thorough inspection.

Index

1. Emergency operation of hatch covers in case of hydraulic failure
2. Draining arrangements for hatch covers

Description

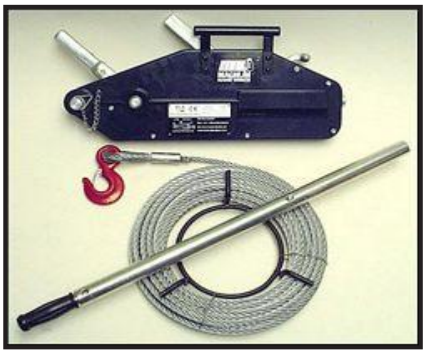
1) Emergency operation of hatch covers in case of hydraulic failure

- Hatch covers come in different designs, most common are mac-gregor single pull type, folding types, side rolling types, lift away types and piggy back types. While the lift away and piggy back types are common on container ships, side rolling types on bulk carriers and single pull types on other cargo ships. All these types, except the lift away types, use hydraulic systems for hatch cover operation. Single pull and side rolling types use hydraulic gypsies to move the hatch cover whereas the folding types and piggy back types operate with the help of hydraulic rams.
- In the event hydraulic gypsy or the rams not operating with the hydraulic system the hatch covers will not open or close. Manufacturers provide instructions for operation of hatch covers in the event of hydraulic failures which shall be followed. Some of the main points to remember are as follows:

❖ Read the manufacturer's instructions for emergency operations.

❖ When operating hydraulic hatch covers in the emergency mode, it is advisable to keep the control lever in the same position as if when operating the hatch-cover hydraulically. This will facilitate releasing the pressure in the line which may be locking the movement of gypsy/ ram.

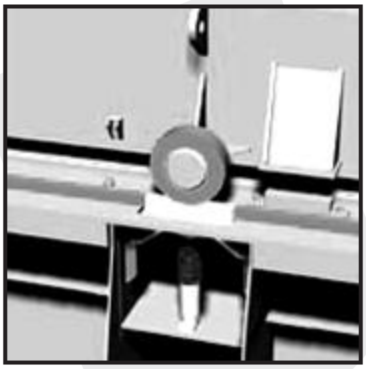
❖ Equipments meant for emergency operations of hatch covers (which may be provided by the manufacturer) like portable jacks, trifors (lever-operated devices for hauling on wires), snatch blocks, securing wires, emergency retaining pins should be kept labelled and should not be used for any other purposes. The gear’s condition shall be checked prior use. In the event of no such material being provided by the manufacturer, wires, shackles, snatch blocks, securing eyes etc will be used; for which the SWL shall be checked in accordance with the manufactures instructions.



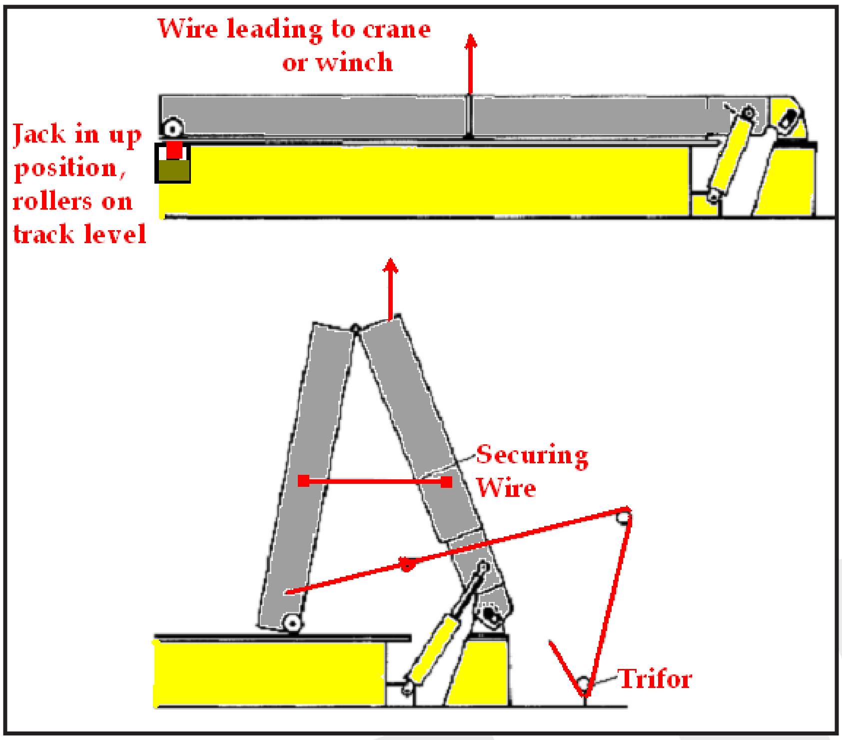
Trifor

Snatch Block

- In the event of hydraulic failure, the hatch covers are usually opened with wires. Even if the system becomes operational after the hatch covers are opened it is advised to close the hatch covers using wires. Once the hatch covers are fully closed, the hydraulic system can be tried out.

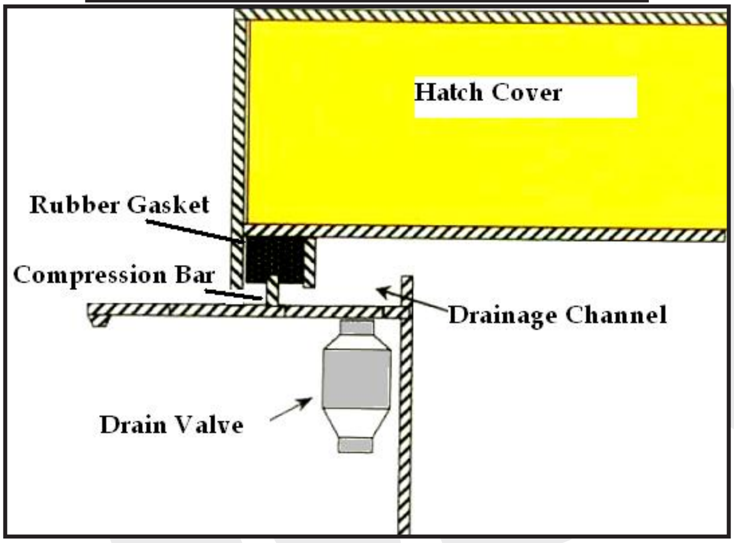


- The hatch cover pontoons move on the hatch coaming with the help of roller wheels. These wheels shall be kept greased, checked free to rotate and not frozen.
- The hatch cover rollers usually rest on top of pads in the slot provided on the hatch coamings. These pads lie on top of hydraulic jacks operated by hydraulic system. Prior operating hatch covers, it shall be ensured that the jacks are in up position and the roller wheels of hatch pontoon are lying in level with the hatch coaming.
- The hatch coaming pontoon roller tracks shall be clear and free of any obstructions. Any quick acting cleat may have been left hanging in the slot locking the hatch cover to coaming, which shall be checked and cleared.
- The hatch covers may be pulled using wires secured to the hatch covers pontoons through securing eyes. The wires are pulled using winches, cranes or davits. However, this may prove to be highly hazardous if the cranes or the winches are not operated correctly. Formal risk assessment is required for the operation. The SWL of cranes and winches need to be checked with reference to weight of the pontoons, expected pull on the wire and the lead of the wire.
- Proper securing arrangements shall be made for hatch covers in the open position to avoid any accidental slippage. The pontoons shall be secured after the hatch cover is opened.
- An emergency hatch opening drill should be carried out once every six months to familiarize the crew and keep the equipment in working condition.

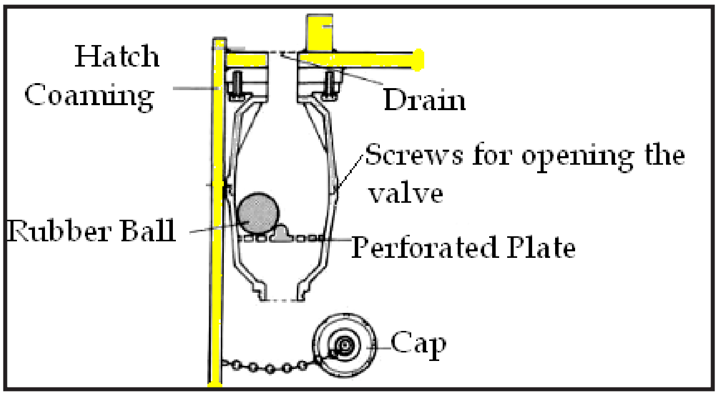


2) Draining arrangements for hatch covers

➢ Hatch covers are made weather-tight by means of a rubber sealing provided in the hatch cover pontoons, which rests on the compression bar of hatch coamings. During the voyage, due to change in temperatures causing cooling of the hatch cover, moisture is likely to be accumulated on the under surface of the hatch cover. This trickles to the sides and get accumulated on the hatch coaming inside the hatch square. To drain if off from the hatch coaming, a channel is made on the coaming leading to a drain fitted with a non return drain valve. The non-return valves are provided in the drains to prevent any backward ingress of water while the vessel ships seas. Where the drains are not provided with an approved automatic means of preventing water entering the hold, the drains are to be capable of being closed by a screw plug or cap which is to be attached by a strong keep chain to the drain.



- The moisture collected in the drain channel, if not drained, is likely to cause cargo damage in the hold. The drainage channel shall be kept clean free from any cargo residues and rust. The drain hole shall be clear and the drain non-return valve operational.
- The non return valve has a rubber ball inside, resting on top of a perforated plate. The ball allows any water to drain from the top, but seals the opening if there is any back flow of water. The valve is further provided with a cap to seal, in cases where the hold is required to be sealed air tight, as in case of hold fire and use of CO_2. Screws are provided on the valve body allowing the valve to be opened and cleaned.



- Improper hatch cover draining arrangements is one of the reasons for involving cargo damage due to moisture and can result in huge claims. Same shall be checked thoroughly.

Apply Your Knowledge

1. List the procedure for opening and closing a hatch cover in an emergency. Use bullet points and diagrams as applicable.

I M U

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: B2.1.9

Topic: Inspection of cargo spaces, hatch covers and ballast tanks

Task Heading

- Identify elements of the ship structure critical to the safety of the ship

Objectives

- Identify the elements of the ship structure critical to the safety of the ship

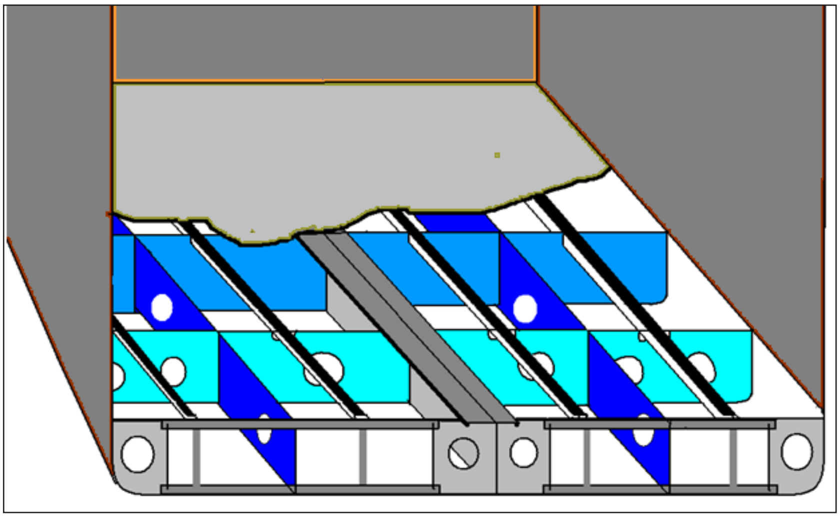
Index

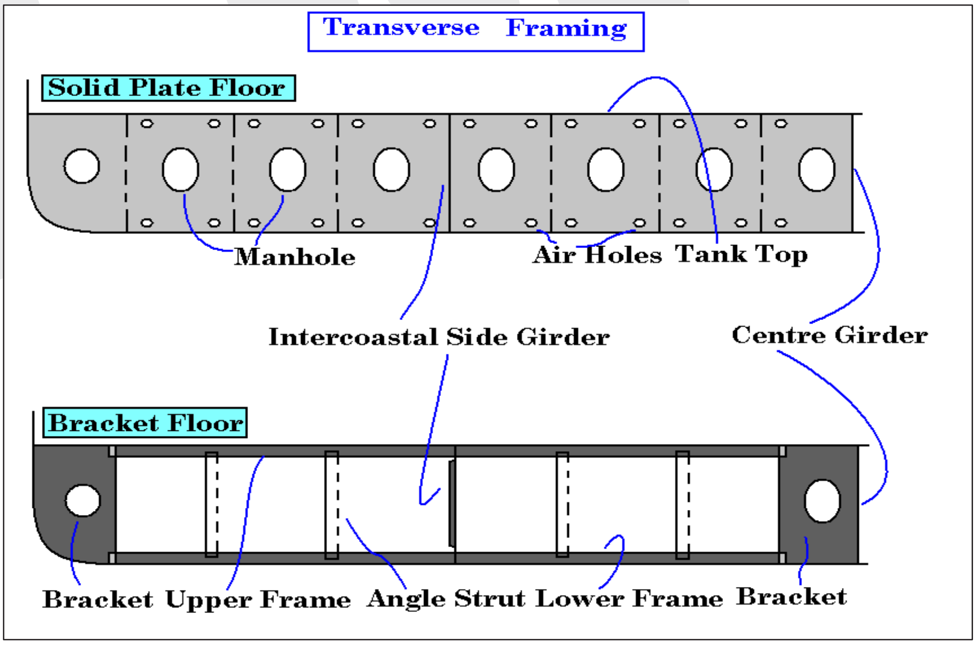
1. **Elements of the ship structure**

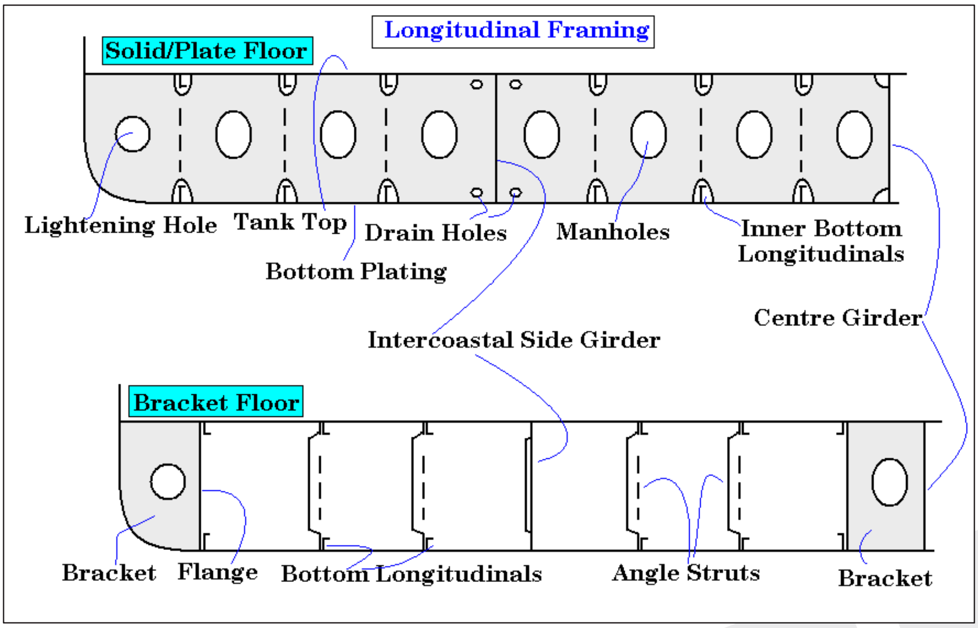
Description

1. **Elements of the ship structure**

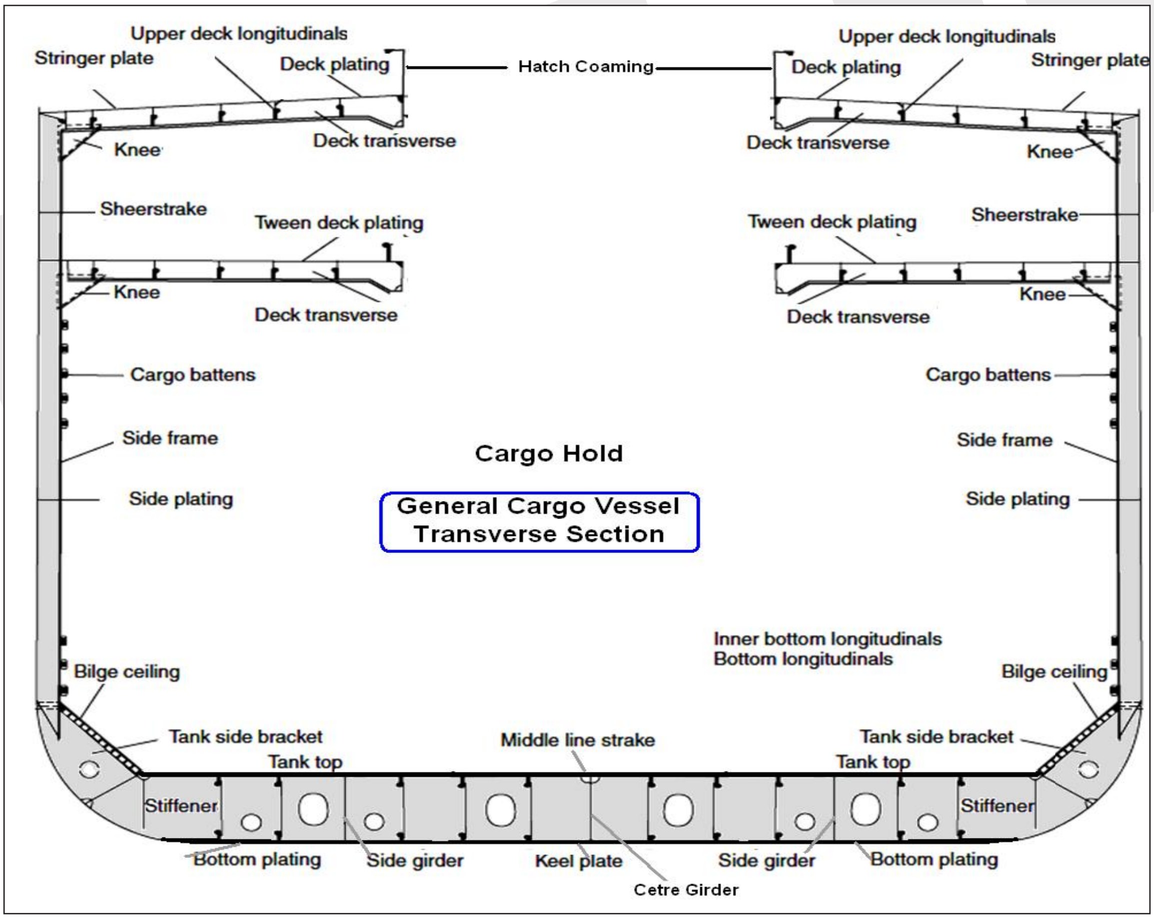
- Ships are designed by the naval architects in accordance with the constructions rules as laid down by the classification societies. The classification societies in turn work in accordance with the IMO requirements for construction and strengthening of vessels. Ship's hull is made of steel conforming to the class standards. Classification societies lay down standards for different portions of the vessel. Materials and plates in the various strength members are not to be of lower grade or thickness than those corresponding to the material classes and grades as specified by classification rules. Hull plating and other stiffeners are gauged at periodical surveys and the wastage considered in relation to reductions allowed by the society, such allowed reductions are based on the nominal thicknesses required by the rules.
- The principle structural components of the ship's hull include the keel, bottom, side and deck plating, double bottoms, transverse and longitudinal bulkheads, transverse and longitudinal stiffeners and peaks.
- Double bottom space is formed by fitting of additional plating above the bottom plating extending from side to side across most of the length of the vessel. The inner bottom plating is called the tank top and is constructed to create a water tight space below it. This water tight space is called "Double Bottom Tank". The double bottom extends from the flat keel to the tank top. It is of robust construction and is water tight so that in case of accident causing an inrush of water into the double bottom, the ship would still be able to keep afloat. The principal parts of the double bottom are the flat keel, vertical keel, floors, intercostal girders, bilge, brackets, tank top, longitudinals, bounding bars and angle clips.

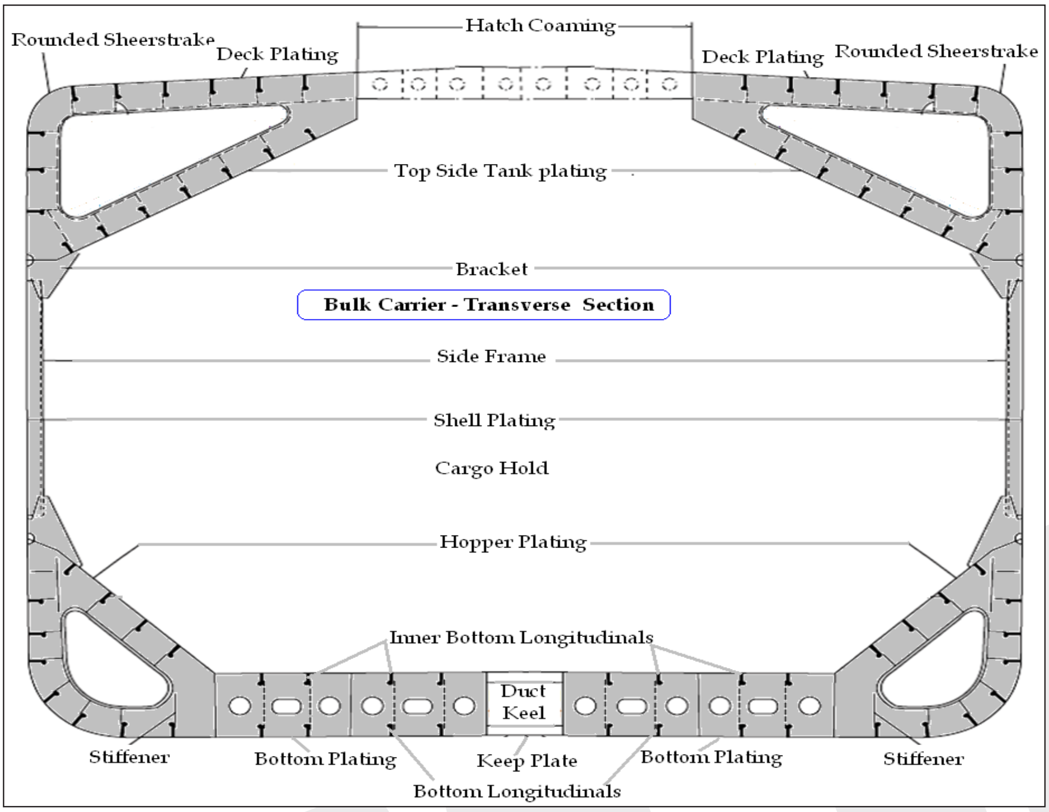



Transverse Framing
Solid Plate Floor
Manhole
Air Holes
Tank Top
Intercoastal Side Girder
Centre Girder
Bracket Floor
Bracket
Upper Frame
Angle Strut
Lower Frame
Bracket

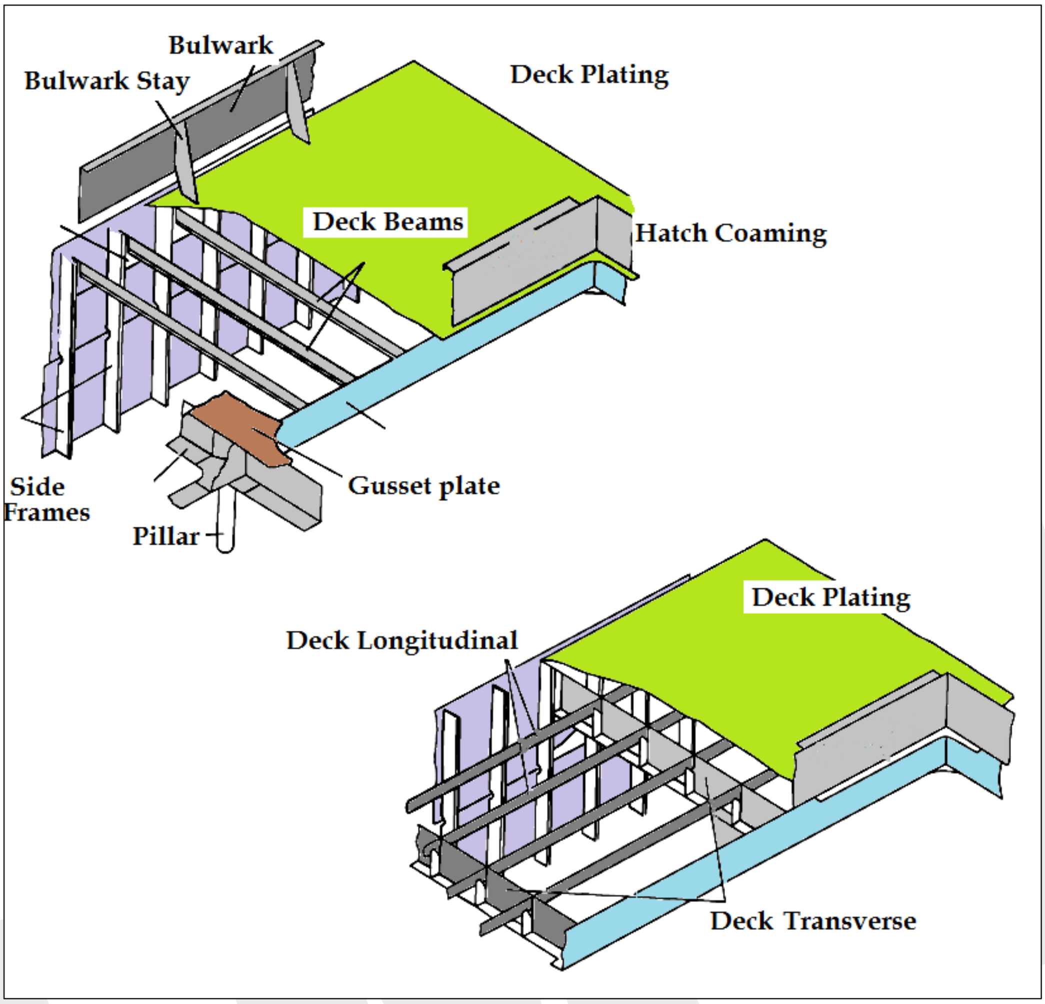


➢ The following images show the transverse cross sections of a general cargo vessel and a bulk carrier showing the positions of various longitudinal and transverse stiffeners.

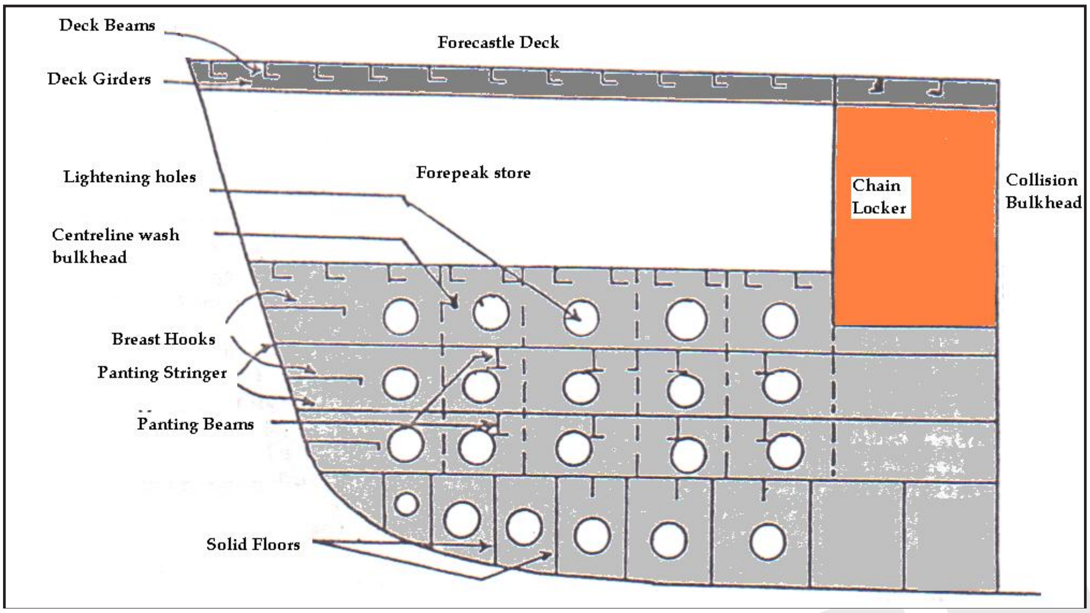


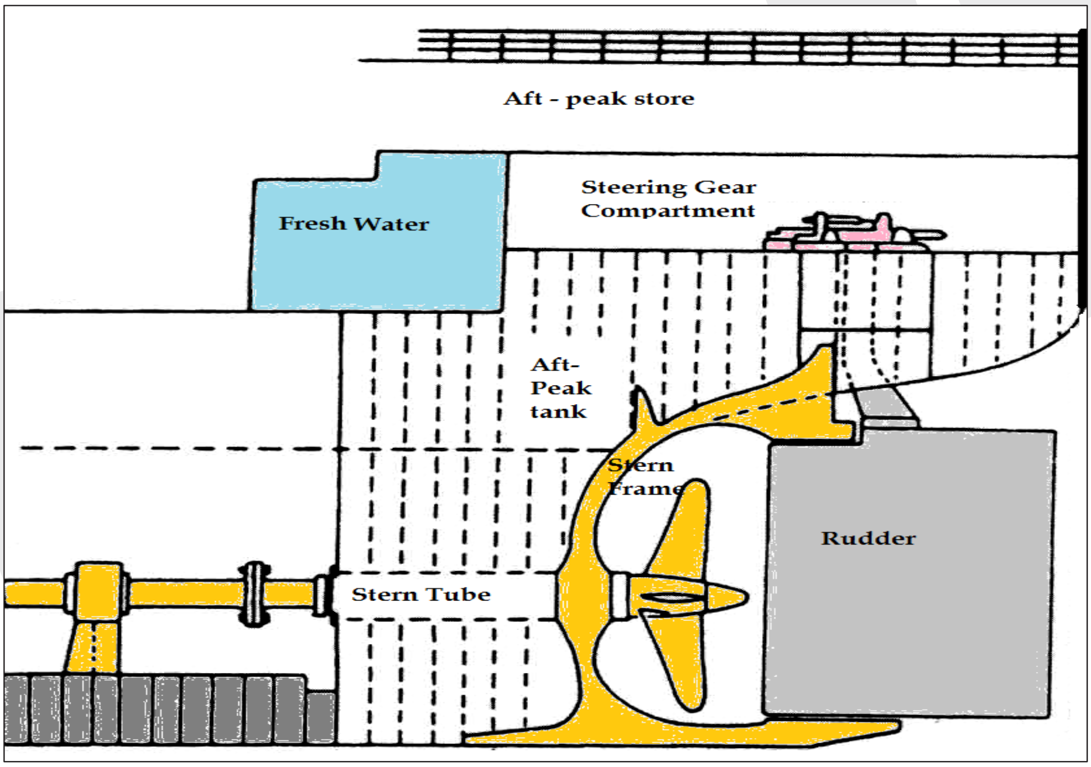


- The transverse and longitudinal bulkheads provide strength to the vessel against racking and longitudinal stresses respectively. The bulkheads further serve to divide the compartments into two or more or to separate the cargo spaces and ballast tanks. The bulkheads are made of plates stiffened with girders and brackets. Alternatively corrugated bulkheads are used on bulk carrier.
- The deck plating is stiffened by girders and beams running underneath as shown in images below.



- The deck openings for hatchways are strengthened by the hatch coamings as discussed under task C2.1.3.
- The forward end of the vessel is provided with forepeak tank, which in itself is especially designed and strengthened. The main strengthening members include, the collision bulkhead, panting stringer, panting beams, breast hooks, solid floors and centerline bulkhead. The aft-peak has stern frame particularly to withstand the vibration caused due to the propeller.





Apply Your Knowledge

1. Discuss the salient features of the longitudinal and transverse framing.

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: B2.1.10

Topic: Inspection of cargo spaces, hatch covers and ballast tanks

Task Heading

- Demonstrate understanding of the causes of corrosion in cargo spaces and ballast tanks and how corrosion can be prevented

Objectives

- Understand the causes of corrosion and the systems to prevent corrosion

Please read this task in conjunction with tasks C2.4.21 and C2.4.22

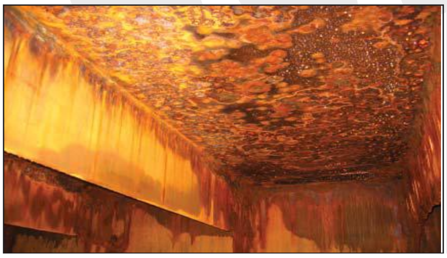
Index

1. Corrosion
2. Forms of corrosion
3. Corrosion control
   a) Sacrificial anodes
   b) Impressed current cathodic protection (ICCP)
   c) Protective coatings (paints)

Description

1) Corrosion

- Corrosion is a process of deterioration of a metal caused due to electrochemical reaction with the surrounding environment. Considering broadly, corrosion may be looked upon as the tendency of the metal to revert back to its natural state similar to the oxide from which it was originally smelted.




- The presence of anodic and cathodic sites on the steel surface and their reaction with oxygen and water results in the transformation of a metal atom to a metal ion by the loss of electrons i.e. anodic reaction. The reaction can only occur if there is a suitable electron acceptor to combine with the electrons released by the iron atom. Seawater contains dissolved atmospheric oxygen which readily serves this purpose. The oxygen is electrochemically reduced to hydroxyl ions in the cathodic reaction. The process is referred to as electrochemical corrosion. The heterogeneous character of steel allows for some sites to favour the anodic reaction and for others to favour the cathodic reaction.

Anodic Reaction

$4Fe \longrightarrow 4Fe^{++} + 8e^{-}$

Iron Electrons Atom — Ferrous Ion

Cathodic Reaction

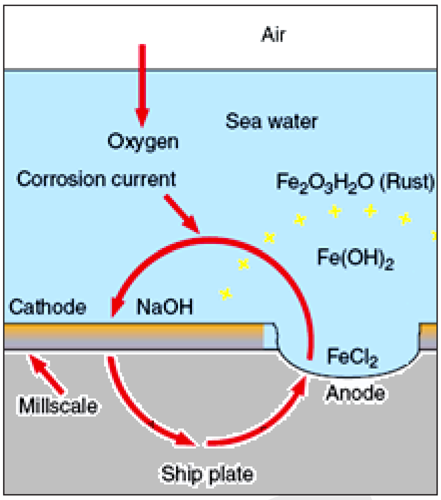
$2O_2 + 4H_2O + 8e^{-} \longrightarrow 8OH^{-}$

Oxygen — Water — Electrons — Hydroxyl Ions

The ferrous ions and hydroxyl ions formed combine together to produce ferrous hydroxide:

$$4Fe^{++} + 8OH^{-} \longrightarrow 4Fe(OH)_2$$

Ferrous Hydroxide



The ferrous hydroxide formed reacts with more oxygen to form hydrated ferric oxide, the familiar reddish brown rust.

$$4Fe(OH)_2 + O_2 \longrightarrow 2Fe_2O_3H_2O$$

Rust

In theory, all of these reactions occur simultaneously and can be simply represented as:

$$\underset{\text{Iron}}{4Fe} + \underset{\text{Oxygen}}{3O_2} + \underset{\text{Water}}{2H_2O} \longrightarrow \underset{\text{Rust}}{2Fe_2O_3.H_2O}$$

2) Forms of corrosion

- **Uniform corrosion**
  Corrosion that occurs uniformly over the entire exposed surface of a metal; Distribution of corrosion is relatively even.

- **Pitting corrosion**
  It is a form of localized corrosion that occurs when a corrosive medium attacks a metal at specific points and results in deep cavities in the metal.

- **Crevice corrosion**
  This form of corrosion occurs when an electrolyte is trapped and stagnant in particular locations such as in joints, corners, and under debris. Joints, corners, and where debris may accumulate are more susceptible to such corrosion.

- **Galvanic corrosion**
  This form of corrosion results from the formation of a galvanic cell by the galvanic coupling of metals having different electrical potentials, which are exposed to an electrolyte.

- **Inter-granular corrosion**
  It is a form of corrosion that attacks grain boundaries in materials. It may occur as a result of a galvanic couple between differing phases within a material.

- **Selective leaching/de-alloying**
  It is a localized form of corrosion where a particular element within a material is preferentially attacked and extracted from the material.

- **Fretting**
  A form of corrosion caused by repetitive friction between two surfaces in sliding motion with respect to each other while exposed to a corrosive environment.

- **Erosion corrosion**
  The increased rate of deterioration and loss of a material due to the combined effects of corrosion and the repeated motion of the surrounding environment is named as erosion corrosion.

- **Stress corrosion cracking**
  A cracking process involving the combined factors of corrosive environment and a sustained tensile stress is termed as stress corrosion cracking.

- **Corrosion fatigue**
  It is the failure of a material caused due to the combined effects of corrosion and fatigue (cyclic stressing).

- **Filiform corrosion**
  It is caused when water permeable organic coatings or edges of alloys coated with metallic coatings are exposed to high humidity.

- Uniform or general corrosion proceeds independent of the material's microstructure and component design. It is highly dependent upon the environmental conditions and the material's composition, generally occurring at a slow rate. All the remaining forms of corrosion are localized, dependent upon the environments, the components and systems designs, and/or the microstructure of the materials. These forms typically produce higher corrosion rates than uniform corrosion, and in some cases can be quite rapid.

- **Factors influencing corrosion rates on board**
- temperature
- percentage of time in ballast or ballasting routine
- moisture content of empty tanks
- temperature of cargo or fuel in adjacent tanks
- cathodic protection, application and design and anode distribution
- coating type and application, including steel surface preparation
- maintenance of corrosion protection systems
- structural design of ship and tanks
- frequency and method of tank washing
- clean or dirty ballast
- cargo type and composition, including contamination
- use and type of inert gas
- presence of a layer of built up corrosion products (rust)
- exposure to vibrations and/or high stress levels
- macro-elements or large aeration cells caused by variations in the oxygen concentration,
- trade, speed and sailing route etc.

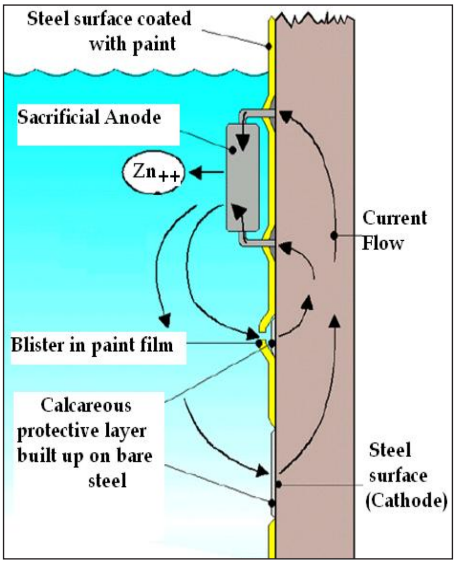
- **Effect of cargoes on corrosion**
- In tankers, acid water containing sulphurous components from the oil may settle out in the bottom of cargo tanks, ballast tanks and cargo piping, causing corrosion problems.
- Impacts from grabs in bulk carriers may damage the corrosion protection systems on both sides of exposed plates.
- Corrosion attacks may occur from water acidified by the ore in ore carriers.
- The chemical properties of cargo such as Sulphur in bulk may greatly affect the ship's hull.

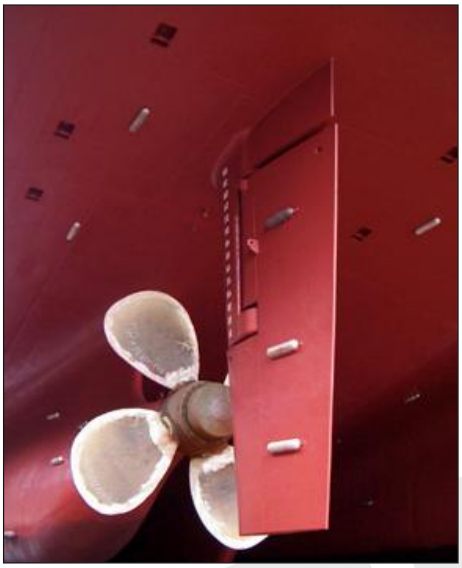
3) Corrosion control

The methods used for corrosion control on ships are
- Use of sacrificial anodes
- Impressed current cathodic protection (ICCP)
- Protective coatings

a) Sacrificial anodes

- When two dissimilar metals are connected in seawater, the metal with the lowest potential will suffer the greatest corrosion. Such metal takes the anodic position in the corrosion cell. Metals such as zinc and aluminium are more active to return to their natural state than mild steel. The corrosion rate of mild steel can therefore be controlled by connecting zinc bars to it, which act as the anode and corrode in preference to the steel. The zinc anode is referred to as a sacrificial anode because it is slowly consumed (corrodes) during the protection process. It should be noted that if the mild steel has a lower potential than other connecting metals, e.g. stainless steel heating coils in a cargo tank, under the right conditions, the mild steel will corrode preferentially. The sacrificial anodes are placed in electrical contact with the metal surface to be protected. Zinc is most common in such use. However, Magnesium and aluminium may also be used.Cathodic protection systems are used in conjunction with coating systems.

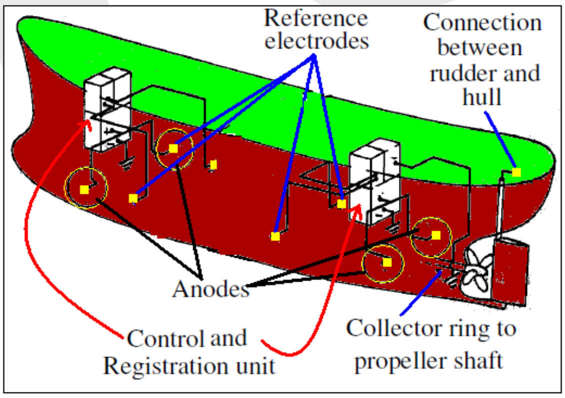




- Sacrificial anodes are more preferred in hull portions submerged in water and in ballast tanks for the advantages that these are simple to install and maintain. No power supply is needed for the system and current cannot be applied in wrong direction. However, current developed depends on anode area and hence is cumbersome on large ships. The anodes provide protection only when submerged in water. The system is more expensive to maintain than a DC supply (ICCP) and wiring for large anode arrays must be large enough to reduce resistance losses

b) Impressed current cathodic protection (ICCP)

- In ICCP, an auxiliary anode is made from a non-consumable material. This anode is permanent and is not consumed during the protection process. An impressed current is used to polarise the anodic areas and balance their electrical potential with that of the cathode. A control unit measures the potential difference and implies the protective current accordingly.



- ICCP offers flexibility as the current may be varied as per the requirement. Wiring does not need to be large since the voltage can be adjusted to allow for resistance losses. However, the system requires a continuous DC supply. The current if applied in wrong direction, can prove disastrous. System needs to be switched off while the ship is made fast to berths. Else the system may draw huge currents trying to protect the jetty.

c) Protective coatings (paints)

The topic of painting has been covered in detail under tasks C2.4.21 and C2.4.22 which shall be referred to.

Apply Your Knowledge

1. Discuss the areas on board which are most commonly corroded and the means of protection employed for the same.
2. Refer to the last dry-dock report of the vessel and check the number, location and sizes of the zinc anodes used on board.

Semester 4

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.
1.	Bunkering procedures	C1.1.4	Demonstrate understanding of the ship's bunkering procedures and various checklists involved with bunkering operations.	1 – 6
		C1.1.5	Participate in pre-bunkering meeting.	
		C1.1.6	Assist in connection and disconnection of bunker hoses.	
2.	Bunkering procedures	C1.1.7	Under supervision, operate and test portable (Wilden) pump.	7 – 9
3.	Pollution prevention regulations	C1.2.5	Demonstrate understanding of the entries made in the oil record book.	10 – 12
4.	Pollution prevention regulations	C1.2.6	Identify the special areas under MARPOL Annex I and Annex V.	13 – 17
		C1.2.7	Read and discuss the criteria for disposal of batteries, tube lights, and expired medicines with STO.	
5.	Bilge and ballast operations	C1.3.2	Set lines for ballasting and deballasting operations.	18 – 24
		C1.3.3	Assist in pumping out chain locker and forward stores.	
		C1.3.4	Set lines for pumping out the bilges.	
6.	Ship stability (including understanding of the fundamentals of watertight integrity)	C2.1.1	Refer to the stability booklet and determine which tanks cause relatively more free surface effect if kept slack.	25 – 26
7.	Securing for sea	C2.3.4	Assist in checking of deck cargo lashings prior to departure.	27 – 28
8.	Seamanship practices	C2.4.10	Demonstrate the use of various portable gas analyzers on board including: ❖ Oxygen analyzer ❖ Multi gas detector ❖ Toxic gas detector ❖ Personal gas monitors ❖ Explosimeters	29 – 39
		C2.4.11	Identify the span gas required for calibrating each portable analyzer on board. Assist in calibrating various portable analyzers and maintain records.	
9.	Seamanship practices	C2.4.12	Keep a deck and gangway watch and tend mooring lines and gangway.	40 – 42
10.	Seamanship practices	C2.4.13	Rig and use stages under supervision.	43 – 45
		C2.4.14	Rig and use bosun's chair under supervision.	
11.	Seamanship practices	C2.4.15	Assist crew with splicing of ropes and wires.	46 – 55
12.	Seamanship practices	C2.4.16	Maintain fairleads.	56 – 57
13.	Seamanship practices	C2.4.17	Receive, check, stow and secure ship's stores.	58 – 59
14.	Seamanship practices	C2.4.18	Assist with rigging of pilot ladder and combination ladders. Monitor Pilot's safety when embarking and disembarking.	60 – 65

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: C1.1.4, C1.1.5, C1.1.6

Topic: Bunkering procedures

Task Heading

- Demonstrate understanding of the ship's bunkering procedures and various checklists involved with bunkering operations.
- Participate in pre-bunkering meeting.
- Assist in connection and disconnection of bunker hoses.

Objectives

- Understand the importance of ship's bunkering procedures and various checklists involved with bunkering operations.
- Understand requirements of pre-bunkering meeting.

Please read this task in conjunction with task C1.1.9

Index

1) Introduction
2) Planning for a bunkering operation
    a) Pre-bunker meeting
    b) Bunker plan
    c) Communication
    d) Moorings
    e) Bunker hose
    f) SOPEP equipment
    g) Monitoring and watch keeping
    h) Record keeping
    i) Bunker measurement calculations
3) Checklists
4) Malpractices related to bunker operations
    a) Fuel oil delivery- quantity
    b) Ullage and soundings
    c) Flow meter re-circulation lines
    d) The cappuccino effect
    e) Water in fuel
    f) Others
5) Some reasons for oil spills during bunkering operations

Description

1) Introduction

- Every vessel needs bunkers. First and foremost, the ship's SMS manuals and the Shipboard Oil Pollution Emergency Plan (SOPEP) shall be referred to for detailed guidelines, instructions and procedures of bunkering. In addition to the IMO regulations, many states, and even individual ports, have their own regulatory regimes covering bunkering operations.

- Bunkering is a potentially high risk operation with regards to pollution. Shipboard SMS mentions the person responsible for the operation and usually chief engineer is designated the overall responsibility for the operation.

2) Planning for a bunkering operation

- All personnel involved in the bunkering operation (including relief personnel) should be briefed on bunkering duties at a pre-bunkering meeting, within 48 hours prior to scheduled bunkering. All crew members involved in the exercise shall be fully conversant with the specification and quantity of fuel to be lifted, the ship's fuelling and tank sounding arrangements, the alarm systems and the loading sequence. The bunkering procedures and checklists shall be completed as due, prior bunkering, during and after completion of bunkering.

- It is of primary importance that all personnel on board are made aware of the intention to bunker so that the vessel's emergency response plan can be activated without delay in the event of a spill. In addition, it should not be forgotten that the bunkering facility itself could be the source of a spill, and the contingency arrangements of the barge or terminal should be checked and discussed beforehand.

- Clear and detailed drawings of the vessel's bunkering system shall be available for use by members of the ship's bunkering team during the operations and it is recommended that a piping diagram is posted in a suitable location for easy reference by the bunkering team. As well as aiding the routine checking of pipeline configurations, access to such diagrams may prove indispensible in an emergency.

- Prior to bunkering the staff and crew involved must be aware of:
- The quantity and grades of fuel to be received.
- The method of delivery (pipeline, barge or road tanker).
- The tanks and pipeline systems on board that will be used during the operation,
- The order in which the tanks will be filled.
- The anticipated pumping rate and duration of the operation.
- Who will be responsible for each aspect of the bunkering?
- All involved should review the appropriate requirements of the vessel SMS and SOPEP or SMPEP.

- Personnel involved in bunkering operations should be briefed on hazards associated with hydrogen sulphide gas and benzene.

a) Pre-bunkering Meeting

The bunkering plan should be discussed in detail. Pollution contingency plans should also be discussed in detail. Training session should be held covering pre - loading plan, procedure for oil transfer / responsibilities, methods of communication - walkie talkie, emergency shut down procedures etc.

Bunkers shall be received in tanks without mixing with the existing bunkers on board, as the fuel needs to be analysed in the laboratories prior it is put to use on

b) Bunker plan

The bunker plan is a schematic piping diagram that represents bunkering system onboard. The plan is drawn showing the distribution of the bunkers along with the amount of fuel to be bunkered, the sequence of berthing and the plan of distribution of bunkers with tank soundings expected upon completion on board as planned, including the amount of fuel already on board. It shall be posted at the bunkering station during bunkering, and must be fully understood and signed by the officers involved in the operation. A copy of the bunker tank sounding tables also should be available to all personnel and form part of the bunker plan.

c) Communication

Prior commencing bunkering, an effective means of communication shall be established and agreed between both parties clearly stating the stop command and slow down command. The most common means of communication during bunker operations is by VHF radio. Emergency stop signal and procedures shall be confirmed as discussed under task C1.1.9. Communication between the bunker station and the engine room is to be tested to ensure that noise from the machinery space does not interfere or block the communication from the deck and lead to misunderstanding.

d) Moorings

If the moorings are not tendered effectively, the ship is likely to move away from the barge and causing undue stress on the bunker line and likely rupture. The moorings from the bunker barge shall be sufficient in number, in good condition and secured properly. They should be checked continually.

e) Bunker hose

Before bunkering commences, the condition of bunker hose shall be carefully checked for any signs of damage. Test certificate of hose must be sighted. Hose is picked up using the crane on the bunker barge. Care shall be taken to ensure that the hose is not damaged by slings or other means. Hose should always be handled with care and should not be dragged over a surface or rolled in a manner that twists the body of the hose. Further it should not be allowed to come into contact with a hot surface such as a steam pipe or at any point where chafing or rubbing can occur. The hoses need to be grounded suitably for any build up of static electricity.

f) SOPEP equipment

At the bunker manifold and wherever necessary, as per the ship's SOPEP plan, the SOPEP equipment should be kept in a state of immediate readiness, to avoid the risk of an oil spill and pollution during the bunkering operation.

g) Monitoring and watch-keeping

As with all shipboard operations, monitoring of the operation and watch-keeping is to be carried out in accordance with the safety management system, ship security plan and good seamanship taking into account the prevailing conditions on board and in the vicinity of the ship. Continuous watch shall be maintained on the following

- ✓ Safe access between shore or ship to ship
- ✓ Bunker transfer connection
- ✓ Bunker transfer progress (transfer rate, bunkers received, capacity and agreed quantity to be received, estimated time of completion, etc.)

h) Record keeping

- ❖ Record shall be maintained of all events and operations which include the following:
- ❖ All bunker-related communications and exchange of documents including:
  - ✓ Bunker Delivery Note (BDN)
  - ✓ Letters of protest
  - ✓ Fact sheets

- ✓ Sounding reports and measurement calculations sheets
- ✓ Bunker quality certificates
- ✓ Bunker receipts
- ✓ Sample distribution and records should be carefully completed, checked, forwarded and filed as appropriate.

i) Bunker measurement calculations

- ❖ Quantity of fuel received are checked both on own vessel and the barge. The own vessel quantity is mentioned on the BDN as ship's quantity while the barge's quantity as the barge figure. The two quantities shall be cross checked with each other. Huge differences may require detailed checks.

- ❖ Proper check shall be made on the soundings and ullages to be used for calculating the bunker quantity. Bunker oil temperature readings shall be noted. The temperature of the fuel oil is important as it affects the volume delivered. Ensure that the temperature of the fuel oil is taken both before and after the completion of bunkering operations as it affects the volume delivered. The tank calibration tables shall be crosschecked for original print and free of any alteration/ modification.

3) Checklists

Various checklists are provided in the shipboards SMS procedures which shall be followed. These include

- ➢ Prior to bunkering checklist
- ➢ Checklist for topping up procedure
- ➢ Post bunkering checklist
- ➢ Checklist to verify compliance of bunker delivery note to Annex VI
- ➢ Checklist to verify sample is in compliance with Annex VI
- ➢ Description of transfer system
- ➢ Prior bunkering checks

4) Malpractices related to bunker operations

Marine fuel oil may cost in a range of around $700 per tonne. In some parts of the world, the supplier may try to deliver lesser quantities or impure fuel for the personal profits. Here are some of the observations which shall be crosschecked carefully while receiving bunkers at notorious locations.

a) Fuel oil delivery: quantity

While measuring the fuel oil quantity on the bunker barge, the bunker supplier may try transferring the fuel oil from a tank to another during the time when the ullages are being taken. This could be by allowing the fuel to flow under gravity from a tank with higher liquid level to tank with lower liquid level. However, the ullages are so taken that first the ullage of tank with lower liquid level is recorded and while other tanks are being checked, the fuel from a tank with higher level is allowed to flow to another tank lowering fuel level in this tank; where ullage will be measured later. This will show as if more fuel as been delivered to the ship.

Counter measure – In case of huge differences, the tank ullages shall be crosschecked including the first tanks.

b) Ullage and soundings

The delivery barge may try to avoid checking of soundings/ ullages contending that seals on sounding and ullage pipes cannot be broken. The reasons being said such as customs seals cannot be broken or the sounding pipe is seized by sounding cock. Usually the only alternative to gauging the tanks is by measurement through a flow meter. Be wary of air being introduced through the meter to increase the measured delivery displayed. This is commonly called the 'cappuccino effect'.

Counter measures – Do not agree to meter only fuel oil deliveries. If customs seals are cited, issue a letter of protest, or comment on the bunker delivery receipt with counter-signature from barge master.

c) Flow meter re-circulation lines

Where flow meters are sued to measure the quantity delivered, sometimes bunker barge flow meters may be fitted with a small bleed-off line after the flow meter that returns the fuel being bunkered to the suction side of the barge bunker supply pump.

This results in fuel flowing through the flow meter twice. The by-pass recirculation line may a thin line but over the bunkering period it can have a big impact on the quantity of fuel bunkered.

Counter measures – Any suspicious lines after the barge's flow meter shall be checked. Use the ship's flow meter (if fitted) as a cross check may be used to crosscheck any major differences. Bunker barge's flow meter calibration certificate shall be requested and the flow meter seal shall be checked to be intact. Bunker barge cargo piping diagram shall also be checked for checking of any suspicious lines.

d) The cappuccino effect

Intentional introduction of air into the flowing oil will result in flow meter showing a greater volume of oil being supplied. However the actual fuel quantity delivered will be substantially less. This could be done through the air line connected to the bunker line for blowing through the bunker line.

Counter measures - The bunker barge tank soundings shall be cross checked along with the applicable trim/ list corrections. The suspicious connections to bunker line shall be checked. The procedure when and how the bunker barge plans to blow through the bunker line shall be discussed in advance. The sounding tape when sounding the fuel tanks both on the barge and during bunkering for any evidence of air bubbles in the fuel shall also be checked.

e) Water in fuel

ISO 8217:2010 standards state that the maximum allowable water content for all heavy fuel oils should be not greater than 0.5%. Excessive water in fuel oil causes the loss of specific energy in the fuel which will affect the fuel consumption. Also water will damage fuel injection equipment, cause corrosion and failure of exhaust valves and turbochargers. Furthermore water so separated is unlikely to pass through a 15 PPM oily water separator, so it has to be retained for disposal later, with a cost to the ship operator.

The water content is checked in the lab analysis of the fuel. However, a check is made while taking soundings using water finding paste on the sounding rod. It shall be noted that water-detecting paste can be used for distillate fuel deliveries but does not work with black residual fuels the colour change is not apparent in this case. Sometimes an incorrect alternative paste is used, like chrome cleaner, which looks and smells the same, but does not change colour on contact with water.

Counter-measures – Check using 'Water in Oil' test. Issue a letter of protest if the percentage of water content is more than stated on the bunker delivery receipt.

f) Others

There are other less sophisticated, underhand methods of reducing the real quantity of fuel oil delivered. These include 'unofficial' piping between the storage tanks and other un-nominated tanks, such as cofferdams or void spaces. At times bunker barges may not provide trim correction tables for the barge for calculating the corrected ullages and the fuel quantity.

Counter-measures – fundamentally, the care, diligence and training of the staff responsible for fuel oil deliveries. A note of protest shall be administered wherever deemed necessary.

5) Some reasons for oil spills during bunkering operations

- Failure to adhere to the stipulated maximum loading rate contained in the vessel's bunker plan
- Presence of air pockets (also called 'blurbs') collected in the top frames of the tank
- Excessive back pressure is not put on the hose or loading lines.
- Failure to close a valve to a tank completely which has finished loading its nominated quantity of fuel
- Failure to adhere to recognized procedures for topping off tanks
- Failure to monitor the progression of loading at adequate intervals resulting in overflow
- Constant monitoring of all the tanks by sounding or ullaging or both
- Failure to plug the scuppers properly, or in the worst scenario, scupper left unplugged (Remember this may happen even during rainfall, when one or few scuppers are opened to ensure the water accumulated on deck is allowed to drain)
- Failure to plug the drip tray and save-all coamings around oil tank air pipes or the plugs even though used are inefficient to hold, for e.g. wooden plugs used instead of threaded steel plugs
- Failure to tend to the vessel's mooring, which may exert excessive tension on the bunker hose, and may part/break the hose
- Mooring has to be monitored constantly of the vessel if receiving bunkering when berthed. Extra vigilance has to be carried out when vessels pass by especially at close range as own vessel or the bunker barge can surge suddenly and violently owing to this.
- Failure to respond to oil spill effectively

Apply Your Knowledge

1. Attend the pre- bunkering meeting and observe the salient points discussed.
2. Based on the last bunkering operation carried out on your ship, answer the following questions in bullet points:
    a) What quantity of HFO and MDO was bunkered?
    b) What specifications of the oil quality were mentioned in the suppliers Bunker Note?
    c) In which tanks was the oil taken? Write the quantity in the tank before bunkering and after bunkering.
    d) What preparations were made prior to bunkering?
    e) What precautions were taken during the bunkering operations?
3. Refer to the BDN of fuel oil received on board your vessel and note the difference in the two quantities mentioned as BDN quantity and ship's figure. Find out the maximum tolerable limits for the difference as might have been specified by the vessel operator.

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: C1.1.7

Topic: Bunkering procedures

Task Heading

- Under supervision, operate and test portable (Wilden) pump.

Objectives

- Understand the principle, operation and maintenance of Wilden pump

Index

1) Wilden pump
2) Working principle
3) Wilden pump - operation
4) Care and maintenance

Description

1) Wilden pump

Wilden pump is a pneumatically operated, double diaphragm, positive displacement pump, named after its inventor, Jim Wilden, who invented it in the year 1955.

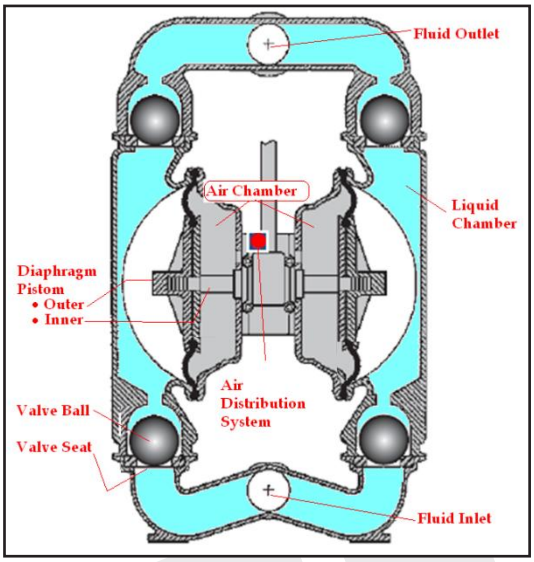
2) Working principle

- Wilden pump is a positive displacement pump that uses a combination of the reciprocating action of a rubber, thermoplastic or teflon diaphragm and suitable non-return check valves to pump a fluid. Sometimes this type of pump is also called a membrane pump. There are three main types of diaphragm pumps
- ❖ With this type, the diaphragm is sealed with one side in the fluid to be pumped, and the other in air or hydraulic fluid. The diaphragm is flexed, causing the volume of the pump chamber to increase and decrease. A pair of non-return check valves prevents reverse flow of the fluid.
- ❖ Second type employs volumetric positive displacement where the prime mover of the diaphragm is electro-mechanical, working through a crank or geared motor drive. This method flexes the diaphragm through simple mechanical action, and one side of the diaphragm is open to air.
- ❖ The third type employs one or more unsealed diaphragms with the fluid to be pumped on both sides. The diaphragms again are flexed, causing the volume to change.

- When the volume of a chamber of either type of pump is increased (the diaphragm moving up), the pressure decreases, and fluid is drawn into the chamber. When the chamber pressure later increases from decreased volume (the diaphragm moving down), the fluid previously drawn in is forced out. Finally, the diaphragm moving up once again draws fluid into the chamber, completing the cycle. This action is similar to that of the cylinder in an internal combustion engine. The flows rates depend on the effective working diameter of the diaphragm and its stroke length. These pumps can be used to handle sludge and slurries with a relatively high amount of grit and solid content.

- Diaphragm pumps

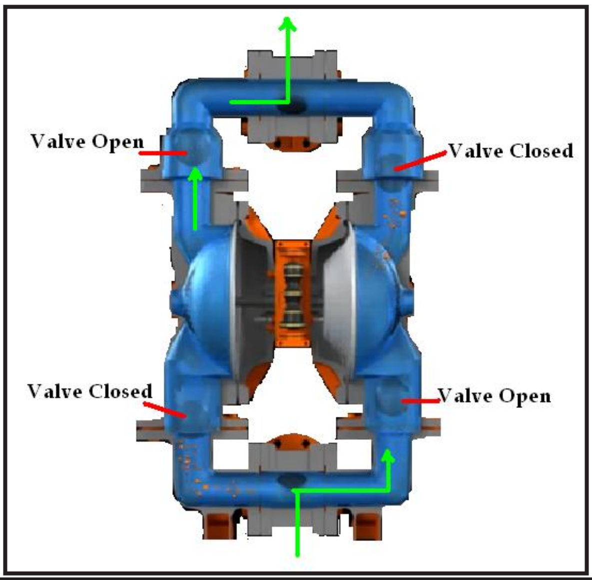
- have good suction lift characteristics
- are suitable for high discharge pressure
- have good dry running characteristics
- have good self priming capabilities
- can handle highly viscous liquids

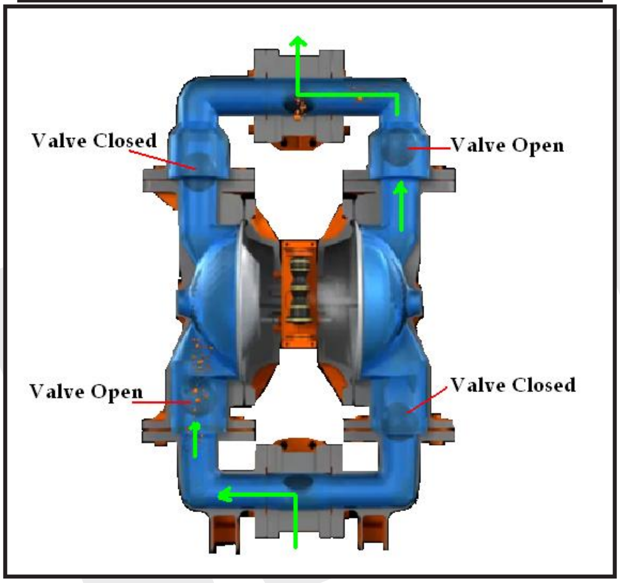


- Wilden pumps used for SOPEP purpose operate pneumatically. During bunkering operation, when using the wilden pump, the following must always be kept in mind.
- Pump must be kept ready with suction pipe near last scupper or area where spillage could occur.
- Discharge hose length should be long enough and all involved should know into which tank the discharge is to be made in case of a spillage.
- Pump must be mounted or secured in place
- Pump body must be earthed, as the use can also create a risk of build up of static electricity.

3) Wilden pump - operation

- The pump displaces fluid from one of its two liquid chambers upon each stroke completion. The two diaphragms are connected by a common shaft, the two inlet valve balls and the two discharge valve balls. The diaphragms act as a separation membrane between the compressed air supply and the liquid. The valve balls open and close on the valve seats to direct liquid flow. The diaphragms operate in such a way that, the movement of diaphragms opens one chamber and seals the other. Simultaneously fluid is sucked into one chamber and is pumped out from the other. The valves are operated using ball valves and the seat. Driving the diaphragms with compressed air balances the load on the diaphragm which removes mechanical stress and therefore extends diaphragm life.





4) Care and maintenance

- The maximum air supply pressure and the maximum fluid housing pressure shall not be exceeded. Reference shall be made to operation and maintenance manual. Maintenance instructions in the Operation and Maintenance manual shall be followed.
- Hand and eye protection gear shall be used to prevent injury during installation and maintenance. Before any maintenance or repair is attempted, the compressed air line to the product should be disconnected and all air pressure allowed to escape. Close system valves to isolate intake and discharge. Carefully drain pressure from intake and discharge piping prior to disconnection. Drain pumps by turning upside down and allowing any fluid to flow into a suitable container. Flush thoroughly prior to performing maintenance.

Apply Your Knowledge

1. With reference to the operations and maintenance manual, check operation of wilden pump provided on board your vessel and discuss the safety checks prior use.

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: C1.2.5

Topic: Pollution prevention regulations

Task Heading

- Demonstrate understanding of the entries made in the oil record book.

Objectives

- Understand the entries required to be made in the oil record book.

Index

- Oil record book
- Entries to be made in ORB part I
- Entries to be made in ORB part II
- General guidance regarding making entries in oil record book

Description

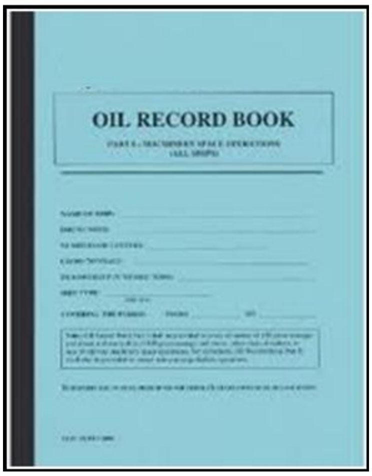
1) Oil record book

Oil record book (ORB) is an important logbook maintained on board a vessel to keep a record of disposal of all oily waste and residues from the vessel. Every officer and engineer should be well familiar with it. MARPOL Annex I - regulation 17 requires the vessel to carry and maintain an oil record book on board.

Oil record book has two parts
- Part I – Machinery space operations (All ships)
- Part II – Cargo and ballast operations (Tankers)

Oil record book Part I, is required to be carried on board every oil tanker of 150 gross tonnage and above, and every ship of 400 gross tonnage and above, to keep a record of relevant machinery space operations.

Oil Record Book- Part I Machinery Space Operations (All Ships)



Oil record book Part II is required to be maintained on board oil tankers to keep a record of relevant cargo/ballast operations. Hence a tanker must maintain two separate oil record books
- Part I - Machinery space operations, which will most likely be kept by the chief engineer; and
- Part II - Cargo and ballast operations, which will most likely be kept by the cargo officer

ORB is often inspected by the port state control officers to check vessel's compliance with MARPOL Annex I regulations. The information provided in it shall be accurate. Any discrepancies may trigger a detailed investigation. In the event of serious ORB discrepancies being found, the vessel may be detained for non-compliance with oil pollution regulations and, in certain jurisdictions, crewmembers and managers/owners may be exposed to civil and/or criminal penalties. It is thus very important that every ship should routinely verify that the oil record book entries are completed as due.

2) Entries to be made in ORB part I

Mentioned below is a list of items of machinery space operations, which shall be recorded in the oil record book Part I. The items have been grouped into operational section, each of which is denoted by a code letter.

(A) Ballasting or cleaning of oil fuel tanks
(B) Discharge of dirty ballast or cleaning water from oil fuel tanks referred to under section (A)
(C) Collection, transfer and disposal of oil residues (sludge)
(D) Non-automatic starting of discharge overboard, transfer or disposal otherwise of bilge water which has accumulated in machinery spaces
(E) Automatic starting of discharge overboard, transfer or disposal otherwise of bilge water which has accumulated in machinery spaces
(F) Condition of the oil filtering equipment
(G) Accidental or other exceptional discharges of oil
(H) Bunkering of fuel or bulk lubricating oil
(I) Additional operational procedures and general remarks

Ship's masters should obtain from the operator of the reception facilities, which includes barges and tank trucks, a receipt or certificate detailing the quantity of tank washings, dirty ballast, residues or oily mixtures transferred, together with the time and date of the transfer. The receipt or certificate should be kept

3) Entries to be made in ORB Part II - Cargo/ballast operations (Oil Tankers)

(A) Loading of oil cargo
(B) Internal transfer of oil cargo during voyage
(C) Unloading of oil cargo
(D) Crude oil washing (COW tankers only)
(E) Ballasting of cargo tanks
(F) Ballasting of dedicated clean ballast tanks (CBT tankers only)
(G) Cleaning of cargo tanks
(H) Discharge of dirty ballast
(I) Discharge of water from slop tanks into the sea
(J) Collection, transfer and disposal of residues and oily mixtures not otherwise dealt with
(K) Discharge of clean ballast contained in cargo tanks
(L) Discharge of ballast from dedicated clean ballast tanks (CBT tankers only)
(M) Condition of oil discharge monitoring and control system
(N) Accidental or other exceptional discharges of oil
(O) Additional operational procedures and general remarks

Tankers Engaged In Specific Trades

(P) Loading of ballast water
(Q) Re-allocation ballast water within the ship
(R) Ballast water discharge to reception facility

4) General guidance regarding making entries in oil record book

The oil record book Part I shall be completed on each occasion, on a tank-to-tank basis if appropriate, whenever any of the following machinery space operations takes place in the ship

- ❖ Ballasting or cleaning of oil fuel tanks
- ❖ Discharge of dirty ballast or cleaning water from oil fuel tanks
- ❖ Collection and disposal of oil residue (sludge)
- ❖ Discharge overboard or disposal otherwise of bilge water which has accumulated in machinery spaces
- ❖ Bunkering of fuel or bulk lubricating oil

Additionally, a statement shall be made in the oil record book Part I in the event of accidental or other exceptional discharge of oil along with the circumstances of, and the reasons for, the discharge. Any failure or malfunctioning of the oil filtering equipment shall also be recorded in the oil record book Part I.

Each operation mentioned above shall be recorded fully without delay so that all entries in the book appropriate to that operation are completed in time.

Each completed operation shall be signed by the officer or officers in charge of the operations concerned and each completed page shall be signed by the master of ship.

The entries in the oil record book Part I, for ships holding an “International Oil Pollution Prevention Certificate” are required to be made in English, French or Spanish. Where entries in an official national language of the State whose flag the ship is entitled to fly are also used, entry in this language is considered to prevail in case of a dispute or discrepancy.

The oil record book Part I is required to be preserved for atleast three years after the last entry has been made. It shall be kept in such a place as to be readily available for inspection at all reasonable times.

The port state control officials may inspect the oil record book Part I on board any ship while the ship is in its port or offshore terminals and may make a copy of any entry in that book and may require the master of the ship to certify that the copy is a true copy of such entry. Such copies are admissible in any judicial proceedings as evidence of the facts stated in the entry.

When making entries in the oil record book Part I, the operational letter code and item number shall be inserted in the appropriate columns along with the date and the required particulars shall be recorded chronologically in the blank spaces. Reference shall be made to the ORB for correct operational letter code and item number.

Tank nomenclature used to identify tanks should be recorded as per the format noted within the International Oil Pollution Prevention Certificate (IOPPC).

If a wrong entry has been recorded in the oil record book (ORB), it should immediately be struck through with a single line in such a way that the wrong entry is still legible. The wrong entry should be signed and dated, with the new corrected entry following.

Recording of quantities retained in bilge water holding tanks and recording of general maintenance of items pertaining to the OWS are voluntary and may not be recorded in the ORB.

Sample entry made in ORB

<table>
<tr><td colspan="4">Disposal of oil residue (sludge) via shore connection</td></tr>
<tr><td>dd-MONTH-yyyy</td><td>C</td><td>12.1</td><td>xx m^3 sludge from [Name of sec 3.1 Tank & Designation],
xx m^3 retained,</td></tr>
<tr><td></td><td></td><td></td><td>to “identify or name of sludge receiver, i.e. barge, tank truck or shore facility” during port stay (Name of Port)</td></tr>
<tr><td></td><td></td><td></td><td>signed: (Officer-in-charge, Name & Rank) dd-MONTH-yyyy</td></tr>
</table>

Apply Your Knowledge

1. Check the blank copies of ORB available on board your vessel and discuss the procedures and format of entries to be made in the book.

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: C1.2.6, C1.2.7

Topic: Pollution prevention regulations

Task Heading

- Identify the special areas under MARPOL Annex I and Annex V.
- Read and discuss the criteria for disposal of batteries, tube lights, and expired medicines with STO.

Objectives

- Identify the special areas under MARPOL Annex I and Annex V
- Understand the criteria for disposal of batteries, tube lights, and expired medicines

Index

1) MARPOL - Special areas
2) MARPOL Annex I – Special areas
3) MARPOL Annex V – Special areas
4) Criteria for disposal of batteries, tube lights, and expired medicines
   a) Disposal of batteries
   b) Electrical components and fluorescent and incandescent bulbs
   c) Medical wastes

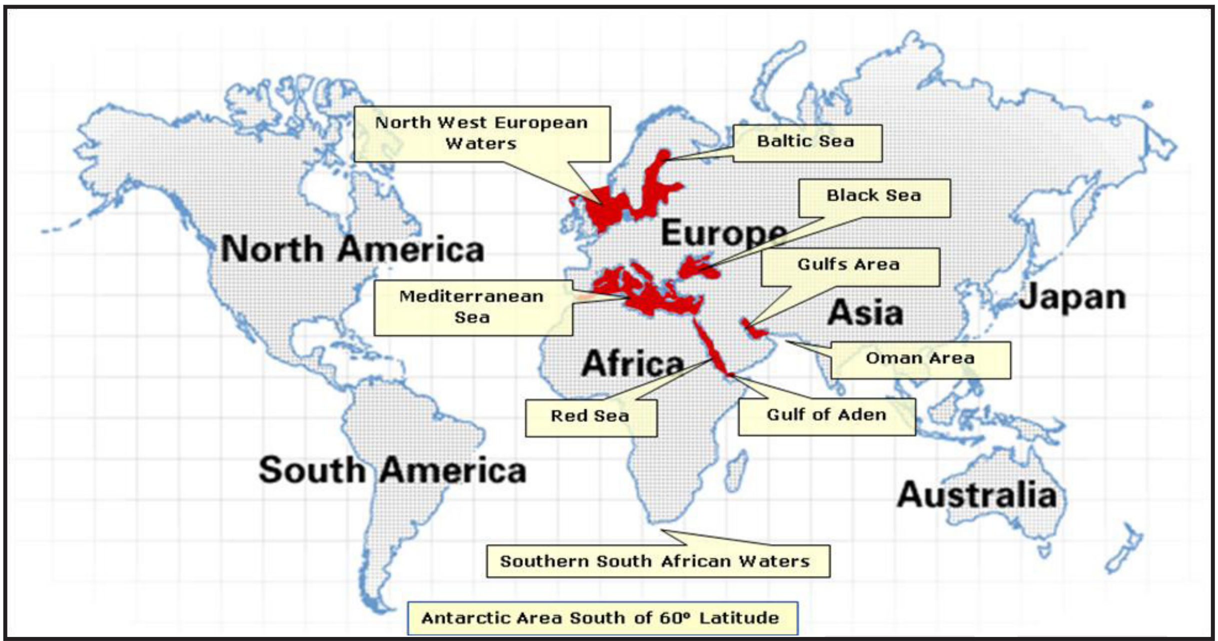
Description

1) MARPOL - Special areas

The MARPOL convention defines certain sea areas as "special areas" in which, for technical reasons relating to their oceanographical and ecological condition and to their sea traffic, the adoption of special mandatory methods for the prevention of sea pollution is required. The intention is to provide a higher level of protection from pollution to these sea areas. These are designated by IMO's Marine Environment Protection Committee (MEPC) by amendments to the relevant MARPOL annexes in consultation with local governments.

2) MARPOL Annex I – Regulations for the prevention of pollution by oil – Special areas

The regulations for preventing pollution by oil from ships are contained in Annex I of the International Convention for the Prevention of Pollution from Ships (MARPOL).
Special areas under MARPOL Annex I are as follows:



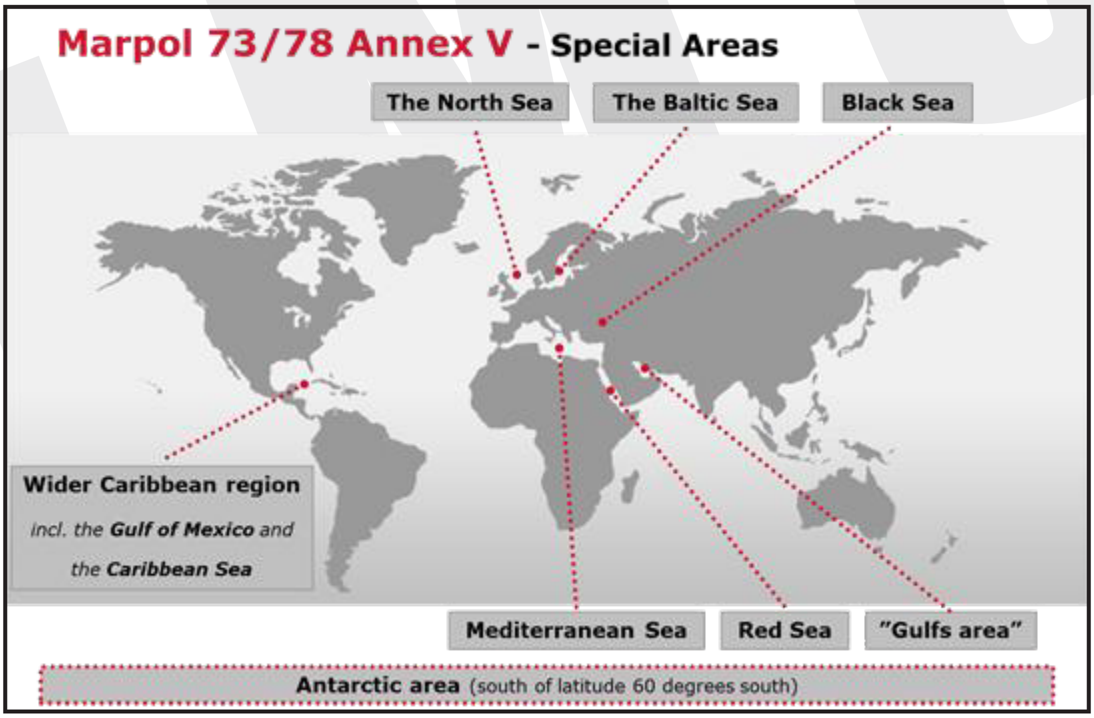
Special Areas	Amendments adopted to the MARPOL Annex	Entry into force of the amendments	More stringent measures in effect from
MARPOL Annex I: Oil			
Mediterranean Sea	2 Nov 1973	2 Oct 1983	2 Oct 1983
Baltic Sea	2 Nov 1973	2 Oct 1983	2 Oct 1983
Black Sea	2 Nov 1973	2 Oct 1983	2 Oct 1983
Red Sea	2 Nov 1973	2 Oct 1983	*
"Gulfs" area	2 Nov 1973	2 Oct 1983	1 Aug 2008 (Resolution MEPC.168(56))
Gulf of Aden	1 Dec 1987 (Resolution MEPC.29(25))	1 Apr 1989	*
Antarctic area	16 Nov 1990 (Resolution MEPC.42(30))	17 Mar 1992	17 Mar 1992
North West European waters	25 Sept 1997 (Resolution MEPC.75(40))	1 Feb 1999	1 Aug 1999 (Resolution MEPC.77(41))
Oman area of the Arabian Sea	15 Oct 2004 (Resolution MEPC.117(52))	1 Jan 2007	*
Southern South African waters	13 Oct 2006 (Resolution MEPC.154(55))	1 Mar 2008	1 Aug 2008 (Resolution MEPC.167(56))

3) MARPOL Annex V – Regulations for the prevention of pollution by garbage from ships – Special areas

Regulations for the prevention of pollution by garbage from ships are contained in Annex V of MARPOL. Under Annex V of the Convention, garbage includes all kinds of food, domestic and operational waste, excluding fresh fish, generated during the normal operation of the vessel and liable to be disposed of continuously or periodically. The special areas under this annex are as follows:

Special Areas	Amendments adopted to the MARPOL Annex	Entry into force of the amendments	More stringent measures in effect from
MARPOL Annex V: Garbage			
Mediterranean Sea	2 Nov 1973	31 Dec 1988	1 May 2009 (Resolution MEPC.172(57))
Baltic Sea	2 Nov 1973	31 Dec 1988	1 Oct 1989 (Resolution MEPC.31(26))
Black Sea	2 Nov 1973	31 Dec 1988	*
Red Sea	2 Nov 1973	31 Dec 1988	*
"Gulfs" area	2 Nov 1973	31 Dec 1988	1 Aug 2008 (Resolution MEPC.168(56))
North Sea	17 Oct 1989 (Resolution MEPC.36(28))	18 Feb 1991	18 Feb 1991 (Resolution MEPC.37(28))
Antarctic area (south of latitude 60 degrees south)	16 Nov 1990 (Resolution MEPC.42(30))	17 Mar 1992	17 Mar 1992
Wider Caribbean region including the Gulf of Mexico and the Caribbean Sea	4 July 1991 (Resolution MEPC.48(31))	4 Apr 1993	1 May 2011 (Resolution MEPC.191(60))

* The special area requirements for these areas have not taken effect because of lack of notifications from MARPOL parties whose coastlines border the relevant special areas on the existence of adequate reception facilities.



4) Criteria for disposal of batteries, tube lights, and expired medicines

Every company has an environmental management system, which details the policy of disposing the above items in detail, in compliance with the requirements of the MARPOL convention. Reference shall be made to the garbage management plan provided with the shipboard safety management system on board.

a) Disposal of batteries


Batteries may cause harm to personnel because of chemicals contained within. The same are likely to explode when incinerated. Hence used batteries should only be disposed off to an individual / body who are authorized by the port state to accept lead acid batteries for disposal. Used dry cells must be landed ashore for disposal.

b) Electrical components and fluorescent and incandescent bulbs


These need to be handled carefully to avoid any personal harm, and should be collected and landed ashore. Fluorescent and incandescent bulbs should be landed ashore in intact condition as far as practicable.

c) Medical wastes

At all times comply with the ship specific "Garbage Management Plan". Expired medicines should be accumulated to a substantial quantity (e.g. a box full) and then landed ashore for disposal.

Receipts must be obtained and retained for all waste items landed ashore. The total quantity of garbage given for disposal should always be given in cubic meters (m^3). Sample format of a landing receipt for expired medicines is provided below for reference.

IMU

Vessel Name :
Port :
Date and Time :

Disposal of expired medicines to shore reception facility.

One box containing expired medicines as listed below handed over to agents for further disposal with concerned authorities on **Date......** at **Port.............**

Sr.No	Name of medicine	Quantity
01		
02		
03		
04		
05		

Total Quantity of Garbage to be landed – m³

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Agent Master

Apply Your Knowledge

1. What garbage is burnt in the incinerator?
2. How is the ash generated in the incinerator disposed?
3. How will you dispose of: (please mention method used for disposal and where it can be disposed)

Oily rags	
Empty paint drums	
Thermocole packing material	
Condemned mooring ropes	
Coal cargo residues	
Coke cans	
Batteries	
Tube lights	
Expired medicines	
Wooden pallets	

Function: Controlling the operation of the ship and care for persons on board

Competence: Ensure compliance with pollution prevention requirements

Task number: C1.3

Sub task Reference number: C1.3.2, C1.3.3, C1.3.4

Topic: Bilge and ballast operations

Task Heading

- Set lines for ballasting and deballasting operations.
- Assist in pumping out chain locker and forward stores.
- Set lines for pumping out the bilges.

Objectives

- Understand the importance of tracing and setting the lines for ballasting and deballasting operations
- Understand the arrangements for pumping out the forward spaces.
- Understand the procedure for pumping out chain locker and forward stores.

Index

1. Ballast & bilge piping system
2. Pumping out chain locker and forward stores

Description

1) Ballast & bilge piping system

- Majority of the problems onboard ship arise because of unfamiliarity with valves/pipelines. Seeing numerous lines and valves onboard, the marking of each and every line/ valve with the identity name is a must. If various piping line systems are known, the probability or errors in operations is greatly reduced. Further, one can carry out the operation in an effective manner and be confident on trouble-shooting should a problem arise.

- Ballast piping system serves the ballasting/ deballasting of tanks whereas the bilge piping system provides to pump out bilges.

- The pumping plan shows the layout of the ship’s bilge, ballast and bunker pumping arrangements and of the air and sounding pipes for the bilge, ballast and bunker tanks. Marked on the ship’s profile in the bilge & ballast piping system or the pumping plan are the positions of all the suctions in the double bottom, topside (if separate) and peak tanks and in the hold bilges, and the pipelines connecting them with the pumps in the engine room.

- Each ballast tank is connected to the engine room by a ballast pipeline running from tank to engine room, through which the ballast water passes as the tank is filled or emptied. Each tank may have its own separate line, or the tanks may be connected to separate common lines on port and starboard side each. These lines may run through the tanks or through duct keel.

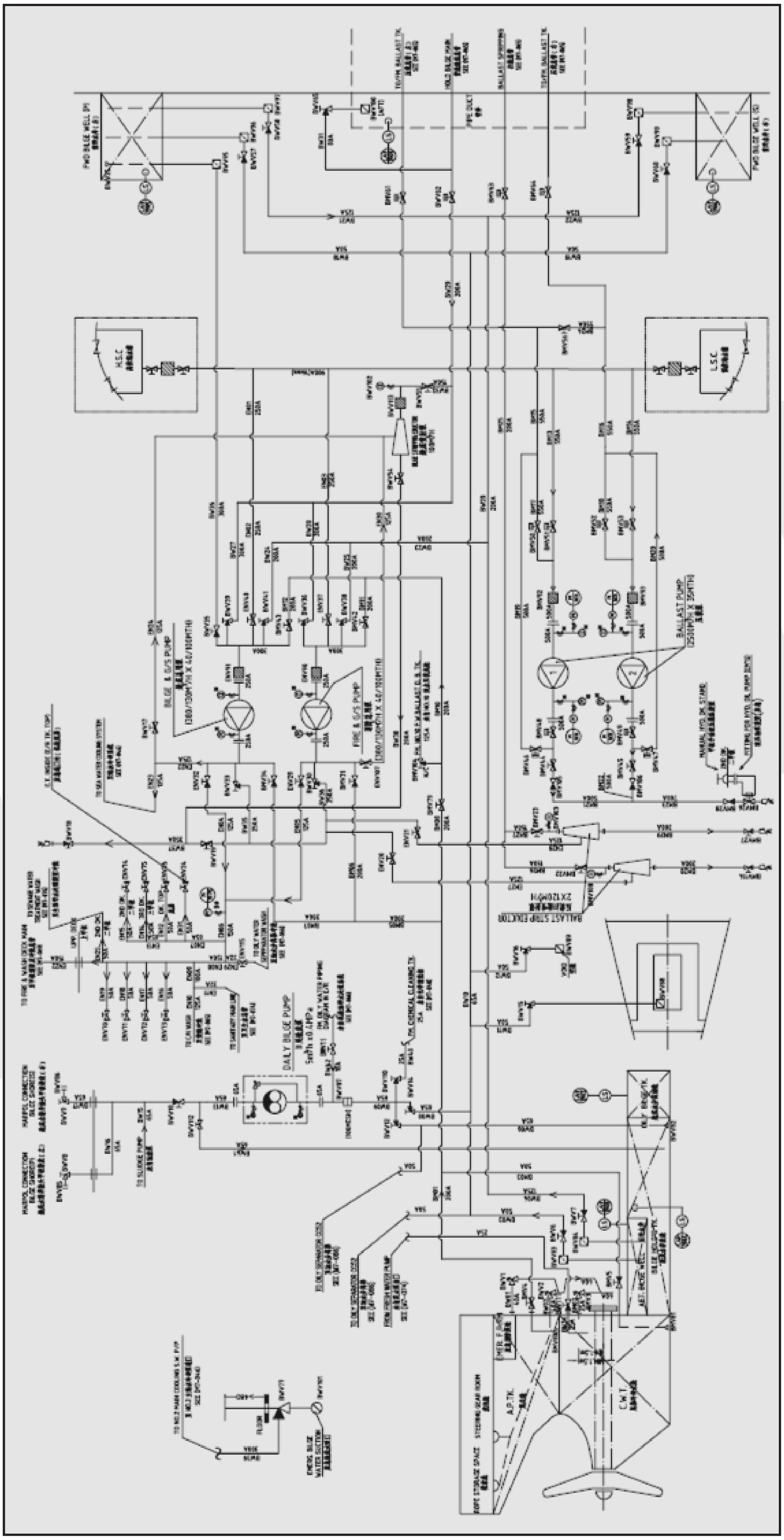
- In the ballast tank the line ends in a ‘bell mouth’, which terminates in the lowest part of the tank few centimeters above the tank base. In the engine room the line is connected to a sea inlet by a choice of pipeline systems served by one or two ballast pumps, and a general service pump, so that the most suitable pumping option can be selected. The valve opening to sea from where the sea water suction is taken is called the “sea chest valve”. The line allowing the discharge of water ballast overboard is called the overboard discharge valve. The line is also connected to an educator or stripping pump for the final stripping of the tank.

- The bilge lines start from the suction in the hold bilge well followed by a non return valve. The line then leads to the engine room where a valve is provided. Various bilge lines are connected to the pump or eductor system to pump out the bilges.
- The ballast controls are centralized in a single position with duplicate controls locally. The ships which have hydraulic remote control system for bilge & ballast valves have remote [programmable logic controller (PLC)] control panel mostly situated either in the ship's office or dedicated ballast control room. Such controls include remote switches for the valves in the ballast system and for the ballast pumps, along with gauges or indicators to show the contents of each tank.

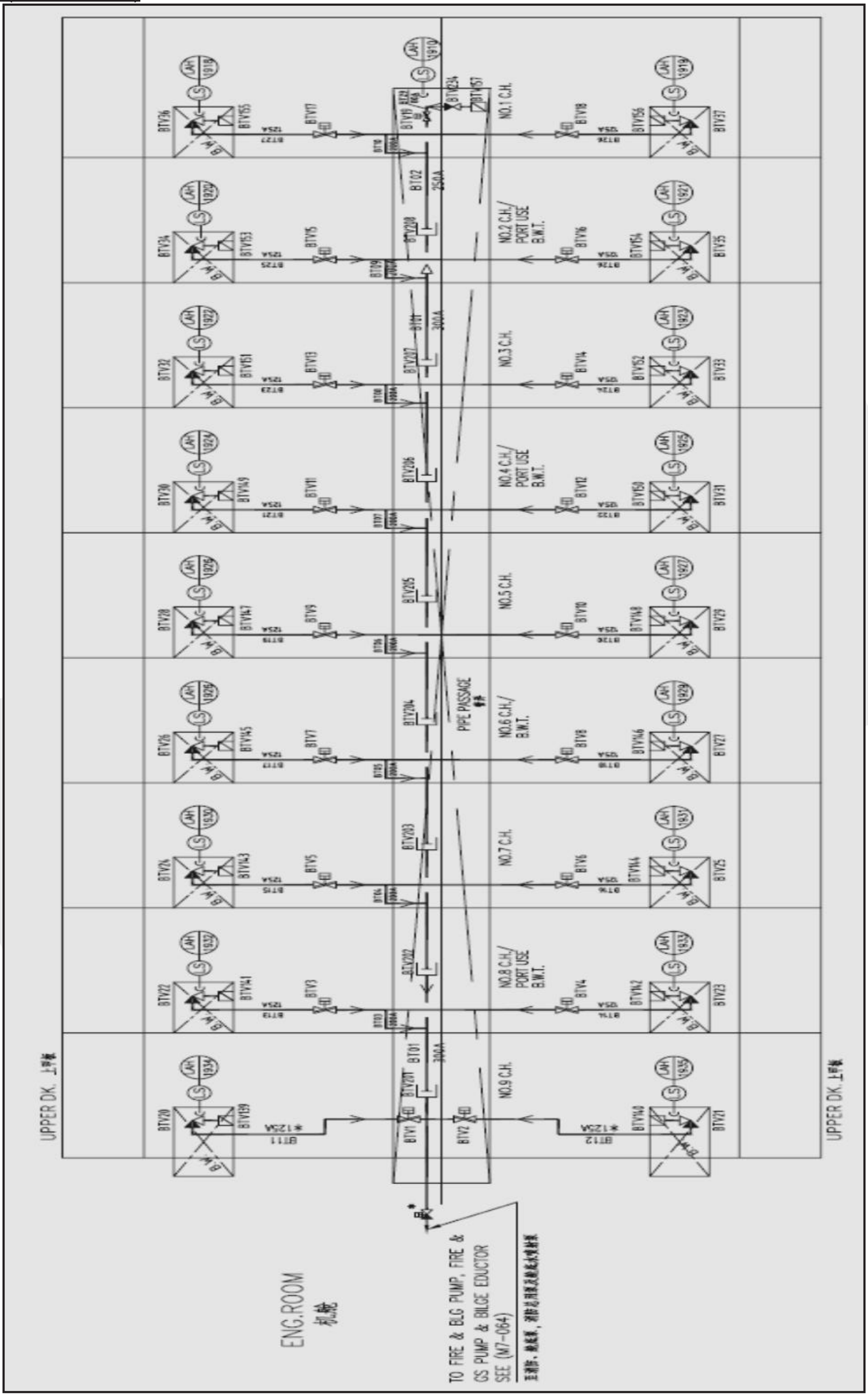
- The working pressure for the hydraulic system should be noted prior planning the operation and monitored during the operation. As a contingency in cases where there is a breakdown or trouble with the hydraulic unit, a separate portable hand pump is always provided on board the ship.
- The valves in the PLC control panel are operated by solenoid hydrolock, situated in the valve cabinet which activates the actuator by hydraulic unit to open or close the remote controlled valve.
- The valves are numbered in the control panel, and usually to avoid any confusion, there is mostly a distinct difference in name of the valves operating the cargo hold bilges and valves operating the ballast tanks.

- **Sample Plans**

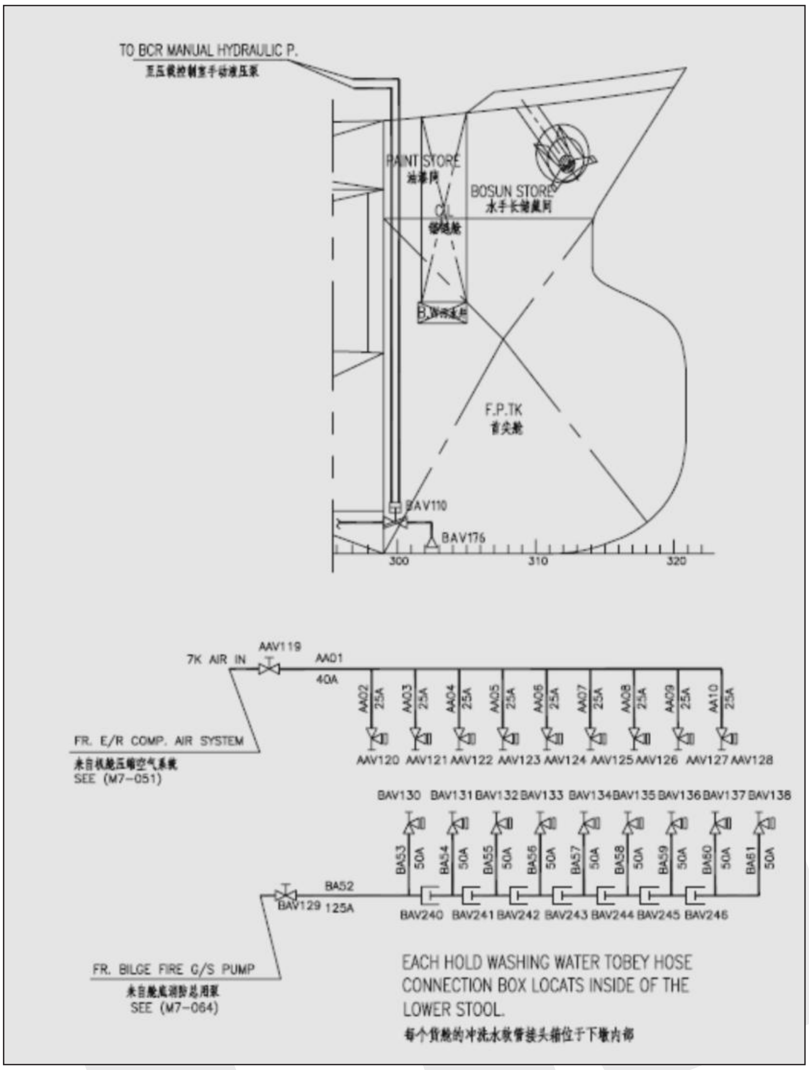
Plan view of location and arrangements of valves in Bilge and Ballast system in Engine room

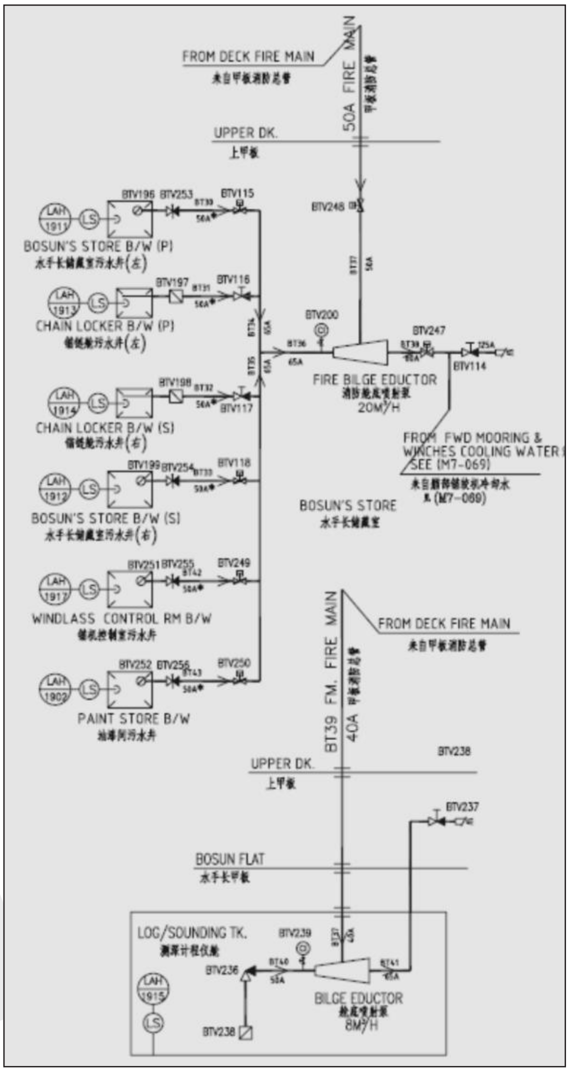


Plan view of location and arrangements of valves in Cargo hold Bilge system outside Engine room (Bulk Carrier)



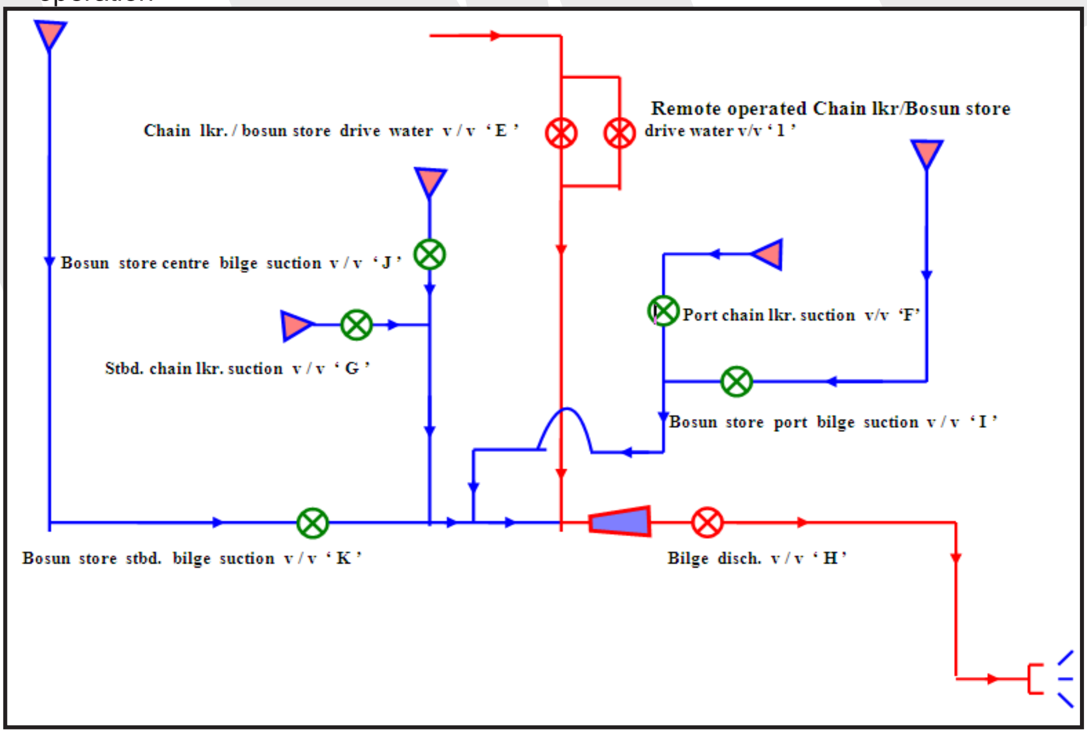
Section view of location and arrangements of valves in fore peak tank including dewatering system for Forward spaces





2) Pumping out chain locker and forward stores

- The chain locker and forward stores are provided with separate pumping out arrangements independent of the bilge & ballast system. The need to monitor any increase of water level in these spaces is extremely vital.
- According to SOLAS chapter XII reg. 13.1 & IACS UI SC 179 all bulk carrier vessels are required to have the "dewatering control system of forward spaces".
- 'Dewatering' means to provide draining and/or pumping facilities to pump out water from spaces which are located forward of foremost cargo hold in case of detection of water inflow into corresponding spaces.
- Each compartment forward of collision bulkhead like chain locker, forward store (bosun store), bow thruster room etc. is equipped with a drainage facility. Spaces are connected to an eductor for drainage usually run by ship's fire line.
- For dewatering of forward tanks the ballast water system is used. The valve specified under SOLAS regulation II-1/12.5.1 has to be equipped with a remote operated actuation. It can be controlled and supervised from mimic panel. The valve has to be open before start of tank dewatering. The actual valve position (open/close) is indicated on mimic panel.
- The forward spaces on bulk carriers and other ships have a water ingress alarm system installed. When water is present in bosun store or forepeak tank or any forward space, the alarm of the water ingress alarm system gets activated. After the activation of the water ingress alarm system, by using the control panel on the bridge, ship's crew can activate the actuators and pump out the water in the bosun store or forepeak tank or any forward space.
- Sample procedure of chain locker and forward stores (bosun store) pumping out operation



- The drive water valves for educting of the chain lockers and bosun store are located in the bosun store, the drive water line being supplied from the fire line. The eductor and discharge valve is located near port chain locker in bosun store.

- The valves are marked as below :
- ✓ Chain locker / bosun store drive water valve ----'E'
- ✓ Port chain locker bilge suction valve ---- 'F'
- ✓ Stbd chain locker bilge suction valve ---- 'G'
- ✓ Bosun store , port bilge suction valve ---- 'I'
- ✓ Bosun store , centre bilge suction valve ---- 'J'
- ✓ Bosun store, stbd bilge suction valve ---- 'K'
- ✓ Bilge discharge valve ---- 'H'
- ✓ Remote operated chain locker / bosun store drive water valve ----'1'

- **The procedure for remote eduction of the bosun store is as follows:-**

i. Ensure following valves are kept open at all times -
   - Bosun store, port bilge suction valve ---- 'I'
   - Bosun store, stbd bilge suction valve ---- 'K'
   - Bilge discharge valve ---- 'H'

ii. Remotely open Valve '1' from operating panel located in ship's office (C/L bulkhead).

iii. After ensuring fire line deck isolation (in fire station) valve is open start the fire pump.

iv. When high level bilge alarm is deactivated, shut valve '1' from operating panel in ship's office & stop the fire pump.

- The procedure for local eduction of these compartments is as follows:-

i. After ensuring fire line deck isolation (in fire station) valve is open start the fire pump

ii. Open the drive water valve 'E'

iii. Open/close the bilge suction valve 'F / G / I / J / K' as appropriate

iv. On completion of eduction, stop the fire pump & shut bilge suction valve 'J' & drive water valve 'E'.

v. Ensure following valves are kept open at all times -
   - Bosun store, port bilge suction valve ---- 'I'
   - Bosun store, stbd bilge suction valve ---- 'K'
   - Bilge discharge valve ---- 'H'

Apply Your Knowledge

1. Refer to the bilge and ballast system piping diagram of your vessel, check the locations where non-return valves are fitted in the system.
2. Discuss the pumping out system for forepeak store and chain locker on your vessel.

Function: Controlling the operation of the ship and care for persons on board

Competence: Maintain seaworthiness of the ship

Task number: C2.1

Sub task Reference number: C2.1.1

Topic: Ship stability (including understanding of the fundamentals of watertight integrity)

Task Heading

- Refer to the stability booklet and determine which tanks cause relatively more free surface effect if kept slack.

Objectives

- Understand the concept of free surface effect/ free surface correction/ free surface moments.
- Understand the procedure of obtaining the information of free surface moments from the stability booklet and applying it to find the value of virtual loss of GM

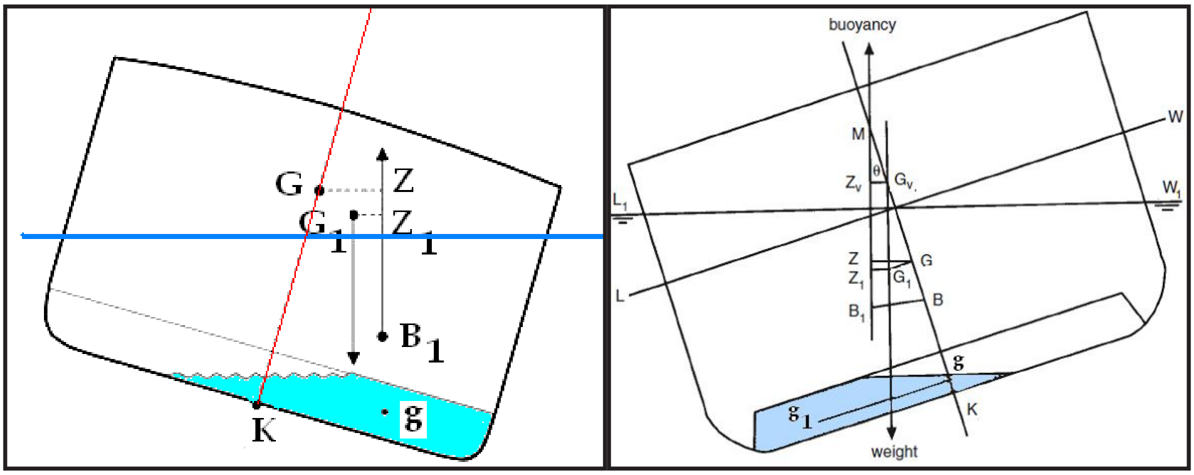
Index

1. Free surface effect
2. Free surface correction calculation

Description

1) Free surface effect

- When a tank is completely filled with a liquid, the liquid cannot move within the tank when the ship heels. For this reason, as far as stability is concerned, the liquid may be considered as a static weight having its centre of gravity at the centre of gravity of the liquid within the tank.
- If a ship's tank is partially filled and the ship heels, the mass of liquid in the tank moves uncontrollably. As the liquid moves across, the centre of gravity of the liquid mass shifts from side to side and vertically. The effect of the inertia of the moving liquid causes a virtual change in the position of G. This change in the height of G of the liquid mass can have a radical effect on the ship's KG, resulting in a virtual loss of transverse metacentric height (GM_T). Any loss in GM is a loss in stability. For a tank which is full, the free surface effect does not appear because of absence of any free movement of water within the tank. The virtual loss in GM is called "Free Surface Effect".
- The free surface effect depends upon the moment of inertia of the tank about the centerline. In case of GM_T, the moment of inertia in consideration is about the fore and aft centerline of the tank.



2) Free surface correction calculation

$$\textbf{Free Surface Correction (FSC)} = i.\ d_i / V.\ d_o$$

i = Moment of Inertia of the slack tank surface about C/L
d_i = Density of liquid inside tank
V = Underwater volume of ship
D_o = Density of water in which ship is floating

The formula can also be written as

$$\textbf{FSC} = (i.\ d_i / W) \text{ metres}$$

W = Displacement of the ship
Also, (i. d_i) is known as Free Surface Moment (FSM)

For cuboid shape tanks, I about the fore and aft CL

$$= LB^3/12$$

Solid GM = KM – KG
Fluid GM = Solid GM – FSC

- Ship's stability particulars provide the FSM of individual tanks for liquids relative density 1.000. For calculating the FSM caused by each partly filled tank, the tabulated value shall be multiplied by the RD of the liquid contained within. The total FSM of all slack tanks is then added to calculate the total FSM for the vessel. The total FSM is then divided by the displacement of the vessel, to get the free surface correction to be applied to obtain the fluid GM of the vessel,

CAPACITIES, CENTRES OF GRAVITY AND FREE-SURFACE MOMENTS OF OIL AND WATER TANKS

1. CARGO TANKS

COMPARTMENT	LOCATION (Frame Numbers)	CAPACITIES			CENTRES OF GRAVITY (Metres)		FREE SURFACE MOMENT
		100% FULL	98% FULL				
		CUBIC METRES	CUBIC METRES	TONNES AT S.G. 1.0	VERT A.B. 98%	LONG FROM A.P.	AT S.G. 1.0 (Tonnes Metres)
	TOTAL						

2. OIL FUEL TANKS

COMPARTMENT	LOCATION (Frame Numbers)	CAPACITIES			CENTRES OF GRAVITY (Metres)		FREE SURFACE MOMENT
		100% FULL	98% FULL				
		CUBIC METRES	CUBIC METRES	TONNES AT S.G. 1.0	VERT A.B. 98%	LONG FROM A.P.	AT S.G. 1.0 (Tonnes Metres)
	TOTAL						

- Throughout any voyage the variation of stability due to consuming and transferring fuel oil, fresh water etc, and by adding of water ballast for trim or to suit weather conditions, is always to be borne in mind to ensure adequate stability.

Apply Your Knowledge

Check the stability manual on board your vessel and locate the three tanks with highest FSM.

Function: Controlling the operation of the ship and care for persons on board

Competence: Maintain seaworthiness of the ship

Task number: C2.3

Sub task Reference number: C2.3.4

Topic: Securing for sea

Task Heading

- Assist in checking of deck cargo lashings prior to departure

Objectives

- Understand the importance of lashing for deck cargo

Please read this task in conjunction with other tasks under header B1.4

Index

1) Lashing and securing of deck cargo

Description

1) **Lashing and securing of deck cargo**

- Deck cargoes refer to items and commodities carried on the weather-deck and/or hatch covers of a ship and thereon exposed to sun, wind, rain, snow, ice and sea, so that the packaging must be fully resistant to, or the commodities themselves not be denatured by such exposure. Even in RO-RO vessels, many areas above the actual 'hold' space can reasonably be considered as 'on deck' even though not fully exposed to the onslaught of wind and sea. The combined effects of wind, sea and swell can be disastrous. Deck cargoes, because of their very location and the means of securing, are subjected to velocity and acceleration stresses greater than cargo stowed below decks. Additionally the wind forces exert pressures on the exposed surface, depending upon the area exposed. The lashings counter these forces as well.
- A ship sailing in sea has six degrees of motion: surge, sway, heave, roll, pitch and yaw. Out of the six types of motion, three are rotational and three are linear. Roll, pitch and yaw are the three rotational motions and sway, surge and heave are the three linear movements. The ship itself bends and twists as waves pass. Hatch covers move relative to the hatch openings and deck cargo move as clearance in the lashing equipments are taken up. It is the lashing system alone that resists these movements and attempts to keep the deck cargo on board.
- The cargo on deck shall be stowed well and the cargo should be prevented from moving and gaining enough momentum to part lashings and damage the ship structure. Solid stow as required under deck, may not be feasible with all deck cargo. Exceptions are containers and timber deck cargoes. Other individual cargoes are stowed as single unit and are stowed accordingly.
- Cargo on deck and under deck shall be well secured before the vessel proceeds out to sea.
- All cargoes, other than solid and liquid bulk cargoes, shall be loaded, stowed and secured throughout the voyage in accordance with the cargo securing manual approved by the administration. In ships with RO-RO cargo spaces, as defined in regulation II-

2/3.14, all securing of such cargoes, in accordance with the cargo securing manual (CSM), shall be completed before the ship leaves berth.

- Ships' officers shall be well conversant with the CSS Code and the cargo securing manual regulations, to understand their applications for the vessel in which they are serving, and to be capable of deploying correctly the hardware which goes with it. The CSM and its associated hardware are subject to port state control inspection.
- While the deck cargoes are stowed and secured as discussed under tasks of header B4.1, the points applying in particular to deck cargoes is checking, inspection and tightening of lashings during voyage. Lashing gear and the lashing fittings on deck shall be of sound construction maintained in a good condition. Hatch covers shall be securely battened down before any cargo is loaded on hatch covers.
- During the voyage the cargo lashing shall be checked regularly and tightened as required, as these are likely to set loose due to motions in a seaway. However, this shall be done only when safe to do so. In rough weather, personnel shall not be sent to check lashing or near areas where cargoes are stowed. It is prudent to check and tighten the lashings on a regular basis and cross checking prior experiencing rough weather.
- Any personnel involved in such operations shall follow the safe procedures as listed in the shipboard SMS.
- The cradles used for cargoes on deck shall be shored suitably using dunnage to prevent any sliding. Same shall be checked while checking the lashings.

Apply Your Knowledge

1. Discuss the routine procedure of checking cargo lashings on a container ship / ro-ro vessel.

Function: Controlling the operation of the ship and care for persons on board

Competence: Maintain seaworthiness of the ship

Task number: C2.4

Sub task Reference number: C2.4.10, C2.4.10.1, C2.4.10.2, C2.4.10.3, C2.4.10.4, C2.4.10.5, C2.4.11

Topic: Seamanship practices

Task Heading

- Demonstrate the use of various portable gas analyzers on board including:
  - Oxygen analyzer
  - Multi gas detector
  - Toxic gas detector
  - Personal gas monitors
  - Explosimeters
- Identify the span gas required for calibrating each portable analyzer on board. Assist in calibrating various portable analyzers and maintain records

Objectives

- Understand the operating principle of portable gas detectors and the importance and procedure of calibrating the gas detectors

Index

1) Regulations pertaining to carriage of gas measurement instruments on-board
2) Sensors used in gas detectors
3) Oxygen analyser
4) Explosimeters
5) Vol % HC analyzers
6) Multi gas detectors
7) Personal gas detectors
8) Toxic gas detectors including chemical tubes
9) The difference between calibration and operational testing of gas measuring instruments

Description

1) Regulations pertaining to carriage of gas measurement instruments on-board

SOLAS CHAPTER II-2: Construction - Fire protection, fire detection and fire extinction, Part D - Fire safety measures for tankers

Regulation 59 - Venting, purging, gas-freeing and ventilation

- *Inerting, ventilation and gas measurement*

4.4.1 Suitable portable instruments for measuring oxygen and flammable vapour concentrations shall be provided. In selecting these instruments, due attention shall be given to their use in combination with the fixed gas-sampling-line systems.

- *Combustible gas indicators*

All tankers shall be equipped with at least one portable instrument for measuring flammable vapour concentrations, together with a sufficient set of spares. Suitable means shall be provided for the calibration of such instruments.

Regulation 62 - Inert gas systems

17 Portable instruments for measuring oxygen and flammable vapour concentration shall be provided. In addition, suitable arrangement shall be made on each cargo tank such that the condition of the tank atmosphere can be determined using these portable instruments.

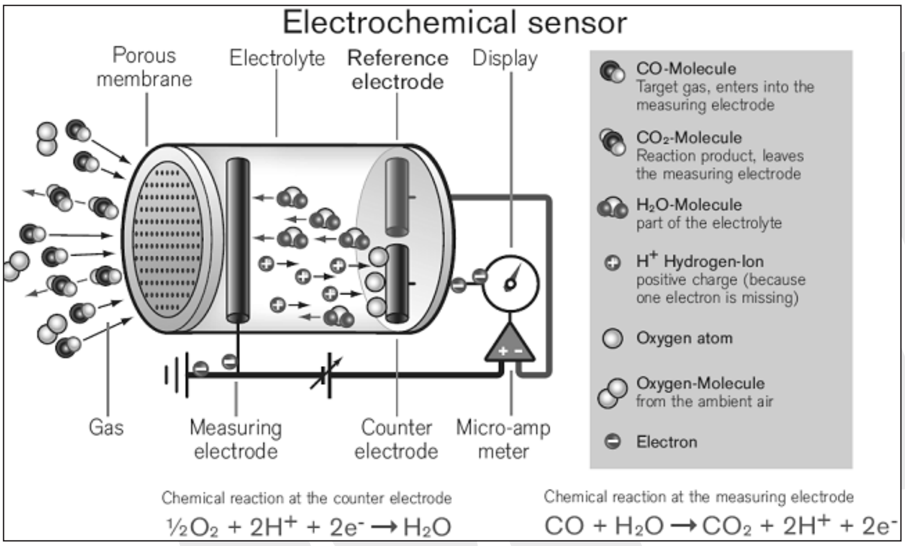
As per the OCIMF ship inspection report program (SIRE), tankers are required to carry the below mentioned gas detection equipment as a minimum. Each tanker should carry at least two each oxygen, % volume hydrocarbon, LEL and toxic gas analyzers. Personal oxygen and hydrocarbon analyzers, which can be carried in a pocket or on a belt, should be available for tank, enclosed space or pump room entry.

- The information to be obtained during a tank atmosphere evaluation are:
- type of atmosphere (constituent gases)
- flammability
- toxicity/ oxygen deficiency
- reactivity

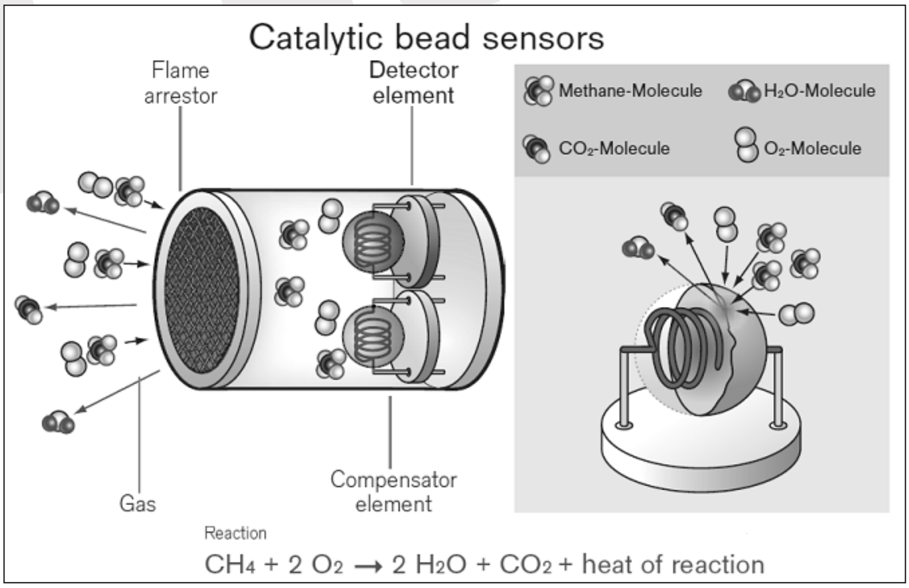
2) Sensors used in gas detectors

There are a number of instruments with a diverse range of measurement principles for detecting gases and vapors: some are shown below for the sake of reference;

Electrochemical sensor



Catalytic bead sensor



Infrared sensors

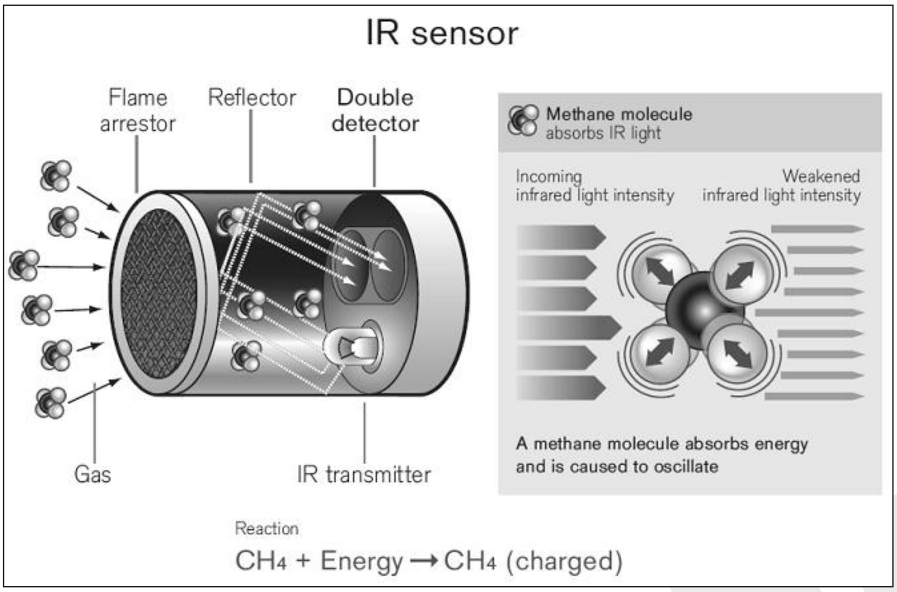
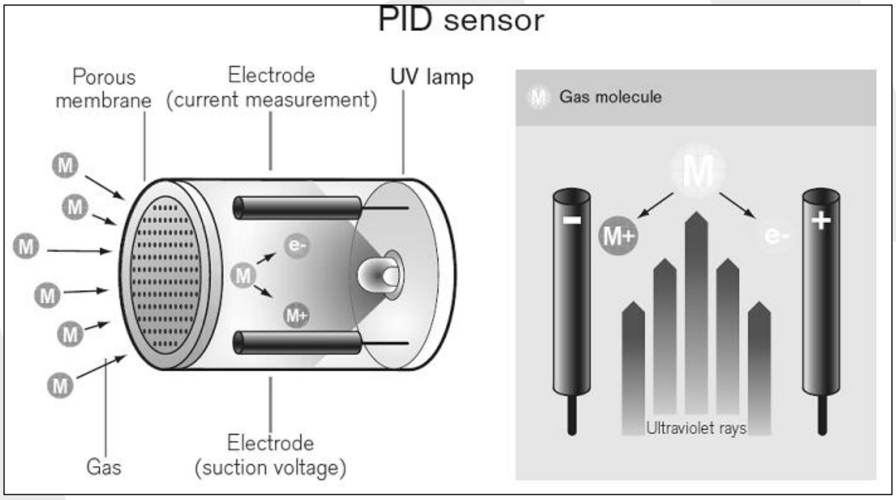


Photo-ionization detector (PID) sensors



3) Oxygen analyzer

Electrochemical sensors are used to measure oxygen. Their measuring range is from between 0 and 25 Vol. % all the way up to 100 Vol. %. Several different types of oxygen analyzer are available. Before use the analyzer should be calibrated, using nitrogen or carbon dioxide to purge the sample cell for a zero check and with air at 21% oxygen for span. The filter should be cleared or replaced when an increase in sample pressure is required to maintain a reasonable gas flow through the analyzer. The same effect is produced if the filter becomes wet due to insufficient gas drying. The need for filter cleaning or replacement should be checked regularly.

NOTE: The batteries should never be changed in a gas dangerous zone. Such instruments sometimes have dual scales each having a separate function. Attention to be paid to the scale in use.

For example:-

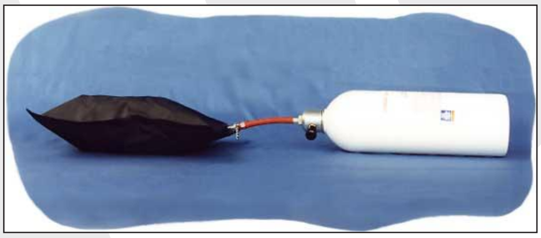
- Scale 1 – oxygen deficiency in air – zero to 25 per cent oxygen by volume.
- Scale 2 – oxygen in nitrogen – zero to 1 per cent oxygen by volume.

As these analyzers are of vital importance, they should be carefully maintained and tested strictly in accordance with the manufacturer's instructions. It is essential that each time an instrument is to be used a check is made of batteries (if fitted), zero setting and calibration. During use frequent checks should be made to ensure accurate readings are obtained at all times. Calibration is simple on all analyzers, using atmospheric air as standard. Zero calibration can be checked with nitrogen or carbon dioxide.

When testing is finished remove instrument from the test area and allows fresh air to be drawn into the instrument for at least 1 minute or until reading stabilizes at 21%. Always switch off the instrument after use and bring it back to its proper place of storage. Enter details of use in the usage log

Calibration and Maintenance

- The instrument should be calibrated frequently throughout its operating range.
- Fill the sampling bag with calibration gas.
- Connect the sampling bag to the gas inlet of the instrument.
- Allow the reading to stabilize, if the reading is different from zero, use the zero adjustment screw to bring the meter reading to zero.
- After calibration, remove the sampling bag.
- Allow fresh air to go into the instrument till the reading stabilizes at 21%.
- Repeat above procedure one more time for final calibration.
- After completion make a record of the calibration in the instrument log.



Limitation

- These instruments should be regularly spanned (calibrated) with fresh air (21 per cent oxygen) and test nitrogen (a virtual zero per cent oxygen content).
- Liquid contamination, pressure or temperature effects may result in drifting of instrument response.

4) Explosimeters

The instruments used to measure % LEL are catalytic filament combustible gas (CFCG) indicators, which are usually referred to as flammable gas monitors or explosimeters. A CFCG indicator (explosimeters) should not be used for measuring hydrocarbon gas in inert atmospheres. The instruments used to measure percentage hydrocarbon vapours in inert gas are the non-catalytic heated filament gas indicators (usually referred to as tankscopes) and refractive index meters. Modern developments in gas detection technology have resulted in the introduction of electronic instruments using infra-red sensors that can perform the same function as the tankscope.

Explosimeter is device that is used to determine the content of hydrocarbon in the atmosphere. The scale used in the explosimeter is marked in terms of lower explosive or flammable limit and as a percentage of the lower limit (LEL). The scale may also be marked in parts per million (ppm). Explosimeter works on the principle of Wheatstone bridge. Infrared and catalytic bead sensors are used to detect this type of risk. These sensors usually detect gas concentrations in the LEL (lower explosive level) range, but some of them can also be used for the 100 Vol. % range. Modern explosimeter have a poison resistant flammable pellistor as the sensing element. Pellistors rely on the presence of oxygen (minimum 11% by volume) to operate efficiently and for this reason flammable gas monitors should not be used for measuring hydrocarbon gas in inert atmospheres.

The pellistor unit balances the voltage and zeros the display automatically when the instrument is switched on in fresh air. In general, it takes about 30 seconds for the pellistor to reach its operating temperature. However, the operator should always refer to the manufacturer’s instructions for the start up procedure.

Flammable vapours are drawn through a sintered filter (flashback arrestor) into the pellistor combustion chamber. Within the chamber are two elements, the detector and the compensator. This pair of elements is heated to between 400 and 600ºC. When no gas is present, the resistances of the two elements are balanced and the bridge will produce a stable baseline signal. When combustible gases are present, they will catalytically oxidize on the detector element causing its temperature to rise. This oxidation can only take place if there is sufficient oxygen present.

The difference in temperature compared to the compensator element is shown as % LEL. The reading is taken when the display is stable. Modern units will indicate on the display when the gas sample has exceeded the LEL.

Preparation for use and operation:

- The instrument is set up to read correctly in the factory using a hydrocarbon gas/air mixture, the composition of which should be indicated on the label fixed to the instrument.
- The calibration of the instrument is such that the response is usually on the safe side for the gases encountered in tanker operations.
- The response should be checked at the beginning of every day during which it is intended to use the instrument. Such a check should also be made after replacing a filament.
- Test kits for use in the field are available for this purpose providing a mixture of hydrocarbon gas in air (such as 50% LFL butane in air).
- At intervals, the instrument should be checked more thoroughly in a laboratory equipped with suitable gas blending facilities.
- During operation it is important to check the instrument and sample lines occasionally for leakage, since the ingress of air would dilute the sample, giving false readings.
- Leak testing may be achieved by pinching the sample line and squeezing the aspirator bulb; the bulb should not expand as long as the sampling line is pinched.
- When testing is finished, remove sampling hose from the test area and allow fresh air to be drawn into the instrument for at least 1- 2 minutes.
- Always switch off the instrument after use and bring it back to its proper place of storage.

Operational features

- Only instruments fitted with flashback arresters in the inlet and outlet of the detector filament chamber should be used. The arresters are essential to prevent the possibility of flame propagation from the combustible chamber; a check should therefore always be made that they are fitted properly in their place.
- Some authorities require, as a condition of their approval, that PVC covers be fitted around meters with aluminium cases to avoid the risk of sparking if the case impacts on rusty steel.

- When hydrocarbons are being measured no filters should be used other than the cotton filter inserted in the gas inlet of the detector to remove solid particles or liquid from the gas sample, although a water absorbent material or water trap may be necessary in the sampling line if the gas is very wet.

Limitation of explosimeter or combustible gas detector

- Silicon, silicates and other compounds containing silicon in the tested atmosphere may seriously impair the response of explosimeter combustible gas indicators. Even minute traces of these materials can rapidly poison the filament so that it will not respond accurately. When there is suspicion that such materials are present, the instrument should be checked frequently at least once after every five tests.
- Leaded gasoline vapours can also poison detector filaments quickly. When such vapours are present, an inhibitor filter should be used to nullify their effect.
- Explosimeter combustible gas indicators are not designed for use in oxygen-deficient atmospheres. At least 10% oxygen must be present for the sensor to work properly.
- Large changes in ambient temperature and excessive pressure of the tank atmosphere being tested, lead to high flow rates which in turn affect the filament temperature. To avoid the effect of gas flow rate, it is recommended practice to take a reading when there is no flow, i.e. between two squeezes of the rubber aspirator bulb. The use of dilution tubes which enable catalytic filament indicators to measure concentrations in over rich hydrocarbon gas/air mixtures is not recommended.

5) Vol % HC analyzers

Since the action of the catalytic gas indicator depends upon combustion with air, it cannot be used for inerted atmospheres because of oxygen deficiency. Vol % HC analyzers usually register over the range 0 to 25 per cent hydrocarbon vapour by volume and are useful for monitoring inerting operations.

Their main purpose is for testing cargo tanks, void spaces and other enclosed spaces and this is most often carried out during gas freeing operations and before entry by personnel.

The catalytic instrument is also used in multi-point form for continuous monitoring of air filled or air ventilated spaces such as compressor rooms, motor rooms, machinery spaces and cargo holds. In multi point form the indicator is installed on ships' bridges or in cargo control rooms. These instruments draw samples sequentially from points in the various spaces monitored. The indications may be automatically recorded and individual alarms are provided when a low percentage of the 'Lower Flammable Limit' is detected.

Where void space is inerted continuously with nitrogen the catalytic type detector will not function and an infrared analyzer is often provided as the central multi-point instrument. This instrument employs the property of hydrocarbon gas to absorb infrared radiation.

Operation

Measuring in inert atmosphere:

- Prepare the instrument according to manual and bring it to the job area.
- When the tanks are inerted, or one expect there to be large concentrations of hydrocarbon, always start measuring with instrument set to 100 VOL%.
- Continue measuring until the reading indicates less than 20 VOL%, then switch down to 20 % by VOL.

- When the reading is below 1% VOL, change to the 100% LEL and so on as the reading decreases.
- When testing is finished, remove sampling hose from the test area and allow fresh air to be drawn into the instrument for at least 1- 2 minutes.
- Always switch off the instrument after use and bring it back to its proper place of storage.

Calibration

The instrument should be calibrated frequently throughout its operating range. Concentration and composition of the span gas should be accurately known. Recalibration should be logged on or near the instrument. Supplies of span gas should be replenished as necessary. The checking of a non-catalytic heated filament instrument requires the provision of gas mixtures of a known total hydrocarbon concentration. The carrier gas may be air, nitrogen or carbon dioxide or a mixture of these. Since this type of instrument may be required to measure accurately either low concentrations (1%-3% by volume) or high concentrations (greater than 10% by volume) it is desirable to have either two test mixtures, say 2% and 15% by volume, or one mixture between these two numbers, say 8% by volume. Gas mixtures may be obtained in small aerosol-type dispensers or small pressurized gas cylinders, or may be prepared in a special test kit. After use always switch off the instrument after use and bring it back to its proper place of storage.

Limitation

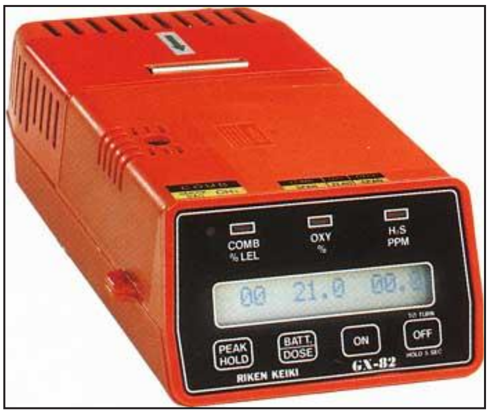
- Correct response from these instruments is achieved only when measuring gas concentrations in mixtures for which the instrument has been calibrated and which remain gaseous at the temperature of the instrument.
- Relatively small deviations from normal atmospheric pressure in the instrument produce significant differences in the indicated gas concentration. If a space which is under elevated pressure is sampled, it may be necessary to detach the sampling line from the instrument and allow the sample pressure to equilibrate with the atmosphere pressure.

6) Multi gas detectors

Portable multi gas detectors come in many styles and configurations. In most cases, they can simultaneously detect three to five gases and alert the user when the gas exposure level becomes a concern.

These detectors consist of multiple sensors in a single case. The electronics then change the sensor output into a numerical display showing the level of gas exposure. There are four basic types of portable gas sensors:

- Catalytic
- Electrochemical
- Infrared
- Photo ionization detectors



These sensors operate in different ways to enable them to detect certain gases. The two most common sensors are the catalytic and electrochemical sensors. Catalytic sensors detect flammable gases and electrochemical sensors detect many toxic gases. Infrared sensors and PID sensors are designed to detect either special gases or especially low gas levels, which cannot be detected by the other two technologies.

Calibration

The recommended calibration gases are:
- 50% LEL butane for the % LEL scale
- 8% VOL butane in CO_2/N_2 for the % VOL scale
- Pure nitrogen (zero % O_2) for the oxygen scale
- 25 ppm H_2S for the H_2S scale

Multi gas detectors can be calibrated automatically using the prescribed multi-gas (combination of gases of known concentration) alternatively multi-gas detectors can also be calibrated manually for one sensor at a time using the appropriate span gas for that sensor.

Limitations

Since sensor output is driven by chemical reactions, there are many circumstances where gases other than the ones we are interested in will cause a reading on the instrument display. This is known as "cross-sensitivity" and chemical engineers designing the sensors do their best to limit this phenomenon. They attempt to make the reaction very specific or install filters when possible.

7) Personal gas detectors

These instruments are used to monitor 3 to 5 different gasses and alert the user at preset alarm levels. Usually in the marine industry they are used to measure the level of oxygen, explosive gases, H2S and CO during entry and inspection.

Calibration

Multi gas detectors can be calibrated automatically using the prescribed multi-gas (combination of gases of known concentration) alternatively multi-gas detectors can also be calibrated manually for one sensor at a time using the appropriate span gas for that sensor.

Note: always consult user manual for the instrument in use and follow usage, calibration, and maintenance procedure as mentioned

The recommended calibration gases are:
- 50% LEL butane for the % LEL scale
- 8% VOL butane in CO_2/N_2 for the % VOL scale
- Pure nitrogen (zero % O_2) for the oxygen scale
- 25 ppm H_2S for the H_2S scale

8) Toxic gas detectors including chemical tubes

- **Chemical tubes**

An important prerequisite to determining the potential of any gaseous air pollutants is the determination of the concentration with a suitable gas measurement device. The kind of device to be used depends on which gases have to be measured and how often. Much to the dismay of both the user and the manufacturer, there is no universal instrument which measures all gases or vapors.

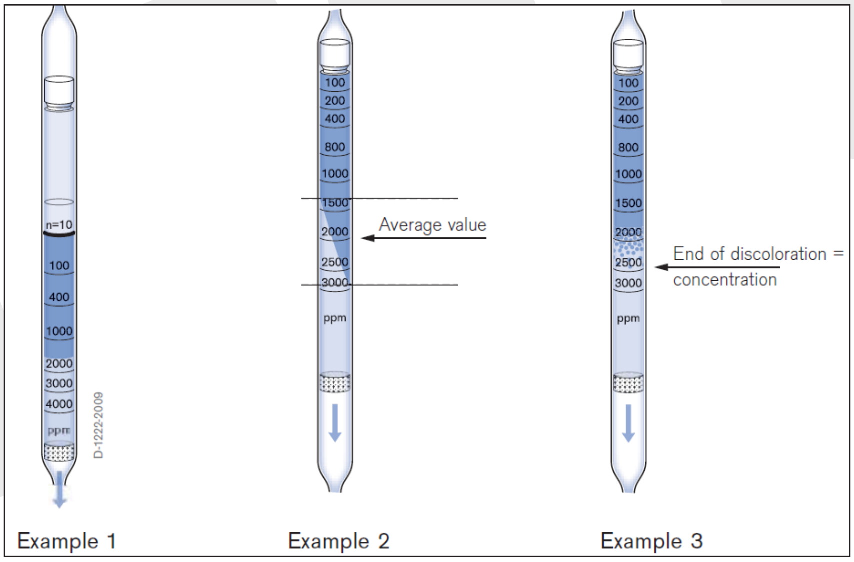
The variety of substances is too wide for a single technique to measure all possible air pollutants. The more chemically complex a substance is, the more complex the gas measurement technique. Toxic gas detectors usually operate on the principle of absorption of the toxic gas in a chemical tube which results in a colour change.

Toxic gas detection tube (e.g. draeger tube) is a vial which contains a chemical preparation that reacts with the measured substance by changing colour. To achieve the normal shelf life of 2 years the tube tips are fused at both ends. Thus, the vial provides an inert package for the reagent system. The printed scale allows a direct reading of the concentration. Thus, calibration by the user is not necessary.

Operation

- Immediately prior to use the ends are broken from a sealed glass tube.
- This is inserted into the bellows units and a sample aspirated through it.
- The reaction between the gas being sampled and the chemical contained in the tube causes a colour change.
- Usually, readings are taken from the length of the colour stain against an indicator scale marked on the tube. These are most often expressed in parts million (ppm).
- Some tubes, however, require the colour change to be matched against a control provided with the instruction manual.

When the colour indication is at a right angle to the tube's longitudinal axis, the concentration can be read directly against the scale (see example 1). If the colour indication is oblique (i. e. runs in a slanting direction to the tube’s longitudinal axis), then a long and a short discoloration can be observed. In this case the average reading indicates the concentration (see example 2). If the colour indication become progressively diffuse, the end of the discoloration may be difficult to evaluate. In this case the final edge of the discoloration has to be read at the point where a faint discoloration is just visible (see example 3)



Limitation

- As tubes may have a specific life, they are date stamped and are accompanied by an instruction leaflet which lists any different gases which may interfere with the accuracy of the indication.
- Chemical tubes don’t give instantaneous readings.
- The number of strokes varies with different gas, it is extremely important to use the exact number of strokes as it is provided in the data.

- **Toxic gas detectors**

Typical photo-ionization detectors measure volatile organic compounds and other gases in concentrations from sub parts per billion to 10 000 parts per million (ppm). The photo-ionization detector is an efficient and inexpensive detector for many gas and vapour analyses. A PID may produce instantaneous readings and operate continuously.

A photo-ionization detector (PID) uses an ultraviolet (UV) light source (photo =light) to break down chemicals to positive and negative ions (ionization) that can easily be counted with a detector. Ionization occurs when a molecule absorbs the high-energy UV light, which excites the molecule and results in the temporary loss of a negatively charged electron and the formation of positively charged ion. The gas becomes electrically charged. In the PID, these charged particles produce a current that is then amplified and displayed on the meter as ‘ppm’ (parts per million) or even in ‘ppb’ (parts per billion). The ions quickly recombine after passing the electrodes in the detector to re-form their original molecule. PID’s are non-destructive: they do not “burn” or permanently alter the sample gas, which allows them to be used for sample gathering.

Calibration

The PID is usually calibrated using isobutylene. Other span gases may produce a relatively greater or lesser response on a concentration basis. Although many PID manufacturers provide the ability to program an instrument with a correction factor for quantitative detection of a specific chemical, the broad selectivity of the PID means that the user must know the identity of the gas or vapor species to be measured with high certainty.

Limitation

- ❖ PID’s are unable to measure:
  - Radiation
  - Air (N_2, O_2, CO_2, H_2O)
  - Common toxics (CO,HCN, SO_2)
  - Natural gas (Methane, ethane)
  - Acid gases ($HC1$, HF, HNO_3)
  - Others: Freons, ozone (O_3), hydrogen peroxide
  - Non-volatiles: PCB’s, greases

9) The difference between calibration and operational testing of gas measuring instruments

Calibration is defined as follows: ‘The set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system and the corresponding values realized by standards.’ The purpose of calibration is to increase the confidence in the reading obtained from the instrument in service. A calibration is a process that compares a known (the standard) against an unknown (the customer's device). During the calibration process, the offset between these two devices is quantified and the customer's device is adjusted back into tolerance (if possible). A true calibration usually contains both "as found" and "as left" data.

Calibration

The accuracy of measurement equipment should be in accordance with the manufacturers stated standards. Equipment should, on initial supply, have a calibration certificate, traceable, where possible, to internationally recognised standards. Thereafter, equipment should be periodically landed to a recognised testing facility for calibration, either during a vessels refit or when the accuracy of the equipment is considered to be outside the manufacturers stated accuracy. Procedures for management of the calibration certification process should form part of the onboard safety management system.

Calibration certificates, showing the instruments serial number, the calibration date and the calibration gas or the method of calibration used, together with reference to applicable standards, should be provided for retention on board. The calibration gas used should be marked on the instrument. The use of an inappropriate gas for calibration could result in erroneous readings during operation, even though the instrument appears to be operating correctly. Calibration should not be confused with operational testing.

Operational testing

Gas measuring instruments should be checked for accuracy before the commencement of operations requiring their use. Instruments should only be used if the checks indicate that the instrument is giving accurate readings and their alarms, if fitted, are operating at the pre-determined set points. During extended operations, the operator should determine the frequency at which operational checks should be made.

Instruments not passing these operational checks should be re-calibrated before they are returned to operational use. If this is not possible, they should be removed from service and clearly labelled to denote that they are not to be used. These procedures should be documented in the safety management system.

Apply Your Knowledge

1. Read the user manuals for the various gas measuring equipment available onboard.
2. Assist chief officer in calibration and maintenance of each of the gas measuring equipment. Note the type of span gas used.

I M U

Function: Controlling the operation of the ship and care for persons on board

Competence: Maintain seaworthiness of the ship

Task number: C2.4

Sub task Reference number: C2.4.12

Topic: Seamanship practices

Task Heading

- Keep a deck and gangway watch and tend mooring lines and gangway

Objectives

- Understand the importance and procedures of keeping a proper and effective deck and gangway watch.

Index

1. Deck and gangway watch
   a) Taking over the deck watch
   b) Performing the deck watch

Description

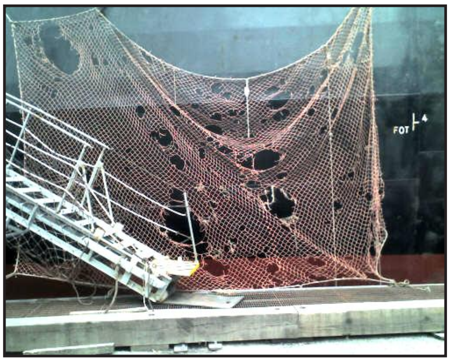
1) Deck and gangway watch

The officer in charge of the deck watch should have a clear understanding of the following procedures to keep a proper and efficient deck watch while the vessel is at port.

a) Taking over the deck watch

Prior to taking over the deck watch, the officer in charge of the deck watch should inform the following to the relieving officer who has come to relieve him off his/her duties. The relieving officer in turn shall check and verify the same.

- the master's standing and special orders
- the depth of the water at the berth alongwith levels of tides, the ship's draught, time of high and low waters
- the arrangement of anchors and the scope of the anchor chain, the securing of the moorings, and other mooring features important to the safety of the ship
- the state of main engines and their availability for emergency use
- all work in progress and work to be performed on board the ship during the watch
- the nature, amount and disposition of cargo loaded or remaining, and any residue on board after unloading the ship
- the level of water in bilges and ballast tanks
- the signals or lights being exhibited or sounded
- the state of fire-fighting appliances
- any special port regulations
- 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
- the procedures for notifying the appropriate authority of any environmental pollution resulting from ship activities
- the number of crew members required to be on board and the presence of any other persons on board
- any other circumstances of importance to the safety of the ship, its crew, cargo or protection of the environment from pollution



b) Performing the deck watch

While performing the deck watch, the officer in charge of the deck watch should consider the following:

- ❖ Rounds shall be taken to inspect the ship at appropriate intervals. This pertains to cargo, safety and security of the vessel.
- ❖ Particular attention shall be paid to
- ✓ the condition and lay of anchor chain and moorings, and gangway 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 moorings and gangway need to be carefully tended depending upon height of tide and rate of tidal stream. As regards to gangway, it shall be remembered that the responsibility of providing safe access from sip to shore remains the responsibility of the vessel.
- ✓ 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. Worsening condition may demand the cargo operations to be stopped till the situations improve.
- ✓ the observance of all regulations concerning safety and fire protection, specially in cases where hot work is in progress or the vessel is involved in loading/ discharging of dangerous cargo.
- ✓ the water level in bilges and tanks, as these need to be carefully monitored. Distribution of ballast is the key factor in controlling stresses on board, whereas the water level in bilges is the first sign of water ingress into cargo hold which could be due to a damage caused to ship structure during cargo operation.
- ✓ all persons on board and their location, especially those in remote or enclosed spaces
- ✓ the exhibition and sounding, where appropriate, of lights and signals
- ❖ Conditions when the weather deteriorates, or in cases where a storm warning is received, the OOW stands responsible to take the necessary measures for the protection the ship, persons on board and cargo. Weather reports, including forecasts, must be monitored in port. Unpredicted changes in environmental conditions can lead to difficulties with moorings. Deployment of additional mooring must be carried out in case of strong offshore winds/currents.
- ❖ Traffic movements of other vessels in port in the vicinity of own vessel must be monitored. This is to keep a check on likely surging of vessel, as surging poses risk of the vessel breaking out from its berth.
- ❖ The OOW shall take every precaution to prevent pollution of the environment by the ship.
- ❖ The OOW shall immediately call emergency stations whenever a threat is observed regarding the safety of the ship. Alarm shall be raised; master informed and all possible measures to prevent any damage to the ship, its cargo and persons on board shall be taken as necessary. It may require requesting assistance from the shore authorities or neighboring ships.
- ❖ The OOW shall be aware of the ship's stability condition.
- ❖ The OOW shall arrange to offer assistance to ships or persons in distress to the extent possible without endangering own ship.
- ❖ The OOW arrange to take necessary precautions to prevent accidents or damage when propellers are to be turned.
- ❖ Cargo watch, safety rounds and security rounds shall be carried out as discussed under other tasks.

- Complete record of the activities during the watch shall be maintained by the OOW.

Apply Your Knowledge

1. Refer to the expected tide levels at any three ports and observe the periods during which the moorings need to be tended to more frequently.

IMU

Function: Controlling the operation of the ship and care for persons on board

Competence: Maintain seaworthiness of the ship

Task number: C2.4

Sub task Reference number: C2.4.13, C2.4.14

Topic: Seamanship practices

Task Heading

- Rig and use stages under supervision.
- Rig and use bosun's chair under supervision.

Objectives

- Understand the procedure of rigging a stage and the precautions that need to be exercised when using it
- Understand the procedure of rigging a bosun's chair and the precautions that need to be exercised when using it

Please read this task in conjunction with task C7.1.2

Index

1. Stage
2. Bosun's chair
3. Precautions to be observed while working with stages and bosun's chair

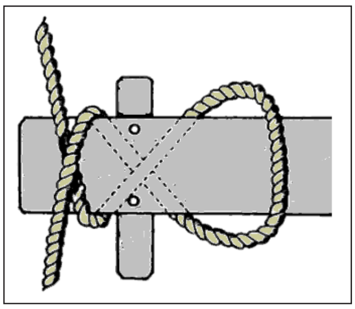
Description

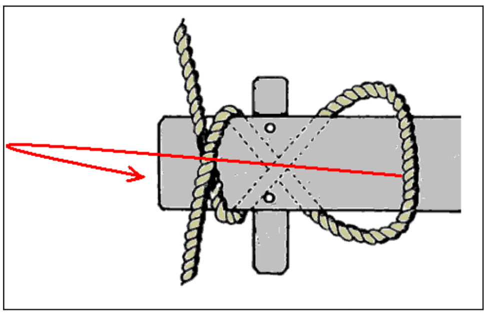
1) Stage

The stage is a stout plank which has two short wooden horns attached underside to it at a right angle to the plank near each end, either by nailing or bolting on, a foot off inward from either end. When the stage is rigged properly, all the weight comes on the plank. The chief purpose of the horns is to hold the plank off the side. The plank stages should be made from sound wood and materials and should be free from defect. The stage and ancillary equipment, lizards (if used), blocks and gantlines should be thoroughly examined before use. The gantline used should be in good condition, and if any doubt exists, a new rope should be broken out.

The most commonly used method of rigging the stage is by the **stage hitch** as shown in the figures below.

- ❖ Lay the bight of the gantline over the stage inside the horn. Cross the two ends of the gantline below the horn and bring them up at the end of the stage outside the horn.
- ❖ Lay the two ends on top of the stage over the horn. Pull the initial bight formed towards the edge of the stage and put it over the ends and under the stage plank.
- ❖ Now tighten the two ends of gantline, ensuring that both are of equal length before securing.
- ❖ Secure the free end to the standing part using a bowline knot.





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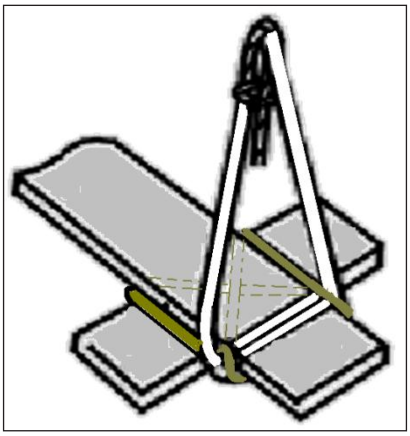

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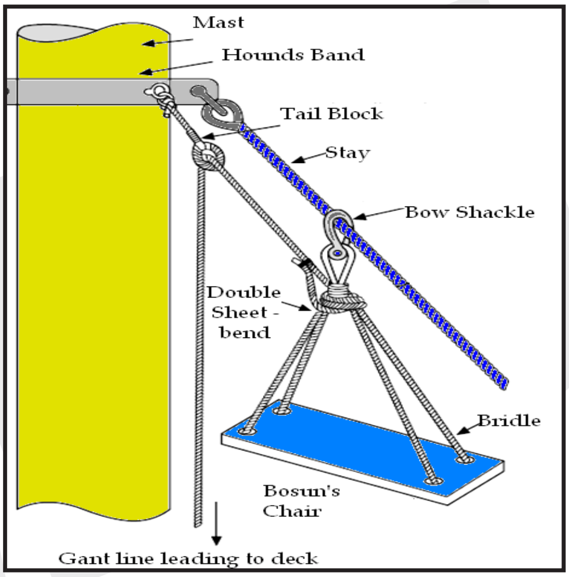
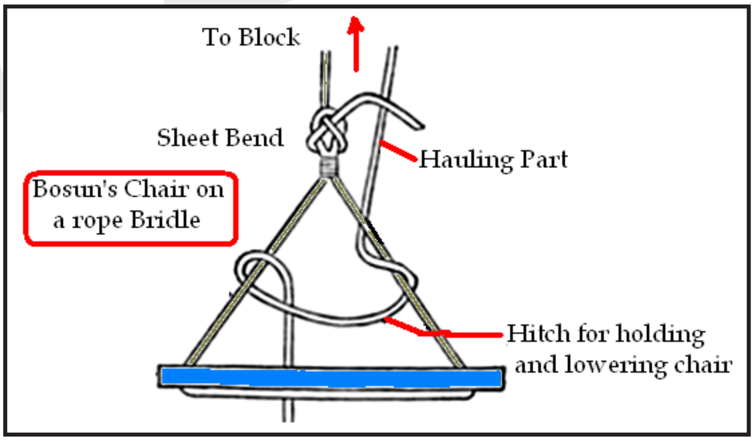
2. Bosun's chair

A bosun's chair 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 the holes provided in bosun's chair and made fast using a double sheet bend. The ends are seized to the standing part with adequate tail. With a man in the chair the bend closes up and lies just below the throat with the hauling part in a vertical line with the standing part. The standing part is bent to the eye with a single or double sheet or becket bend. A three or four foot tail is left to be used to pull or hoist to the mast and ride out to the yard. It may be used for variety of purpose on board a ship such as wash down the outside bulkheads of the accommodation, wire greasing of topping lifts of cranes and derricks, cleaning and painting the funnel etc.





3. Precautions to be observed while working with stages and bosun's chair

Stages or the boatswain's chair (bosun's chair) are used to carry out works aloft or over-side. The precautions while working aloft or over-side using stages and bosun's chair are discussed under task C7.1.2 which shall be read in conjunction to this task. The precautions are:

- Before rigging the stage shall be checked clean and free from grease and that the wood is not rotten. Check that the gantlines to be used are clean and new. The stage and bosun's chair should be load-tested to four times the intended load.
- The two gantlines used in rigging the stage should be at least long enough to trail into the water when a stage is rigged over-side. This is to provide additional lifelines should the operator fall. Additionally a lifebuoy and line should still be kept ready at a close position.
- Stages should not be rigged over-side for working when the vessel is under way. Also, stages should not be rigged suspending over a dock.
- Not more than two persons shall be allowed on a stage at one time.
- The gantlines should be of adequate length, and rigged clear of sharp edges. Check shall be kept that the ropes are not nipped. Gantlines used for working aloft should not be used for any other purpose.
- The securing points for lines, blocks and lizards etc must be of adequate strength, preferably being a permanent fixture to the ship's structure.
- Hanging stages should be restricted against movement to the extent practicable.
- In machinery spaces, staging and its supports should be kept clear of moving parts of machinery and hot surfaces. A crane gantry should not be used directly as a platform for cleaning or painting in the engine room. However, it may be used as the base for a stable platform if suitable precautions are taken
- A correct stage hitch, together with lowering turns, must be applied. Great care must be taken to keep movements of the stage small and controlled, where personnel working from a stage are required to raise or lower themselves,.
- The gantline shall be secured to the bosun's chair with a double sheet bend.
- Hooks shall preferably not be used to secure bosun's chairs. If required, the same shall have a marked safe working load which is adequate for the purpose and should be prevented from accidental dislodging.
- The chair shall always be hoisted manually, and never on a winch.
- All tools, paint pots etc. should be secured by lanyards. Any loose articles should be removed to prevent falling when aloft.
- It shall be ensured that the bolt of the bow shackle passes through the becket of the bridle when riding a stay. This bolt should be moused.
- 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.

Apply Your Knowledge

- Discuss the occasions where the stages and bosun's chair are used on board. Check the sizes of the ropes, shackles and other gear used in the operation.

Function: Controlling the operation of the ship and care for persons on board

Competence: Maintain seaworthiness of the ship

Task number: C2.4

Sub task Reference number: C2.4.15

Topic: Seamanship practices

Task Heading

- Assist crew with splicing of ropes and wires.

Objectives

- Know the different types of splices
- Understand the procedures of splicing a fibre and wire rope and
- Understand the precaution that needs to be exercised when splicing a fibre and wire rope

Index

1) Splicing
2) Splicing fibre ropes
3) Splicing hawsers
4) Finishing a splice
5) Precautions to be taken when splicing fibre ropes
6) Wire rope splicing

Description

1) Splicing

- Splicing is a method of permanently joining the ends of two lines or of bending a line back on itself to form a permanent loop or an eye. Splicing is always preferred to a knot. However, it is noteworthy that when two ropes are joined using splicing, most splices reduce the strength of the rope by one-eighth (12%). During splicing, strands on an end of each line are un-laid and interwoven with those of the standing part of the line.

- Tools required for splicing a fibre or a wire rope:-
  - ❖ A wooden spike (hand fid) or a swedish fid for fibre ropes
  - ❖ Marline spike for wire rope.
  - ❖ Setting fid for mooring ropes
  - ❖ Serving board
  - ❖ Serving mallet (heavy) for heaving tucks into place.
  - ❖ A sharp knife
  - ❖ Twine for whipping
  - ❖ PVC tape for taping up where necessary
  - ❖ A lighted candle to fuse strand ends of manmade fibres.

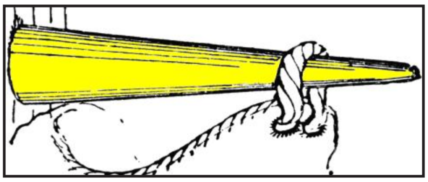
❖ **Hand fid**
A hand fid is a tapered piece of hard wood, usually lignum vitae, and round in section, used to open up the lay of a rope when putting in a splice.

❖ **Swedish fid**
This is a hand fid, constructed with a wooden handle attached to a U-shaped taper of stainless steel. .

❖ **Serving board**
This is a flat board, fitted with a handle for the purpose of serving the wire eye splice.

❖ **Serving mallet**
This wooden mallet, cut with a deep-set groove running the full length of the hammer head, is used to turn the serving (marline or spunyarn) about the wire rope.

❖ **Setting fid**
This may be described as a giant version of the hand fid. It is used for splicing larger types of rope, e.g. mooring ropes, often in conjunction with a mallet to drive the taper of the fid through the strands of the rope.

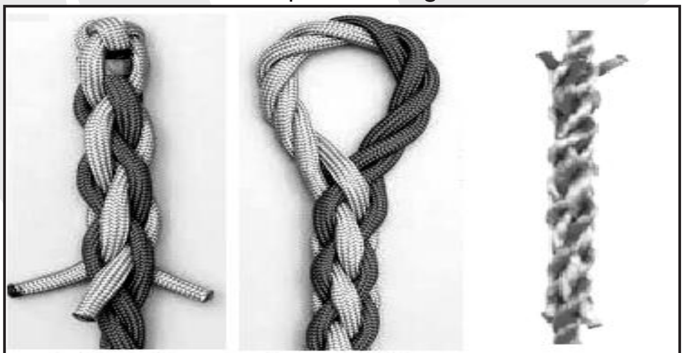


2) Splicing fibre ropes

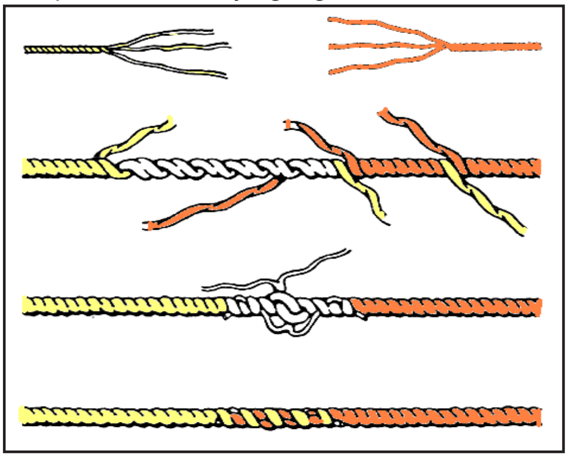
➢ **Back splice**
Used to prevent the rope from un-laying, the end of rope is finished using back splice. However, this increases the diameter of the rope and hence it cannot pass through a block, whipping is used in such cases. The rope is whipped to a distance equal to about 20 times its diameter from its end. Strands are un-laid till the whipping and all the three strands are also whipped. A crown knot is made on top and splicing is continued tucking the strand backwards.

➢ **Eye splice**
This is used to make a permanent eye at the end of a rope. For a natural fibre rope a good splice is obtained after about 3 full "tucks. It means that all the three strands of the rope have been roved through the standing part 3 times. For man-made fibre ropes due to the nature of the rope, the number of tucks required is five.

➢ **Short splice**
Used to join two ropes when the joint does not have to pass through a block, as this increases the rope diameter; Each rope is whipped to a distance from its end equal to about 15 to 20 times the diameter of the rope. A general thumb rule is, if you want to take 3 tucks of splice then un-lay the strands of the rope about 3 full turns and if 4 tucks are to be taken then un-lay the strands of the rope about 4 full turns. Each strand of the rope is then whipped strongly. Both the ropes are then married so that one strand of each rope lies between two strands of the other rope. The opposing strands are pulled together closely until both rope ends are lying against each other. Holding these in position by means of a temporarily seizing, the loose strands are spliced with the standing part of the other rope. This is done with either rope. Once done the whipping on each rope, done earlier, is released.



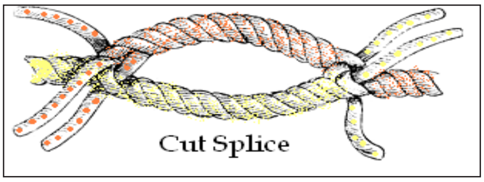
Back Splice Eye Splice Short Splice



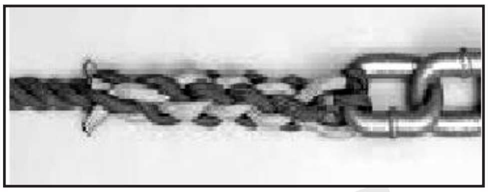
➢ **Long splice**
It is used to join two ropes when the joint has to pass through a block. If the long splice is done well the diameter of the rope does not increase. The splice is not as strong as a short splice and is generally used as a temporary method of joining

ropes together as they pass through a block. This splice is used only on natural fibre ropes as the splice is unsatisfactory on man-made fibre ropes. If the splice is done well, it will not increase the diameter of the rope nor will it weaken the rope, but it is more prone to unraveling than a short splice, so is not used for lifting cargo.

- **Cut splice**
  It is also used to join two ropes and can be used instead of a long splice. This type of splice is used when required to make a permanent eye on the bight of the rope.



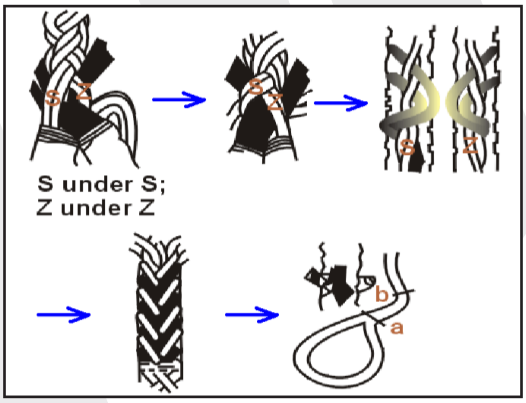
- **Chain splice**
  This splice is used when the rope is needed to be passed into a link of a chain as in chain stopper. This is also used when a thick rope might not pass through the link of the chain. This splice is effective in natural fibre cordage only.



3) Splicing hawsers

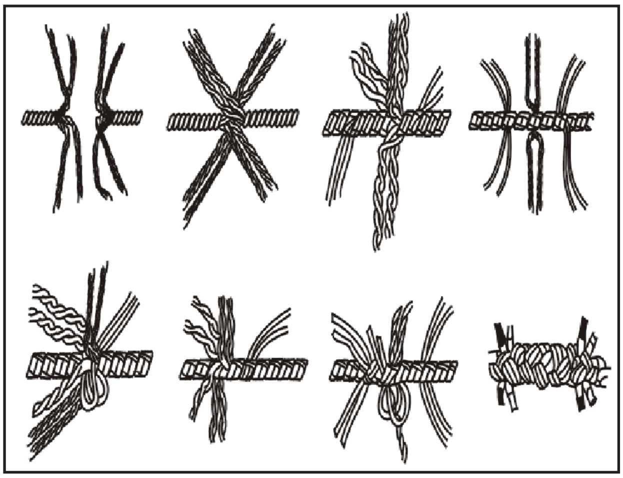
- **Splicing of 8 strand - plaited hawsers**

❖ **Eye splice**



In a plaited rope there are four strands which are right handed and four which are left. A throat splice is made approximately about 20 times the diameter of the rope, which will be the point of the splice. The strands are un-laid taking care not to disturb the natural lay. The pairs of Z strands and pairs of S strands are married making them 4 pairs in all. One pair of Z strands is tucked under the nearest convenient pair of Z-lay strands in the standing part of the rope. Next the adjacent pair of S strands is tucked under the unoccupied pair of S-lay strands of the rope adjacent to the Z strand. The rope is then turned over and another pairs of Z and S strands are tucked similarly. Then all the paired strands are separated out so that we have 4 Z strands and 4 S strands. Now each strand is tucked separately like one S strand under S-Lay strand on the standing part, One Z strand under Z-lay strand on the standing part etc. When all 8 strands are done - the second tuck is finished. The second tuck is repeated 3 more times to have at least 5 full tucks on the splice. The splicing is finished off by dogging the ends or tapering.

❖ **Short splice**

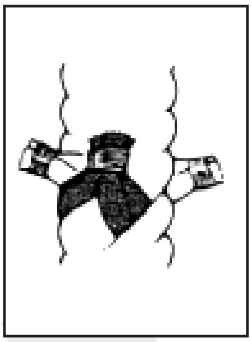


A short splice is used to join two 8 plaited hawsers in cases where it is required to join two pieces as in joining a parted mooring rope. As with the other splices the ropes are unlaid for a distance approximately equal to about 8 plaits along its length from the end. This should suffice to take 4 full tucks. The pair of strands of each rope is separated according to their lay and each pair of strands is tied together. The strands of the **same** lay in each rope are married together and the ends tied off. For easy identification, tie together 2L & 3L, 2R & 4R, 1L & 4L, and 1R & 3R respectively. Untie strands 1R and 3R and commence tucking 1R under the nearest convenient pair of (black) strands. Tuck 1R for 4 tucks, following the same direction as the white strands in the whole portion of the rope. Follow 1R with 3R in the opposite direction and complete 4 tucks. The above sequence is repeated for 1L and 4L, followed by 2L and 3L. The splicing is finished off by removing the whippings and dogging the ends.

4) Finishing a splice

- **Dogging the ends**

  On completion of three or five full tucks, the ends of the strands are halved. Overhand knot each of the strand to its neighbour over the adjacent strand of the main rope and whip together.

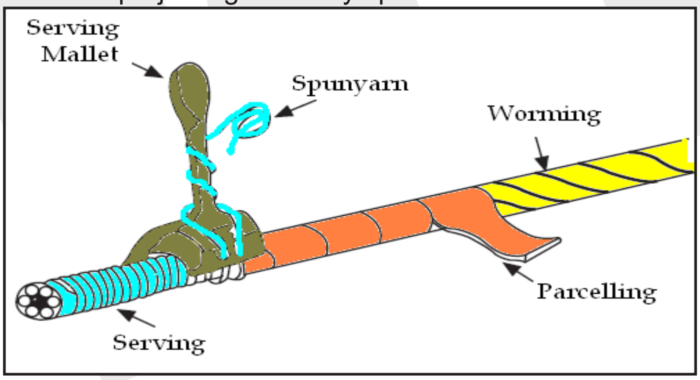


- **Tapering the splice**

  Once the tucks are completed as required each strand is split into three parts. The two-thirds of the strand are tucked again once as before for all the three strands. Although the other one-third is discarded but not cut off till completion of the splice. Once again the reduced strands are halved on the second tuck and one part of the same is tucked as before. This is repeated with all the three reduced strands. Now all parts are hauled taut, including the discarded ends, which are now cut off.

- **Worming, parceling and serving**

  The purpose of the operation of worming, parceling and serving a rope or a wire is to protect its outer surface against wear from chafing, to make its outer surface smoother, to prevent other ropes from chafing when led over it and to protect the hands of those using it from sharp ends of wire projecting from any splice in it.



- **Worming**

  A 'filler' of suitable small stuff is woven around the wire, in between the strands. This effectively prepares the way for the parceling to produce a smooth finish, prior to serving. Marline should not be used for the worming because it is too hard and will not easily compress. When parceled over it may cause the surface to be uneven. Small stuff suitable for the purpose of worming includes spunyarn, hemp yarns, or small rope, depending on the size of the wire being worked. The worming should be carried out in the direction of the lay of the wire.

- **Parcelling**

  Covering of the wire and the worming by oiled sacking, burlap, or tarred canvas in known as parceling. The material is cut into strips up to 3 inches in width and turned about the wire in the direction of the lay. To ensure that the parceling does not unravel while in the operation of serving, a lacing of sail twine may be drawn over with a marline hitch. Worming and parceling is done with the lay.

- **Serving**

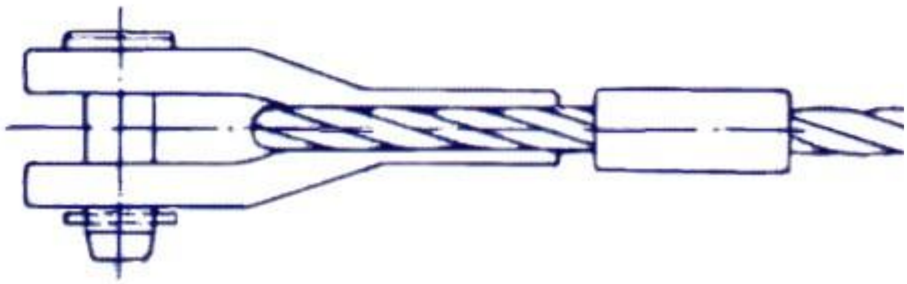
  This consists of binding a splice or a length of rope with close turns of spun-yarn. Each turn is pulled taut with a special serving mallet which has a score on its head, to fit the rope, and a wooden handle about 40 cm long. A service is always bound on in the direction opposite to that of the parceling, to avoid bunching up the latter. Hence it is always done against the lay of the rope. Having completed the required length of service, it is finished off by passing the end back under the last four turns, haul all parts taut and make a crown and wall knot.

5) Precautions to be taken when splicing fibre ropes

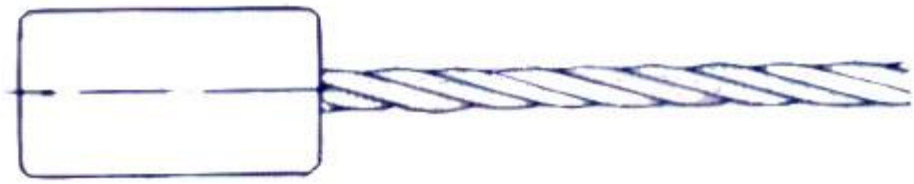
- The yarns forming the strands should be disturbed as little as possible. Being synthetic, the yarns get mixed up very easily. It's preferred to heat fuse the end of the strands of the rope before opening the strands for splicing.
- The man-made fibre ropes tends to elongate under strain their diameter would subsequently reduce. Due to this it is not advisable to serve the rope as the serving will get loose due to alternate stretching and release of strain on the rope.
- Strands are not allowed to run forward but are pulled back as far as possible. This ensures a close tight splice.
- A smaller fid shall be used first followed by a larger fid and opening the rope just wide enough for the strand to pass through. This will avoid unnecessary kinks of both the standing part and the strands.
- When splicing a man-made fibre rope like polypropylene or nylon, great care must be taken, since due to the slippery nature of the ropes, the chances of injury are high.

6) Wire rope splicing

- A sharp pointed metal spike known as the "Marline spike" is used for splicing a wire rope. Before splicing a wire, the wire needs to be cut and there is a way of doing so. Before cutting a wire rope, seizing is placed on each side of the place where the rope is to be cut, in order to prevent un-laying of the strands. Whipping may be used in place of seizing for temporary purposes. The wire ropes are cut using a wire rope cutter. Alternatively, cutting can be done by hammering using a sharp chisel and hammer.
- When preparing a wire for a splice the strands must always be firmly whipped before being un-laid from the rope. Further, the bending of the wires during the process of splicing may injure the galvanized surfaces of wires. For this reason, splices should be dipped in a preservative, such as mineral tar or tallow after completion of splicing. The twisting and pulling caused in tucking the strands tend to distort the natural set of lay of the wire rope and hence should be reduced to a minimum.
- There are many types of wire eye splices in use but they are broadly divided into two groups - those which are after the first tuck, tucked against the lay and those that are after the first tuck, tucked with the lay. The type mentioned below is the one which is tucked with the lay - This splice is also known as the 3, 2, 1 eye splice. The greatest disadvantage of this splice is it cannot be used for rotating wires like the cargo runners as the splice will tend to open out.
- Types of wire rope ends in use are shown below:



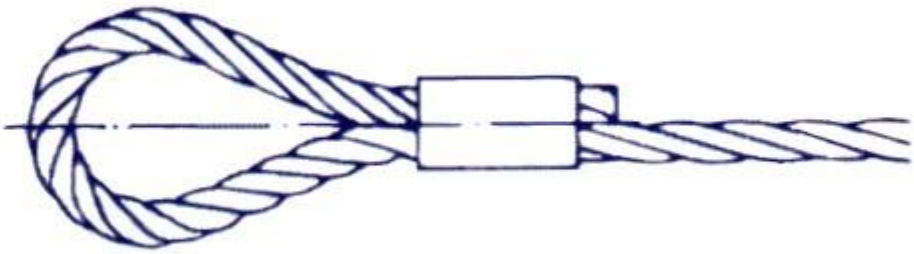
Aluminium swaged open thimble



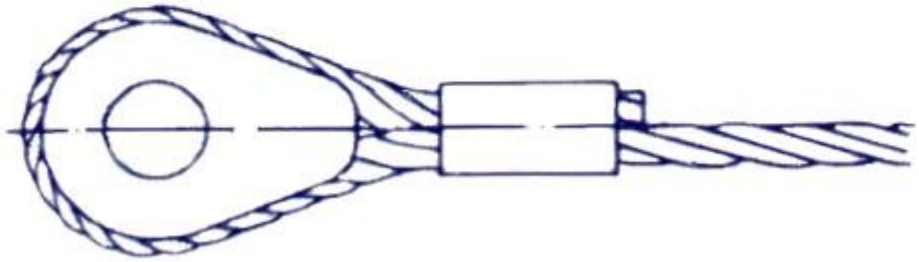
Cylindrical socket

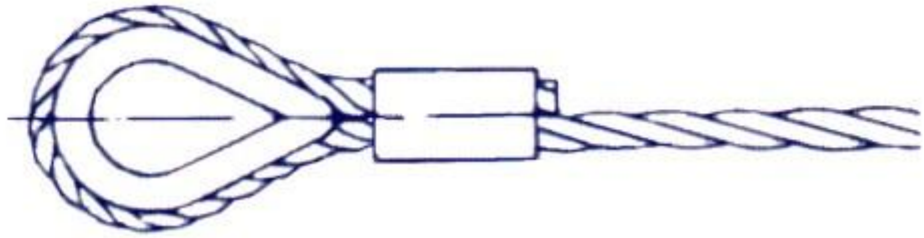
Hand spliced soft eye

Hand spliced thimble eye

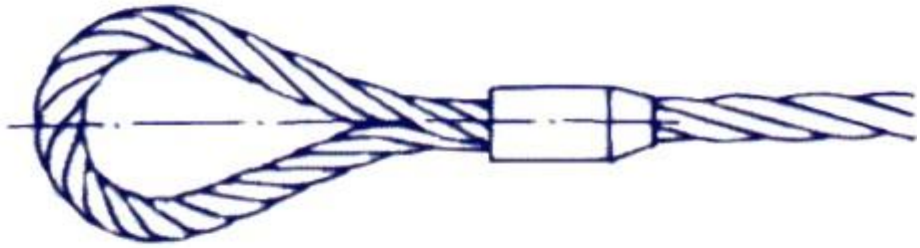


Mechanical spliced soft eye

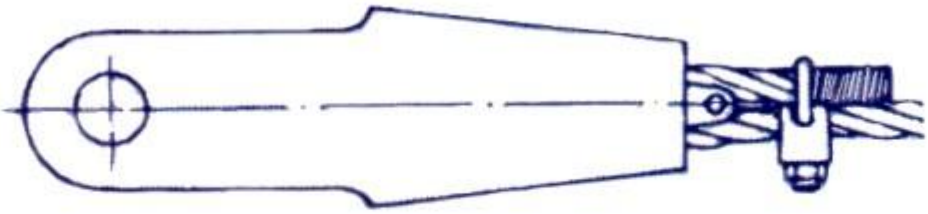




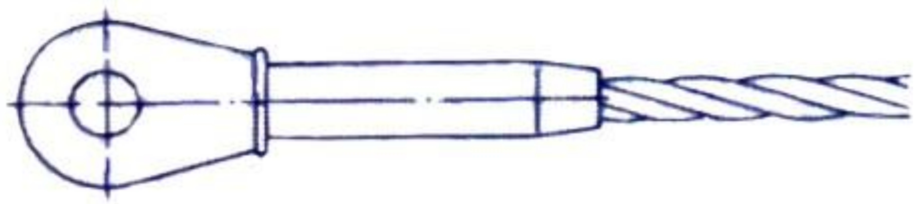
Mechanical spliced solid thimble eye



Mechanical spliced thimble eye

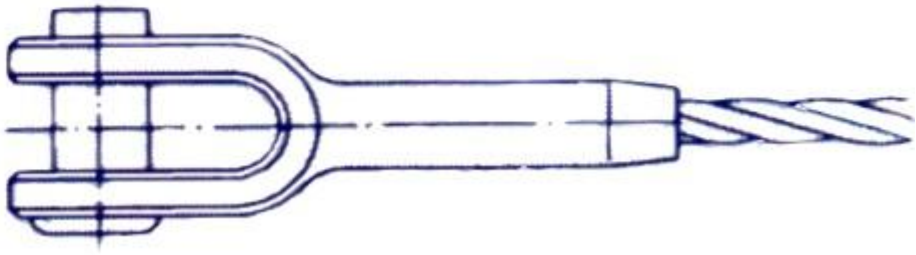


Molly Hogan or Flemish eye or dutch eye

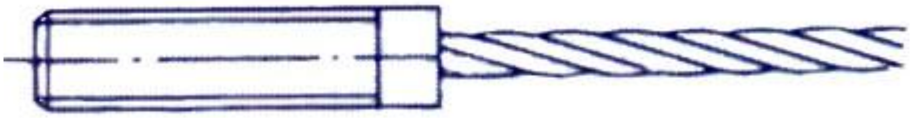


Open wedge socket

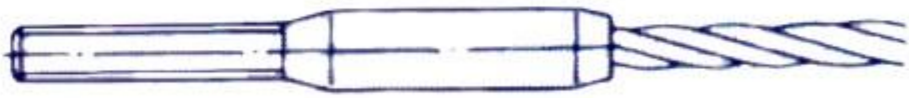
Swaged closed socket



Swaged open socket



Swaged threaded sleeve



Swaged threaded stud

Wire rope clips or bulldog grips

- **Eye splice**
  - The six strands of the wire are divided in two. Three of them are placed over the standing part of the wire in the same direction of the lay and the other three below the standing part in the same direction. The spike is then forced through the middle of the wire and No.1 strand is inserted so that it lies with the lay of the rope between three fixed strands. Strand No.2 is put in the same opening but under two fixed strands. Strand No.3 is placed in the same opening but under only one strand. Once the first 3 strands are

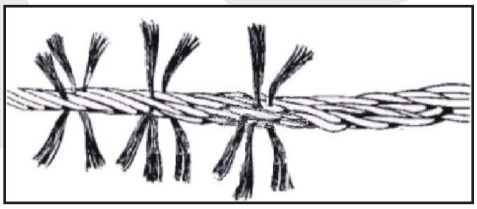
tucked in, all the strands are grasped with the left hand and with the right hand the wire is hammered down until they are close to the seizing. This tightens up the splice and makes it round and even. The eye of the splice is then turned over and strands Nos.4, 5 and 6 are spliced one after the other each under one strand with the lay of the rope. When doing this each one must be inserted a little to the right of the preceding one. This completes the first tuck of the splice. The second tuck is then started with strand No.1, splicing it with the lay of the rope around and under the strand from under which it emerged when first tucked. The other strands being spliced in the same fashion as strand No.1. After each strand is tucked in three times so that the wire has 3 "tucks" of splice then the splice is tapered and finished off.

- **Boulevant or five tuck or the locking splice**
- ❖ This splice is suitable for use on all flexible wire ropes and is particularly suitable for cargo runners, "spinning" wires and springs. It has a good lock as the majority of the tucks are laid against the lay of the wire rope.
- ❖ The sequence for tucking the strands in this type of splice is as follows.
  - ✓ No.1 end - Under the first and most convenient strand, with the lay.
  - ✓ No.6 end - Under the second strand, with the lay. The spike is not drawn out.
  - ✓ No.2 end - Also under the second strand, against the lay. It lies above the No.6 strand and locks the splice.
  - ✓ No.3 end - Under the third strand, against the lay.
  - ✓ No.5 end - Under the fourth and fifth strands, against the lay3.
  - ✓ No.4 end - Under the fourth strand only, against the lay.

> This is the locking tuck which is required by the Factory Act to be made in any wire splice on a wire which, when free, such as a cargo runner, is liable to spin and so cause the wire strands to open out.

- ❖ This completes the first series of tucks. After hammering down, the second and third series are all tucked against the lay with each end over one strand and under the next.

- **Short splice**



- ❖ This splice is used for joining two wire ropes when the joint does not have to pass through a block. To make this splice, a good whipping is put on each rope at a distance of about 40 times the diameter its end. All the strands of each rope are whipped to prevent un-laying of the rope. The strands of both the wire ropes are then un-laid up to the main whipping. The central core of the rope is cut. The ropes are married in such a way that each strand of one rope rests between two strands of the other rope. The strands are then hauled taut so that both the whippings lie as close as possible. Once hauled and made taut the strands are seized strongly to the standing part of the other rope. This enables the other part of the marry to be spliced maintaining the taut position between the ropes. Begin normal tucking after cutting the whipping same as with the fibre rope, each strand is taken over the strand on its left and tucked under the next one and it emerges between the later and subsequent one. Having tucked all the 6 strands of the first wire once in the above fashion, a seizing is taken over the first tuck to prevent the tucks from easing back during the subsequent stages. Now the process is repeated with the second rope. Strands are tucked 3 or 4 times depending on the diameter the rope.

- **Long splice**

The ropes which are to be spliced are whipped approximately at a length of about 110 times the diameter of the wire rope from the end. Every alternate strand is whipped and cut to about 15 - 30 cm length. This means each rope has 3 long strands and 3 short strands. Both the ropes are then married. The shorter strand is then unlaid and the longer strand of the other rope is laid in place of the shorter strand. The length of this lay is approximately 100 times the diameter of the rope from the marry position. Similar to above the second and third short strands of one rope is replaced with long strands of the other rope except that they are only laid up to 60 times the diameter and 20 times the diameter respectively from the marry position - thus having 2 strands equidistant from each other. All the other three short strands of the second rope are also dealt with in a similar fashion. The splice is ended by burying the ends of the strands inside the rope, heart being cut out where each strand is buried.

Task of rope splicing requires practical knowledge and practice. It is recommended that the same is practiced under supervision of experienced seamen.

Apply Your Knowledge

1. Practice splicing assisting the deck hand while engaged in splicing jobs.
2. Discuss the common tasks on board where the spliced wire ropes are used on board.
3. Discuss the risks associated if the splicing of an eye on a wire rope slips.

IMU

Function: Controlling the operation of the ship and care for persons on board

Competence: Maintain seaworthiness of the ship

Task number: C2.4

Sub task Reference number: C2.4.16

Topic: Seamanship practices

Task Heading

- Maintain fairleads.

Objectives

- Understand the importance of proper maintenance of various types of fairleads

Index

1) Definitions
2) Care and maintenance of fairleads

Description

1) Definitions

- **Chock**
  A chock is a reinforced construction in a bulwark or railing without moving parts provided to guide a mooring line which enables the line to be passed through a ship's bulwark or other barrier.

- **Fairlead**
  Fairlead is a reinforced construction in a bulwark or railing, having moving parts provided to guide a mooring line which enables the line to be passed through a ship's bulwark or other barrier, or to change direction through a congested area without snagging or fouling.

- **Panama type fairlead**
  It is a non-roller type fairlead mounted at the ship's side and enclosed so that mooring lines may be led to shore with equal facility either above or below the horizontal. The fairleads are so named pertaining to fairleads complying with Panama Canal Regulations, but often applied to any closed fairlead or chock.

- **Pedestal roller fairlead**
  A pedestal roller fairlead usually is one operating in a horizontal plane. It is used to change the direction of lead of a mooring or other line on a ship's deck.

- **Universal fairlead**
  A universal fairlead is one which has with three or more cylindrical rollers.


Chock


Roller Fairleads

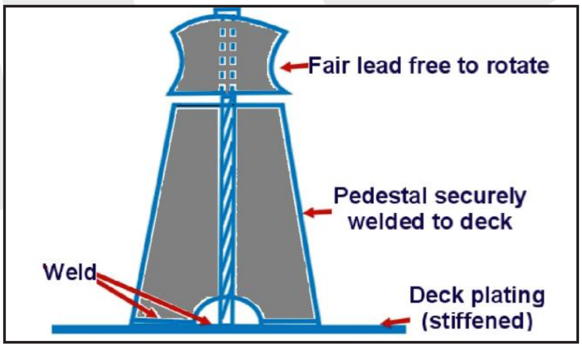

Universal Fairlead


Pedestal Roller Fairlead

2) Care and maintenance of fairleads

- The maintenance of fairleads is necessary for taking care of mooring lines. Further, the personnel involved in mooring operations shall be well aware of the correct use of fairleads for reasons of personal safety.
- While deciding on the use of fairleads, the governing factor is the lead of the rope. Sharp turns are never preferred for the reason that they affect the rope physically and the strength is greatly affected. Furthermore, where a roller fairlead or a pedestal roller fairlead is used to change the direction of the rope, it results in building up heavy stresses on the fairlead. In this case the roller, if not strong enough, is likely to get uprooted and cause serious injuries. Ship's mooring arrangement plan shall be referred to check the correct lead of ropes and SWL of the fairleads.

- The fairleads shall be inspected regularly for corrosion and welding seams. The pins, joints and the strengtheners shall be of sound construction and securely attached to the ship structure. Same shall be checked for corrosion, any cracks or signs of fatigue. The moving parts and the rollers shall be greased regularly thorough the greasing points. The movement shall be checked free.



- All fairleads are smoothly finished both inboard and outboard to prevent chafing of ropes. The surfaces in the chock and through other rollers shall be smooth and free of any corrosion and rust.
- Pedestal fairleads and the roller fairleads are of the cantilever pin type. The cantilever pin and its attachment are very critical. Pin assembly shall be regularly inspected as its failure can lead to serious accidents. Pedestal fairleads are also likely to fail at the pedestal-to-deck connection due to improper design or workmanship.
- The rollers of universal fairleads are likely to freeze if not greased regularly. The effectiveness of the fairlead is lost if the rollers are frozen.
- The stiffeners of the chocks shall be maintained in a good condition as these govern the strength of the fairlead.
- The maintenance of fairleads should be undertaken on a regular basis in accordance with the ship's PMS.

Apply Your Knowledge

1. Check the mooring plan of the vessel and identify the type of fairleads to be used for tug's line, head line, stern line, breast lines and springs.
2. Locate the greasing points on the fairleads and assist in greasing.

Function: Controlling the operation of the ship and care for persons on board

Competence: Maintain seaworthiness of the ship

Task number: C2.4

Sub task Reference number: C2.4.17

Topic: Seamanship practices

Task Heading

- Receive, check, stow and secure ship's stores.

Objectives

- Understand the procedure of receiving, checking, stowing and securing ship’s stores.

Index

1. Receiving, checking and securing of ship’s stores

Description

1) Receiving, checking and securing of ship’s stores

- Stores are preferably received at ports where the ships call quite often or ports designated by the shipping company. The items commonly received include, nautical charts and publications, flags, medicines, deck spares, ropes, wires, tools, paints and other deck stores, machinery spares, lubricants, tools, provisions and saloon stores.
- As and when stores are received on board, the concerned department head shall be advised to take the receipt. However, for the handling, deck cranes or lifting gear may require to be used. Such operations shall be supervised and monitored carefully. Care shall be taken not to damage any of the parcels. As soon as the parcels are received, these shall be moved to a safe and secure location for security against theft.
- The stores/ spares are received on board during the ship’s call at the port while at berth or at anchorage. The stores may be received while in transit as well. The circumstances may not allow sufficient time to cross check the stores received immediately after being placed on board owing to large quantities or limited port stay. However, efforts shall be made to check the list of items on the invoice and apparent condition of items/ parcels; especially of critical items such as nautical charts, machinery spares, provision etc. Further, perishable items such as medicines and frozen stores shall be moved to the designated location on priority basis.
- The stores come along with a supplier’s note, invoice and tally sheets. Sealed parcels shall be preferred particularly when it is not feasible to check the items received immediately. The invoice/ receipt shall be signed by the master alongwith the department head, putting suitable remarks, as observed regarding the apparent condition of the parcel/ items. It shall be clearly mentioned on the receipt if the contents of the parcel are not checked on receipt.
- The received items shall be checked at the earliest opportunity. Whenever, the items are checked, invoice/ receipt along with the requisition form and inventory register shall be taken with reference. The items shall be correctly identified, quantity and condition checked, and noted. The quantity and specifications shall be checked against that mentioned in the invoice and that was requested.
- The defective/ damaged items or those not meeting the specifications will need to be returned to the supplier via a suitable port or the agencies of the supplier at different port. The event is organized in coordination with the shipping company. Details regarding the same shall be notified to the shipping company.

- Once received and checked, the inventories are updated. Stowage and securing should be immediately taken after final cross check. Items should be put in their proper designated places, and not kept lying around. The items shall be moved to their designated places and stored.
- The stores shall be kept organized keeping the items in suitable locations so that same can be easily located when required. Labels shall be used to identify what is kept where. Stores will require squaring up at regular intervals and after experiencing heavy weather at sea.
- Stores should be secured for sea, ensuring proper lashing, if required have been taken of these items. Company specific instructions shall be followed for procedures of preparing requisitions, receiving, checking and returning of stores.

Apply Your Knowledge

1. Assist in receiving stores and cross checking with reference to the list of items in the invoice. Discuss the company specific procedure fro notifying any defective items received on board.

IMU

Function: Controlling the operation of the ship and care for persons on board

Competence: Maintain seaworthiness of the ship

Task number: C2.4

Sub task Reference number: C2.4.18, C2.4.19

Topic: Seamanship practices

Task Heading

- Assist with rigging of pilot ladder and combination ladders. Monitor Pilot's safety when embarking and disembarking.
- Assist crew in checking condition of pilot ladder ropes, steps and securing arrangements.

Objectives

- Understand the importance and procedure of rigging the pilot ladder and combination ladders correctly and safely.
- Understand the procedure of monitoring Pilot's safety when embarking and disembarking

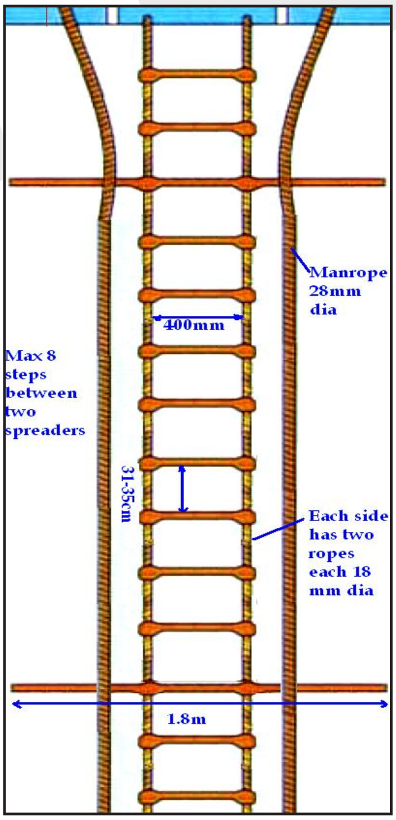
Index

1) Pilot transfer arrangements
2) Pilot ladder construction
3) Accommodation ladders used in conjunction with pilot ladders (combination ladders)
4) Pilot transfer by helicopter
5) Rigging pilot ladder/ combination ladder

Description

1) Pilot transfer arrangements

- Normally, Pilot's board and disembark using a traditional rope ladder called the pilot ladder. The operation is of a critical nature and requires safety measures to be taken in conjunction with seamanship. A poorly maintained pilot ladder, incorrect rigging or lack of monitoring is likely to result in accidents.



- SOLAS Chapter V, regulation 23 sets out the principal requirements for the pilot transfer arrangements. The pilot ladder is a critical interface that clearly requires the highest standards and a standardized approach from all vessels.

- Pilot transfer arrangements are provided to enable the pilot to embark and disembark safely on either side of the ship. This includes pilot ladder (and combination ladder) to be available on either side or, the same shall be readily transferable.

- Means of transfer include
  - ❖ a pilot ladder requiring a climb of not less than 1.5 m and not more than 9 m above the surface of the water
  - ❖ an accommodation ladder in conjunction with the pilot ladder (a combination arrangement), or other equally safe and convenient means, whenever the distance from the surface of the water to the point of access to the ship is more than 9 m

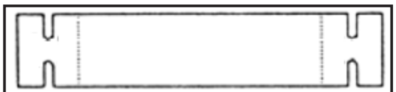
- Pilot ladders must be clearly identified. These ladders are subject to general examination without any load test checked during safety equipment surveys. A record shall be kept onboard with the date the pilot ladder is placed into service and any repairs carried out.
- These ladders alongwith associated appliances should be kept clean, properly maintained and stowed and should be regularly inspected to ensure that they are safe to use. Ladders should be stowed in a dry and well ventilated location, clear of the deck. It shall preferably be fitted with a cover to protect from sunlight, chemical or paint spills, etc and inspected for damage to steps, ropes and lashings before use.
- These ladders should be used solely for the embarkation and disembarkation of personnel. Officers and crew rigging the pilot ladder should always check the condition of the ladder before it is rigged and also ensure it is secure to the ship.
- The rigging of the pilot transfer arrangements and the embarkation of a pilot shall be supervised by a responsible officer. The responsible officer shall be in communication with the navigation bridge. A portable transceiver is generally carried as means of communication between the officer and the navigation bridge. The responsible officer shall arrange for the escort of the pilot by a safe route to and from the navigation bridge. Personnel engaged in rigging and operating any mechanical equipment shall be well conversant with the safe procedures and the equipment. The equipment shall be tested prior to use.

2) Pilot ladder construction

> Use of mechanical pilot hoists is prohibited. Shipside doors that are used for pilot transfer shall be those not opening outwards.

- The steps of the pilot ladder should be made of one piece hardwood free of any knots. Hardwood generally includes ash, oak, elm, beech or teak. Other than hardwood, materials may be used for steps provided they should be of equivalent strength, stiffness and durability to the satisfaction of the flag state administration. Steps made from aluminium alloy are unacceptable. The lowest four steps are vulnerable to failure upon being squeezed between the ship and a pilot boat and hence these may be made of rubber of sufficient strength and stiffness or other material to the satisfaction of the administration.
- The dimensions of the steps should be not less than 400mm between the side ropes, 115mm wide and 25mm in thickness, excluding any non-slip device or grooving. The surfaces should be efficiently non-slip surfaces.

- In the ladder, the steps are equally spaced not less than 310mm or more than 350mm apart. They should be secured in such a manner that each will remain horizontal evenly leveled in both the longitudinal and transverse directions.

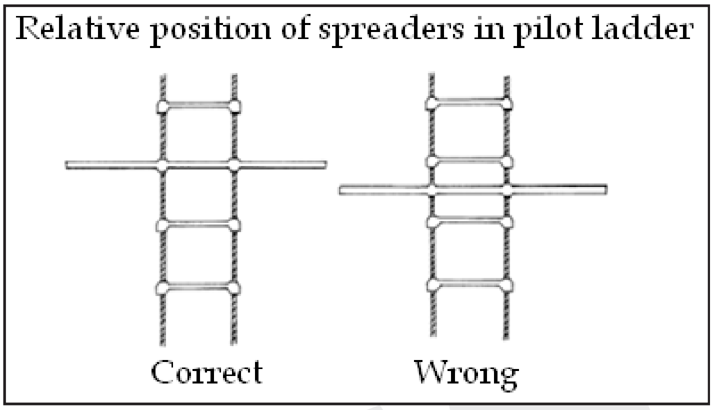


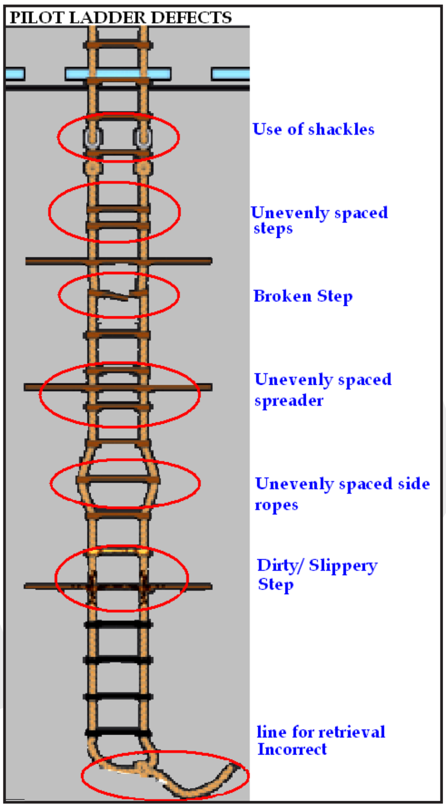
Replacement step

- When steps in a pilot ladder are replaced due to some reason, these should be replaced as soon as reasonably practicable by steps secured in position by the method used in the original construction of the pilot ladder. Maximum two replacement steps may be secured in position temporarily, by a method different from that used in the original construction of the ladder.
- Pilot ladders having more than five steps should be fitted with spreader steps in between steps replacing the intermediate steps. The spreader steps shall be less than 1.8m long. The position of spreaders in the ladder shall be such as to prevent the pilot ladder from twisting. The lowest spreader step should be the fifth step from the bottom of the ladder and the interval between any spreader step and the next should not exceed nine steps.

❖ A permanent marking shall be provided at regular intervals (e.g. 1 m) throughout the length of the ladder consistent with ladder design, use and maintenance in order to facilitate the rigging of the ladder to the required height.

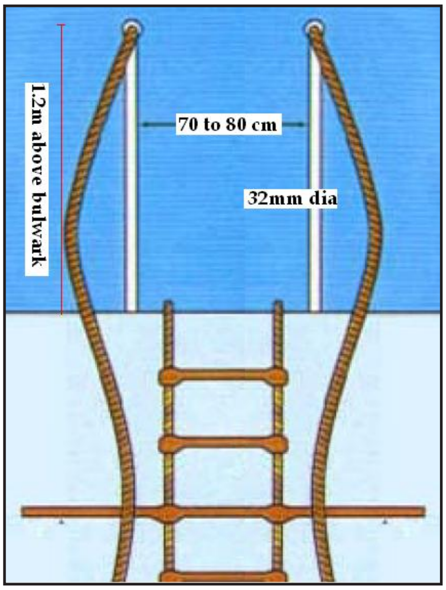
❖ The pilot ladders are made using two manila ropes (or a material with similar properties with regards to strength, durability, elongation characteristics and grip) on either side. These side ropes should be uncovered ropes atleast 18 mm in diameter on each side and should be continuous, with no joints. The breaking strength of these ropes shall be at least 24 Kilo Newton per side rope. The two side ropes should each consist of one continuous length of rope, the midpoint half-length being located on a thimble large enough to accommodate at least two passes of side rope.





❖ Each pair of side ropes should be secured together both above and below each step with a mechanical clamping device properly designed for this purpose, or seizing method with step fixtures (chocks or widgets), which holds each step level when the ladder is hanging freely. The preferred method is seizing. Use of metallic bull dog grips is not acceptable.

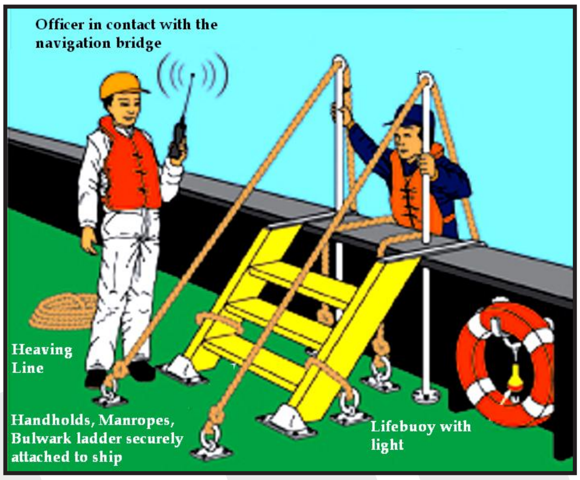
❖ Safe convenient and unobstructed access to deck from the pilot ladder/ combination ladder shall be provided. Such access should be gained directly by a platform securely guarded by handrails. Adequate handholds shall be provided where a gateway is provided in the rails or bulwark. Further, a bulwark ladder, two handhold stanchions rigidly secured to the ship's structure at or near their bases and at higher points shall be fitted. The bulwark ladder shall be securely attached to the ship to prevent overturning. The clearance between two handhold stanchions should be not less than 0.7 m or more than 0.8 m apart. The handholds, further, should be not less than 32 mm in diameter and extend not less than 1.2 m above the top of the bulwarks. These shall be rigidly secured to the ship's structure at or near its base and also at a higher point. Stanchions or handrails should not be attached to the bulwark ladder.



➢ In addition to above arrangements, additional equipments that shall be placed near pilot ladder are

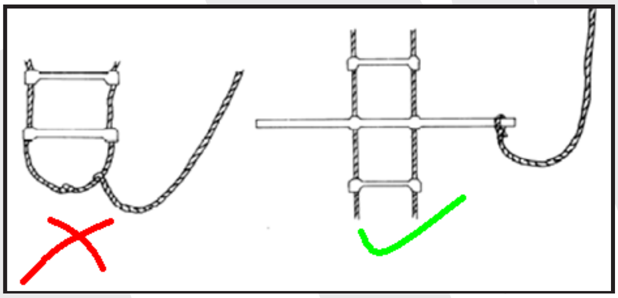
- ❖ two man-ropes of diameter minimum 28 mm and not more than 32 mm properly secured to the ship if required by the pilot
- ❖ a lifebuoy equipped with a self-igniting light
- ❖ a heaving line
- ❖ It is recommended to have additional man standby for last minute requirements at the pilot boarding point and to carry a hand held torch and a heaving line

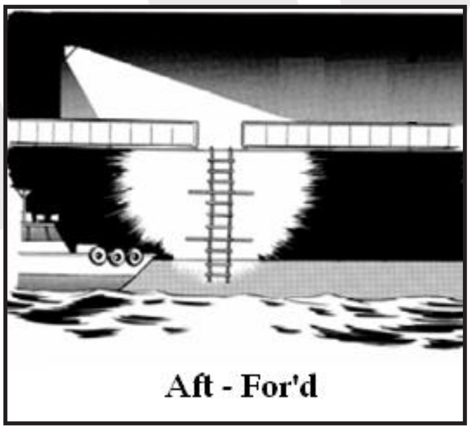
- ➢ Although many pilots do not use man-ropes, positioning of unused man-ropes in such a case might interfere with pilot transfers. It, therefore, is necessary to follow the instructions of the pilot on the preferred disposition.



- ➢ The pilot boarding area, including the pilot ladder, shall be well lit. Usually the flood lights provided on the bridge wings are used for the purpose. The light used for the purpose shall project towards forward.

- ➢ When a retrieval line is considered necessary to ensure the safe rigging of a pilot ladder, the line should be fastened at or above the last spreader step and should lead forward. The retrieval line should not hinder the pilot nor obstruct the safe approach of the pilot boat. Recognizing dangers involved, due to being trapped by a hanging line in a loop with one end connected to the lower end of the pilot ladder for recovery operation, it is recommended that such a line should not be used.

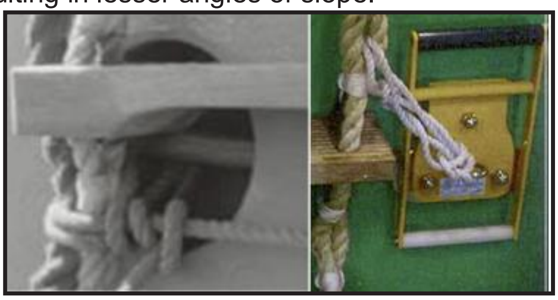




- ➢ Ships having rubbing bands or other constructional features might prevent the safe approach of a pilot boat. These may require be cut back to provide at least 6 metres of unobstructed ship's side.

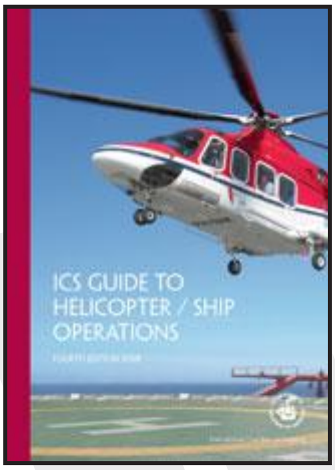
3) Accommodation ladders used in conjunction with pilot ladders (combination ladders)

- ➢ In cases where the freeboard of the vessel is 9 metres or more, combination ladders are used. The accommodation ladder should be at least 600 mm wide and long enough so that its angle of slope does not exceed 45°. In ships with large draft ranges, several pilot ladder hanging positions may be provided, resulting in lesser angles of slope.



- ➢ When rigged, the lower platform of the accommodation ladder should be in a horizontal position atleast 5 m above sea level. It shall be secured to the ship's side when in use. This may be done by permanent connection points in the hull, or alternatively other equipment such as suction or magnetic pads that provide a sufficient holding force may be used. Treads and steps of the accommodation ladder should be so designed that an adequate and safe foothold is given at the operative angles.

- The ladder and platform are equipped with stanchions and rigid handrails on both sides. However, in case hand ropes are used, these should be tight and properly secured. The vertical space between the handrail or hand rope and the stringers of the ladder should be securely fenced.
- The pilot ladder should be rigged immediately adjacent to the lower platform of the accommodation ladder, the upper end extending at least 2 m above the lower platform. The horizontal distance between the pilot ladder and the lower platform should be between 0.1 and 0.2 m.
- Where a trapdoor is fitted in the lower platform to allow access from and to the pilot ladder, the aperture size should not be less than 750 mm x 750 mm. The trapdoor should be designed to open upwards and be secured either flat on the embarkation platform or against the rails at the aft end or outboard side of the platform. This should not form part of the handholds. The pilot ladder should extend above the lower platform to the height of the handrail and remain in alignment with and against the ship's side.



4) Pilot transfer by helicopter

Where embarkation or disembarkation involves the use of a helicopter, reference shall be made to the ICS Guide to Helicopter/Ship Operations.

5) Rigging pilot ladder/ combination ladder

- The pilot ladder/ combination ladder shall be rigged clear of any possible discharges from the ship. Any overboard discharges from which the discharge is likely to fall onto the pilot ladder site, shall be plugged on the occasion, if so required.
- These shall be rigged within the parallel body length of the ship and, as far as is practicable, within the mid-ship half length of the ship. Each step of pilot ladder shall firmly rest against the ship's side. Where constructional features, such as rubbing bands, would prevent the implementation of this provision, special arrangements shall, to the satisfaction of the administration, be made to ensure that persons are able to embark and disembark safely.
- The single length of pilot ladder shall be capable of reaching the water from the point of access to, or egress from, the ship. Due allowance shall be made for all conditions of loading and trim of the ship, and for an adverse list of 15°.
- The pilot ladder shall be secured to strong securing point using shackles and securing ropes which are at least as strong as the side ropes of the ladder.
- The accommodation ladder used in combination ladder shall be sited leading aft.
- When in use, means shall be provided to secure the lower platform of the accommodation ladder to the ship's side, so as to ensure that the lower end of the accommodation ladder and the lower platform are held firmly against the ship's side within the parallel body length of the ship.
- When a combination arrangement is used for pilot access, means shall be provided to secure the pilot ladder and manropes to the ship's side at a point of nominally 1.5 m above the bottom platform of the accommodation ladder. In the case of a combination arrangement using an accommodation ladder with a trapdoor in the bottom platform, the pilot ladder and man ropes shall be rigged through the trapdoor extending above the platform to the height of the handrail.

- Whether to use pilot ladder or combination ladder for checking the 9 mtr criteria, mark is made on the shipside. The height is measured from the water surface to the landing point on deck, or incase crossing bulwark, from water surface to top of bulwark. If the mark is at or above water surface that means, combination ladder is required.
- When the height from the water to the point of access to the ship is less than 1.5 metres, the pilot may embark or disembark the ship directly without using the pilot ladder.

Apply Your Knowledge

1. Refer to the pictures below and match the fault observed with the right picture.

   Fault

   a. Poor condition of steps

   b. Pilot ladder rigged instead of combination ladder, thought the freeboard is more than 9 metres

   c. Pilot ladder step loose

   d. Steps not correctly secured in the ladder

   e. One Manrope missing

Picture 1	Picture 2	Picture 3
		

Function: Controlling the operation of the ship and care for persons on board

Competence: Maintain seaworthiness of the ship

Task number: C2.4

Sub task Reference number: C2.4.20

Topic: Seamanship practices

Task Heading

- Assist crew in rigging accommodation ladder, gangway and gangway net.

Objectives

- Understand the importance and procedure of rigging the accommodation ladder, gangway and gangway net correctly and safely.

Index

1) Gangways and accommodation ladders
2) Rigging of gangways and accommodation ladders
3) Gangways and accommodation ladders – rigging checklist

Description

1) Gangways and accommodation ladders

- The ship's gangway and accommodation ladders are required to be of suitable construction conforming to standards laid out by IMO and ISO. These are further subject to maintenance and annual survey requirements as discussed later in this task.
- The structure of the accommodation ladders and gangways and their fittings and attachments is made so as to allow regular inspection, maintenance of all parts and lubrication of their pivot pin. Special care is taken to ensure that the welding connection works are properly performed.
- Every accommodation ladder or gangway carry a marking plate fitted on the bottom end plate which mentions the maximum and minimum permitted design angles of inclination, design load and maximum load and operational load restrictions.
- At every five-yearly survey, the gangway is required to be operationally tested with the specified maximum operational load. The winch is tested as a part of the complete gangway unit through a minimum of twice hoisting and lowering of the gangway. New gangway is subjected on installation to a static load test of the specified maximum working load.
- Where possible, boarding arrangements shall be positioned clear of the cargo working areas where cargo is likely to pass overhead. It may require hiring a shore gangway if the same cannot be achieved with ship's own equipment.
- Gangways should be secured to the ship only at designated points of suitable construction designed for the purpose. If positioned through an open section of bulwark or railings, any remaining gaps should be roped off to a height of at least one metre.
- Gangways should not be used at an angle greater than 30° from the horizontal and accommodation ladders should not be used at an angle greater than 55° from the horizontal, unless designed and constructed for use at angles greater than these and marked as such.
- A safety net should be installed in way of gangways where it is possible that a person may fall from the means of embarkation and disembarkation or between the ship and quayside. These nets are often the subject of observations and are frequently found to be secured to each side of the ladder along its entire length. This results in the net hanging

uselessly below the steps instead of leading away to the side of the ship to catch anyone unfortunate enough to fall off.

- ➢ The means of embarkation and disembarkation, the position on deck where persons embark or disembark, and the controls for the arrangement shall be suitably illuminated.
- ➢ A lifebuoy with a self-activating light and a separate buoyant lifeline should be stationed at the point of access ready for immediate use.
- ➢ A person should be assigned to monitor the gangway or accommodation ladder for regular adjustment to adjust to the movement caused by tidal conditions and variations in draft and trim. Watch should be maintained on potential dangers ashore such as bollards, tracks and cranes.
- ➢ Any cargo residues accumulating on the ladder and its approaches during a port stay should be cleaned away regularly to prevent a slip/trip hazard. Also, steps, handrails and platforms should be free of oil, grease and ice.
- ➢ The inspection and maintenance of accommodation ladders and gangways be conducted periodically. Monthly inspection and maintenance is included in the planned maintenance system and should always be carried out in accordance with manufacturers' instructions. Each time the ladder is rigged, it shall be checked, including the underside of gangways, for signs of damage, distortion, cracks and corrosion.
- ➢ The lifting equipment should be inspected, tested and maintained, paying careful attention to the condition of the hoist wire.
- ➢ Bent stanchions should be replaced or repaired, and guard ropes should be inspected for wear and renewed where necessary. Moving parts should be free to turn and should be greased as appropriate.
- ➢ The wires used to support the means of embarkation and disembarkation should be renewed when necessary.
- ➢ The **Annual surveys** of the gangways and accommodation ladders include the following:

❖ Accommodation ladder
Thorough examination of
- ✓ steps
- ✓ platforms
- ✓ all support points such as pivots, rollers, etc.
- ✓ all suspension points such as lugs, brackets, etc.
- ✓ stanchions, rigid handrails, hand ropes and turntables
- ✓ davit structure, wire and sheaves, etc

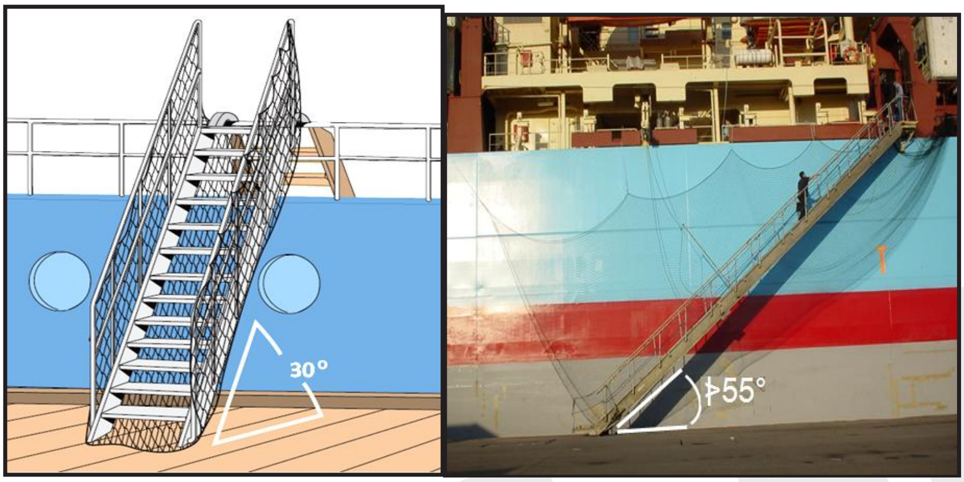
❖ Gangways
Thorough examination of
- ✓ treads
- ✓ side stringers, cross-members, decking and deck plates
- ✓ all support points such as wheel and rollers
- ✓ stanchions, rigid handrails and hand rope

❖ Winches
Thorough examination of
- ✓ brake mechanism, including condition of brake pads and band brake, if fitted
- ✓ remote control system
- ✓ power supply system (electric/air motor)

- ➢ Records shall be maintained concerning surveys, testing and maintenance of accommodation ladders/ gangways and fittings. These include
- ✓ details of the dates of inspection / maintenance
- ✓ details of the work undertaken
- ✓ the name of the person or body undertaking the work

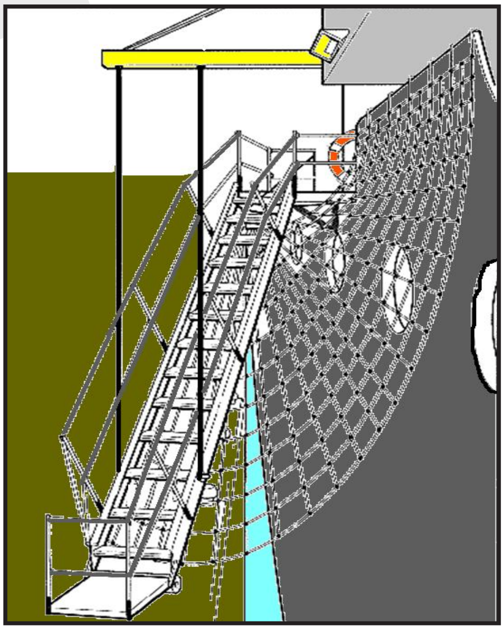
- ✓ the due date for the next inspection
- ✓ the date of the renewal of the fall wires

- It is also recommended that the date of fall wire renewal is stenciled in the vicinity of the fall wire winch.
- The accommodation ladder or gangway should be subject to a visual inspection each time it is rigged.



2) Rigging of gangways and accommodation ladders

- Operating instructions should be posted in the vicinity of the boarding arrangements.
- The personnel required to rig ladders or operate lifting gear shall be sufficiently experienced.
- A risk assessment or job safety assessment is required to be carried out beforehand wherever new joiners are involved in operation. Additional measures to reduce the risk are necessary before commencing the operation.
- Suitable protective equipment should be worn as appropriate including personal floatation devices and safety harnesses of the arrestor type. Fall arrestors should always be attached to suitable securing points fixed to the ship's structure.



- When landed on the quay, care should also be taken to ensure that the lifting bridle and/or davit arm is kept well above head height or moved clear as necessary.
- As far as practicable the approaches to the ladder both on deck and on the quay should be free of hazards to allow safe access and egress to and from the vessel.
- Close attention should also be paid to any significant difference in height between the ends of the ladder and the quay or deck. This may mean placing and securing a portable step or steps in such locations to minimize the risk of slips and falls. Warning notices should be posted in such cases.
- When gangways are designed to be placed on top of bulwarks, a suitable bulwark ladder should be used between the deck and the gangway. It should be adequately secured and

all gaps between the top of the bulwark ladder and the gangway should be fenced off to a height of at least one metre.

- **Important check items on the rigged gangway/ accommodation ladder**
  - Steps free of oil, grease and ice
  - Rope guardrails tight and free of damage and/or degradation
  - Stanchions free of distortion and all in place
  - Safety net positioned between ladder and ship, free of damage and/or degradation
  - Lifebuoy fitted with a light and a lifeline with a quoit available at the point of access
  - Lighting arrangements positioned effectively
  - Hoisting arrangements clear of head height
  - Bottom platform level (where fitted)
  - Base clear of obstructions

3) Gangways and accommodation ladders – rigging checklist

- Preparatory work
  - Sufficient number of experienced personnel available
  - Less experienced personnel supervised
  - Work plan discussed and tasks allocated
  - Risk assessment conducted if deemed necessary and close out all action points
  - Personal protective equipment including suitable personal floatation devices and fall arrestors are worn as necessary
  - Boarding arrangements will be clear of working areas
  - Obstructions likely to impede lowering/positioning checked
  - Lifebuoy with light and buoyant line with quoit placed in close by position

- Rigging
  - Test and position lighting arrangements
  - Check that ladder is sufficiently stable
  - Check that the angle of inclination is satisfactory
  - Check safety net for wear and defects
  - Fit safety net correctly to span gap between the outboard side of the ladder and the vessel
  - Inspect rope guardrails for wear and ensure ropes are pulled tight
  - Examine stanchions and fixed guardrails for damage and secure in position
  - Ensure bottom platform is level (accommodation ladders, where fitted) and suitably fenced
  - Check boarding arrangements are free of oil, grease and ice
  - Ensure that lifting equipment/bridle does not cause an obstruction
  - Position and secure additional steps if required
  - Post notices warning of additional steps as appropriate
  - Ensure bulwark ladders, where used, are properly secured
  - Rope off any gaps in the bulwark or railings
  - Verify that safe access exists at shore side end of ladder
  - Verify that safe access exists at shipboard end of ladder
  - Examine ladder closely for signs of distortion, cracks or corrosion
  - Examine hoisting wires and equipment for wear and damage
  - Report and record all defects found and equipment replaced
  - Post sailing board

- Tending
  - Ensure gangway watch is maintained throughout
  - Check regularly whether repositioning is required
  - Check regularly whether safety net/rope guardrails require adjustment
  - Watch out for potential obstructions ashore
  - Keep the access arrangements and approaches clear of ice, oil, grease and cargo residue
  - Carry out regular checks to ensure that safe access is maintained

Apply Your Knowledge

1. Discuss the procedures required to place a gangway/ accommodation ladder at berths where the distance between the shipside and the jetty are large.

IMU

Function: Controlling the operation of the ship and care for persons on board

Competence: Maintain seaworthiness of the ship

Task number: C2.4

Sub task Reference number: C2.4.21, C2.4.22

Topic: Seamanship practices

Task Heading

- Prepare steel plates and other surfaces for protective coating.
- Demonstrate various painting techniques and correct procedure for mixing of paints.

Objectives

- Understand the importance of preparing the surface prior painting
- Understand the various painting techniques and correct procedure for mixing of paints.

Index

1) Surface preparation
   a) Removal of oil and grease
   b) Removal of salts
   c) Surface preparation grades
   d) Surface preparation using manual tools
   e) Surface preparation by power tools
   f) Surface preparation using water
   g) Surface preparation by abrasive blasting
   h) Safety precautions during surface preparation
2) Painting
   a) Paint systems on board
   b) Application of paint coatings
   c) Means of paint application
   d) Application conditions
   e) Causes of paint failure
   f) Personal protection

Description

1) Surface preparation

Proper surface preparation is essential for the success of any marine coating scheme for corrosion prevention. Removal of oil, grease, old coatings, surface contaminants such as mill scale, rust, salts dirt and dust etc play a prominent role. The most expensive and technologically advanced coating system is likely to fail if the surface preparation is incorrect or incomplete. The main objective of surface preparation is to ensure that all such contamination is removed to reduce the possibility of corrosion and to create a surface profile that allows satisfactory adhesion to the coating to be applied.

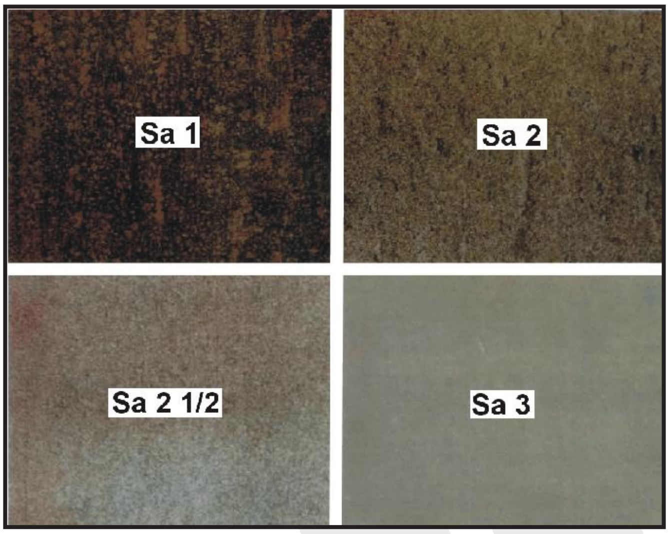
a) Removal of oil and grease

- The presence of even a very thin layer of oil or grease impairs adhesion of paint. Solvents (e.g. paraffin or white spirit) can be used to dissolve the grease, but the same need to be removed completely. Commercial chemical cleaners, such as detergents which can be rinsed with water are available but before they are used it must be determined that they will not adversely attack the painted surface. It is imperative that all traces of the cleaner should be removed before painting.

b) Removal of salts

- Sea salts are present in abundance. Paint over salt residues will certainly lead to detachment or blistering of the fresh paint. Surface irregularities, porosity, fine hair cracks in a paint surface, spongy antifouling films etc hold these salts on the surfaces. The salts are fairly easily dissolved in water. However, high pressure fresh water washing or water hosing with thorough scrubbing should be employed to remove these salts from the surfaces.

c) Surface preparation grades



National Association of Corrosion Engineers (NACE), Steel Structures Painting Council (SSPC) and Swedish Standards grade surface preparation. According to Swedish standards, the different grades of surface preparation possible by manual preparation on board are as follows.

- ❖ **St 2** - Hand tool cleaning
- ❖ **St 3** - Power tool cleaning

Surface preparation levels possible by blast cleaning are graded as follows:

- ❖ **Sa 1** Light blast cleaning
- ❖ **Sa 2** Thorough blast cleaning
- ❖ **Sa 2 ½** Very thorough blast cleaning
- ❖ **Sa 3** Blast cleaning to visually clean steel

d) Surface preparation using manual tools

Chipping is done using hand held chipping hammers, scrapers and wire brushes. Some of the scrapers are fitted with long handles enabling better leverage when scraping decks. Long handle scrappers are very useful to remove loose paint on the surface prior to repainting a good surface. However, the process is time consuming and only small areas can be covered. The manual chipping tools cause dents and pitting on the steel surface and hence only standards of St2 and St3 can be obtained by this method. Loosely adhering mill scale, rust and old paint coatings may be removed from steel by hand wire brushing, sanding, scraping and chipping. However, these methods are incomplete, and always leave a layer of tightly adhering rust on the steel surface.


e) Surface preparation by power tools

- ❖ Some of the power tools most commonly used on board the ship are
  - Needle chisel (commonly known as the Jet chisel)
  - Pneumatic scrapper/ hammers
  - Electrical / pneumatic chipping machines
  - Electrical / pneumatic wire brushes
- ❖ Electrical chipping machines are used on decks, hatch covers tops and flat surfaces excluding vertical surfaces and bulkheads. The end result is good but they do create

medium to heavy indentations. Mechanical wire-brushing may be used where blast cleaning is impossible. It is important to bear in mind that although steel wire brushing process tends to give the surface a bright polishing effect, a lot of rust does remain. The polishing effect may also lead to a very smooth surface which gives bad adhesion to paint coating. Hence steel wire brushes should be used in conjunction with other tools when removing thick layer of rust and the surface should be thoroughly cleaned after wire brushing prior to applying a coat of paint. On ships carrying hazardous cargoes or tankers, electric tools are not used and pneumatic versions are used.






f) Surface preparation using water

❖ **Low pressure water washing**
Used to clean surface salts, dust and very loose surface debris, the pressure normally is less than 68 bar (< 1000 psi)

❖ **High pressure water washing**
The pressure in this type of washing normally varies between 68 and 680 bar (1000 - 10,000 psi). A pressure of between 68 - 204 bar is used to clean salt, dirt, loose coatings and leached layer of anti-fouling and a higher pressure between 204 - 680 bar is used for cleaning salt, dirt, intact coatings and selective removal of coatings.

❖ **High pressure fresh water washing (Hydro-blasting)**
This is a cleaning technique which relies entirely on the energy of water striking a surface to achieve its cleaning effect. Two different operating pressures are usually used:
- High pressure hydro-blasting operating at pressure above 680 bar (10,000 psi).
- Ultra high pressure hydro-blasting operating at pressures above 1700 bar (25,000 psi).

- Advantages of hydro-blasting over dry abrasive blasting are
  - No abrasive used and hence injury potential reduced.
  - No respiration problems for operators from dust.
  - Lower levels of noise.
  - No spark production.
  - It minimizes disruption of other work in the vicinity.
  - No dust contamination on wet paint.
  - No clean up requirements.
  - No waste disposal after blasting.
  - Reduced salt levels on the surface after hydro-blasting.



g) Surface preparation by abrasive blasting

Abrasive blasting is an efficient method of surface preparation. It removes rust, mill-scale and other matter and will also develop a surface roughness, which is needed to promote the adhesion of some paint coating. Steel shot and grit, mineral grits, sand and metal slags are used as abrasives. Blasting can either be done with dry abrasives or with wet abrasives. However, this method does not totally remove soluble salts, dirt, oil stains and grease and hence thorough high pressure water washing and drying is a must prior to coat application. Some of the dry abrasive methods are as follows.

Technique	Sand Blasting	Grit Blasting	Shot Blasting
Abrasive Used	Silica Sand	Copper or Iron Slag	Steel or chilled iron shots with added steel grit
System Functioning	Uses Dry Compressed air, open blasting, no recycling of abrasive, the abrasive is expendable	open blasting, no recycling of abrasive, the abrasive is expendable	Equipment consists of rotating impellers, no compressed air, closed type, abrasive is recycled
Uses	Can be used on all surfaces old and new, fine sand- poses a health hazard,	Can be used on all surfaces old and new	On new steel to be shop primered for new construction,
Surface Preparation	Can give standards Sa1 to Sa3, profile fine and angular	Can give standards Sa1 to Sa3, profile angular	Can give standards Sa1 to Sa3, good results obtained only on flat surfaces
Remarks	Cheapest form of blasting, banned in most developed countries, progressively being banned	Causes large amounts of dust and pollution, portable and used in difficult areas, most surfaces can be treated	-

- **Shot blasting**

This type of blasting is usually used in a shipyard and is a very big and a closed system in which the shot is slung against the plates from rotating wheels. The shot is collected, cleaned of dust and automatically returned for use. Equipment for dust-free blasting is also available; this has two hoses to the nozzle, one inside the other, with the inner hose containing both the blasting material and compressed air and the outer hose sucking back the used blasting material and the dust into a bag. One disadvantage with this equipment is it is mainly used for small areas like welded seams.

❖ **Grit and sand blasting**
Open blasting machines are used for grit and sand blasting. The equipment consists of a sand or grit container, a kind of hopper feeder for grit and air, air hoses and nozzles. Grit either flows on its own into the blasting hose or is driven by pressure from the grit container. The grit in the container is subject to the same pressure as it runs through the blasting hose and through the grit valve. The container sizes vary depending on the purpose for which the machine is used and containers up to 200 litres are available. The grit should be filtered through a mesh to prevent pieces of paper from the bags or other foreign matter from entering the container, as this may block the valve or the nozzle.

❖ These three methods, shot blasting, grit blasting and sand blasting are dry blasting methods. Steel surfaces can also be prepared by using wet abrasive, for example: slurry made of abrasive and water. As with the water washing and hydro-blasting, slurry-blasting is also done either at low pressure or at high pressure.

h) Safety precautions during surface preparation

❖ All persons involved in any of these operations should wear personal protective equipment which includes full sleeve boiler suits, safety shoes, hand gloves, safety helmets, ear muffs and eye protectors. When doing sand blasting safety suit on top of the boiler suits and head mask should be worn.
❖ Manufacturer's instructions for all pneumatic, electrical and hydraulic tools and equipment used for chipping, sandblasting and painting shall be followed.
❖ When using electrical equipment ensure that the electrical cables are in order with no damage, the instrument is properly connected to the socket by means of a plug and not by just inserting the wires into the socket. The electrician on board should check the equipment for earthing on a regular basis and the cable should be led on deck in such a way that other moving objects on deck will not damage it.
❖ An air-supplied hood that protects the head, neck and shoulders must be worn by sandblast operators. The supplied air breathing equipment may be removed only when they are well away from the work location as silica dust and other contaminants can remain suspended in air for long.
❖ Work gloves, safety footwear, and coveralls providing suitable protection from rebounding abrasives are a necessity.
❖ The blast nozzle must be grounded, if an electro-statically conductive blast hose is not available. The sandblast pot also must be grounded at all times.
❖ Sandblasting operations shall be carried out so that the abrasive materials and other articulate materials are contained, and pose no hazards to workers or the public.

❖ The entire sandblasting unit must be carefully examined for defects before any work commences. A safety shut down must be provided with the sandblast pot and the sandblast pot must be shut off while being filled with abrasives. The operator must blow out all air lines and hoses.
❖ Sandblasting nozzles must be equipped with a remote control (deadman) switch that allows the operator to control the sandblast at the nozzle.

2) **Painting**

a) **Paint systems on board**

Depending upon the environment to which different parts of the ship's structure is exposed, the paint system is devised. The external ship structure can be divided into three regions:

❖ **Below the water line**
Here the plates are continuously immersed in sea water. The ship's bottom has priming coats of corrosion inhibiting paint which is followed by an anti-fouling coat. Paints used for steels immersed in seawater are therefore required to resist alkaline conditions and should have a good electrical resistance so that the flow of corrosion currents between the steel and sea water is limited. Some of the suitable paints are pitch or bitumen types, chlorinated rubber, coal tar or epoxy resin, or vinyl resin paints. The anti-fouling paints may be applied after the corrosion inhibiting coating and should not come into direct contact with the steel hull, since the copper and mercury compounds present may cause corrosion.

❖ **The waterline or boot topping region**
Where immersion is intermittent and a lot of abrasion occurs due to contact with jetty, tug boats and fenders. The paints used in this area are usually vinyl and alkyd resins or polyurethane resin paints.

❖ **The topsides and superstructure areas**
These are areas which are exposed to various types of weather such as salt spray, rain and sunlight. Also these areas are prone to damage through cargo handling or dragging of heavy loads. Conventional primers like red lead or zinc chromate is used as primers. Depending on the painting system of the ship other primers may also be used. Lead based paints should never be applied on aluminium such as the gangway. Zinc chromate paints are generally used on aluminium.

➢ **Types of paints and their properties**

❖ **Tar and bitumen**
- ✓ Tar from distillation of coal
- ✓ Bitumen from distillation of crude oil
- ✓ Water resistance good
- ✓ Colour black / brownish
- ✓ Low cost
- ✓ Poor resistance to sunlight,
- ✓ Good penetration

❖ **Chlorinated rubber paint**
- ✓ Water resistance good
- ✓ Chemical resistance good
- ✓ Yellows due to chlorine content
- ✓ Disintegration of thin top layer due to sunlight- reduces gloss

❖ **Acrylic paint**
- ✓ Water resistance good
- ✓ Good colour stability
- ✓ Good gloss stability
- ✓ Relatively poor wetting
- ✓ Normally used in gloss finishes for brush application

❖ **Vinyl paints**
- ✓ Chemical resistance good
- ✓ Resistant to weak solvents
- ✓ May become yellow because of chlorine content
- ✓ Low solids content and thus resists strong solvents

- ✓ Relatively poor wetting
- ✓ Solvent borne vinyl based paints are being used less and less, mainly because of the low content of solids and the high price.

❖ **Alkyd based paints**
- ✓ Reasonably good colour and gloss stability
- ✓ Good penetration
- ✓ Relatively low cost
- ✓ Non-resistance to alkali
- ✓ Non-resistance to long term water exposure
- ✓ Used in primers and in quick drying finishes where appearance and flexibility are of less importance.

❖ **Epoxy based paints**
- ✓ Epoxy resin reacts with a curing agent
- ✓ Chemically resistant
- ✓ Good mechanical adherence
- ✓ Disintegration of thin top layer due to sunlight- reduces gloss
- ✓ Delivered as two pack product
- ✓ It is a thermosetting paint

❖ **Polyurethane**
- ✓ Curing occurs when the two components are mixed
- ✓ Curing processes can take place at temperature down to –10º C.
- ✓ Good gloss stability
- ✓ Excellent colour stability
- ✓ Good chemical and mechanical resistance
- ✓ Moisture sensitive during production and application
- ✓ Delivered as two pack product

❖ **Zinc (Ethyl) silicates**
- ✓ Two pack product
- ✓ Cure by absorption of carbon di oxide from air
- ✓ Excellent anti corrosive
- ✓ Excellent wearability and impact resistance
- ✓ Excellent solvent resistance
- ✓ Withstand temperatures up to 400º C

❖ **Silicone paints**
- ✓ Silica based resins, cure at elevated temperatures
- ✓ Temperature resistance up to 550C (pigmented with aluminium)
- ✓ Good corrosion resistance

b) Application of paint coatings

To achieve the protective properties of paint, it has to be applied correctly. Not only the paint thickness, is important for a good result but also the method of application of the paint.

c) Means of paint application

❖ **Conventional flat brushes**

Flat brushes come in varying sizes and types depending on the usage on board. For example: flat brushes, dogleg brushes, round and stencil brushes. The size of the brush also varies with use - pencil brush, ½" brush, upto 4" brush. These are generally used for on board maintenance and small jobs. They are convenient to use in difficult to reach places like corners and angles. The first coat is recommended to be applied using a flat brush. Use of conventional brushes however is very time consuming and multiple coats may be required to achieve required paint thickness. On an average coverage up to 93 m^2 / man can be achieved in a day. Before use these brushes shall be kept immersed in water for some time to allow the wood to swell making a firm grip on the brush bristles.

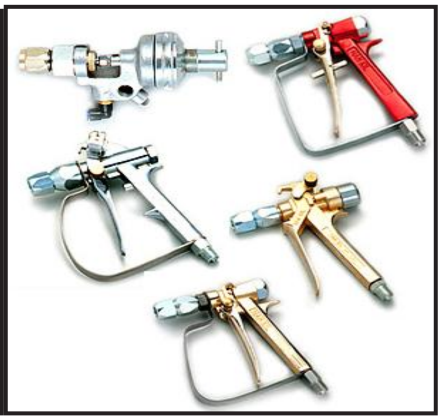
These brushes are usually dipped in water after use so that they do not get hard. Never leave the paint brush in the paint pot after use.

- **Roller brushes**

Roller brushes are used on flat surfaces like bulkheads, decks and deck heads and may not be easy to use in corners and small places. These provide faster coverage of flat areas usually about 186 - 372 m^2/ man day in comparison to a flat brush. Multiple coats by these rollers may be required to achieve correct paint thickness. The use of rollers is not recommended on very porous and rough surfaces. The first coat should preferably be applied by a paint brush or by an airless spray and not with a paint roller because when the paint is rolled onto the surface, large amounts of air are introduced into the paint where it is retained. This air contains moisture thus giving ideal condition for rust formation.

- **Airless spray**

These are machines provided for painting. Paint is compressed to a pressure between 100 and 450 bar and released through a fine nozzle on the spray-gun. This gives the paint a very high speed necessary for atomization, an even and desired thickness can be achieved using these machines. The most important part of the airless spray equipment is the nozzle. The correct nozzle for the required job shall be chosen. The manufacture's instruction booklet recommends the most suitable nozzle for different types of paint job which shall be referred before use. A nozzle is very expensive and it must be handled with great care. It has a tungsten carbide tip with a narrow opening through which the paint is forced. The dimension of the opening varies for different nozzles. Manufacturer's instructions shall be followed for maintenance of the equipment. The equipment is cleaned after use. When the equipment is not in use it should have thinner or cleaner in the whole system, from the ball valve in the bottom of the paint pump to the valve in the spray gun. High pressure hose and spray guns should never be dismounted when the spraying equipment is put away. The equipment requires proper training for the operators. Never point the spray gun at anyone or at yourself. It shall be remembered that the pressure of the spray is high around 300 kg/cm^2**.** Avoid using the spray painting machine at full pressure when the spray gun is not fitted with a nozzle.



Procedures for using airless spraying

- Check tip size and output pressure (use product data sheet provided)
- Hold spray gun 30 - 45 cm from the surface.
- Spray gun to be parallel to surface, 90º from it. As far as possible keep the spray gun pointed at 90º to the steel surface. Holding the spray gun at different angles would produce varying paint thickness.
- Horizontal pass 50cm -100cm and to ensure even film thickness, overlap the previous pass by 50%.
- Trigger should be released at the each pass.
- Individual blocked out areas to be overlapped.
- Follow the paint manufacturer's instructions for drying and over coating times. Each product data sheet gives details of how long it takes to dry for touching or over coating and what is the recommended thickness of the paint film.

d) Application conditions

- ❖ After the preparation of the surface to an acceptable standard of cleanliness and profile, it is important that the steelwork is not allowed to deteriorate. Re-rusting can occur very quickly in a damp environment and unless the steel is maintained in a dry condition coating of the surface should proceed as soon as possible. Any re-rusting of the surface should be considered as a contaminant and be removed by re-blasting.
- ❖ Paint should not be applied in adverse weather conditions. If the temperature is below 5ºC, then only low temperature cure paints should be applied. It is not recommended to apply paint over 35ºC due to dry overspray. Do not apply paint in very windy conditions (this may lead to heavy overspray losses). Not to apply paint on surfaces which are wet due to rain, snow, ice, fog or condensation.
- ❖ Allow painting only when the surface temperature is 3ºC or more above the dew point.

➢ **Paint mixing**

Paint is mixed to disperse solids that may be present. Products like epoxies come in a two-pack where the 'base' and 'hardener', when mixed, chemically react together and cure. All items used for mixing like paint tins, mixer and stick should be clean. This is to avoid any contamination to the paint. A mechanical mixer shall be used when possible. When mixing a two-pack product ensure that the ratio of the base and hardener is correct. This can be obtained from the product data sheets. Whenever possible try and mix full packs of 'base' and 'hardener'. Otherwise, these shall be split to the correct ratio. When mixing a two-pack product always mix with a mechanical mixer.

➢ **Paint thinning**

Thinners shall be used to thin the paints only when necessary. Correct thinner shall be used for the product. This information will be available in the product data sheet. Use of more than 5% by volume of thinners can cause Solvent entrapment, Runs, sags and slumping in painted surface, Retarded cure of paint film and affect wet-film thickness to dry-film thickness ratio.

e) Causes of paint failure

Factors that contribute to paint failure are as follows.

- ❖ Poor surface preparation.
- ❖ Painting in an unfavourable weather condition
- ❖ Incorrect mixing of two pack paints (incorrect ratios).
- ❖ Mixing of thinner and paint incorrect
- ❖ Paint applied by incorrect methods
- ❖ Improper painting done in areas which are difficult to paint
- ❖ Incompatible paints used, for example: the primer and top coats do not match.
- ❖ Proper drying time not allowed between coats
- ❖ Prolonged exposure to the environment such as engine fumes or boiler fumes

- Abrasion caused on the shipside due to the ship coming heavily alongside the jetty, damage done by tugs or fenders and on deck due to moving heavy objects

f) Personal protection

Protective equipments to be used during painting are as follows.

- **Eye and hearing protection**
  - Solvent spray or splashing into the eye can lead to eye damage. Safety goggles should be worn to protect eyes from paint materials as well as the particulates created during sanding and grinding.
  - Some painting equipment such as grinders and compressors create loud noise. Hearing protection should be used.

- **Protective clothing**

  Some of the chemicals can injure skin or cause dermatitis. Coveralls and gloves prevent these chemicals from coming into contact with skin, reducing the risk of damage. Coveralls and gloves shall be worn whenever working with chemicals. The gloves shall be cleaned gloves and coveralls washed regularly to prevent chemicals from accumulating, especially around the cuffs where they can easily come into contact with skin. As an additional protective measure, barrier creams may be used on hands, face and neck.

- **Respirators**
  - Respirators are commonly used during spray painting. The correct type of respirator shall be used for the job depending upon the chemicals being used.
  - The air-purifying type of respirator should be used only during exposure to those specific chemicals described on the respirator cartridge. These cartridges are good only for a limited time and must be replaced with new ones when they have been used for their specific lifetime, they become difficult to breathe through and/ or when one can smell vapours in the mask
  - The atmosphere-supplying type of respirator must be used in some paint spraying operations, particularly with urethane paints or when painting in a confined space e.g. inside a tank.
  - Respirator used must fit properly to ensure adequate protection. Respirator maintenance and cleaning is important. It shall be kept clean and free from leakages. The respirator shall be maintained in good condition by cleaning and sanitizing it regularly. Store it in a clean place. It shall be checked for pliability and signs of deterioration before wearing. If the respirator needs repair, the manufacturer’s recommended replacement parts shall only be used.

- **Fire and explosion hazards**

  Because of the danger of fire and explosion where paints which contain flammable solvents are being used, care should be taken to remove all potential sources of ignition before starting work. This includes naked flames, cutting and welding torches, gas fired heaters and materials which may give off sparks, whether electrical, mechanical, friction or static, and there must be no smoking. Make sure the correct types of fire extinguishers are available at the work site. Flammable materials are required to be stored is flammable materials storage cabinets. Many paint and solvents are flammable materials.

- **Safety precautions during spray painting**
  - Hazardous chemicals in coatings and solvents can enter the body several ways. Workers can inhale chemical vapours from spraying, absorb the chemical by skin contact or inject the chemical with high pressure spray painting equipment.
  - Proper ventilation is important when working with paint coatings. Many coatings contain flammable substances that are aerosolized when sprayed through powered equipment and without proper ventilation, these vapours can build up and create an explosion and fire danger. To prevent sparking a flammable substance, smoking and other sources of

flame near spray painting operations should be prohibited and tools should be properly rated and grounded for work in a spray painting area.

Apply Your Knowledge

1. Discuss the procedures for surface preparation, tools to be used for surface preparation, paints to be used, painting instruments and related safety precautions when the following three spaces are to be painted as per PMS.

   - Dry provisions store
   - Fore peak store
   - Boat deck

I M U

Function: Controlling the operation of the ship and care for persons on board

Competence: Prevent, control and fight fires on board

Task number: C3.1

Sub task Reference number: C3.1.8

Topic: Operation and maintenance of fire fighting appliances (FFA)

Task Heading

- Demonstrate understanding of operation of fixed fire detection and alarm system.

Objectives

- Understand the operation of fixed fire detection and alarm systems

Please read this task in conjunction with task C3.1.18

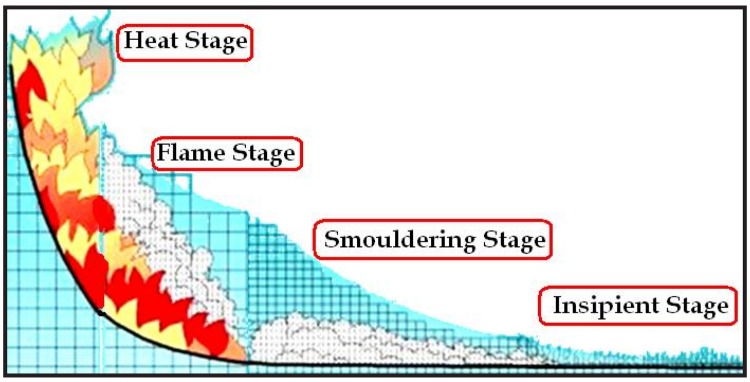
Index

Description

1) Fire detection and alarm systems

- Automatic detection and alarm systems are provided for the purpose of alerting personnel and initiating a system to respond with the aim of reducing loss of life and property due to fires or other hazardous conditions. These systems are usually incorporate one or more circuits where automatic fire detectors, manual activation points, water flow alarm devices, combustible gas detectors and other initiating devices are connected. They may further be equipped with one or more indicating device circuits to which alarm indicating signals, such as control panel indicator and warning lamps, outdoor flashing lights, bells and horns are connected. The sole intention of the system is early detection and possible extinction of a fire before it becomes too deep seated. This is achieved by having sensitive and reliable detection equipment covering the entire area for which it is placed.

- There are various types of automatic detection systems, depending on the area and type of usage. The detectors used on board can be better illustrated with the understanding of the stages of fire and its characteristics in that respective stage, as shown below.



Stage of Fire	Characteristic	Detector Type
Incipient Stage	Invisible particulate matter No visible smoke No flame No appreciable heat	**Ionization and combustion gas detector**
Smoldering Stage	Visible smoke No flame No appreciable heat	**Smoke detector**
Flame Stage	Visible smoke Visible smoke Appreciable heat	**Flame detector**
Heat Stage	Extreme heat Rapidly expanding air	**Heat detector**

- Based on the area of operation, fire detectors operate on one of three principles, sensitivity to heat, reaction to smoke or gaseous products of combustion, or sensitivity to flame radiation and depends on one of the four main characteristics of fire namely:

- Heat: Rise in temperature due to heat produced in a fire can be used to detect fire.
- Smoke (aerosols): A fire always produces aerosols (tiny particles). In this type of detector, an ionization chamber is employed which detects such particles.
- Smoke (visible): Visible smoke is an indication of fire. Some of the detectors use the principle of light scatter on smoke particles to detect fire.
- Radiation: The principle used in these types of detectors is detecting the infra-red or ultra-violet radiation emitted by the fire source.

> Gas Sensing Fire Detectors sense and respond to one or more of the gases produced during the combustion. These detectors are rarely preferred for the reason that fires may go undetected till detectable levels of gases are reached.

2) Heat detectors

- Heat detectors are best suited for fire detection in confined spaces subject to rapid and high heat generation. Since the heat generated by small fires tends to dissipate fairly rapidly, heat detectors are best used to protect confined spaces, or located directly over hazards where flaming fire could be expected. Heat sensing fire detectors fall into two general categories, fixed temperature devices and rate-of-rise devices.
  - Fixed temperature detectors : which respond when the detecting element reaches a predetermined fixed temperature OR
  - Rate of rise detectors: which respond to a specified rate of temperature change

  Some devices combine both principles (rate-compensated detectors).

- Heat detectors respond to the connected thermal energy of a fire. These are designed to sense a prescribed change in a physical or electrical property of a material or gas when exposed to heat. These have the lowest unwanted alarm rate and are the slowest to respond, generally requiring minutes instead of seconds and hence, heat detectors are mostly used in large areas where early warning is not the foremost concern.

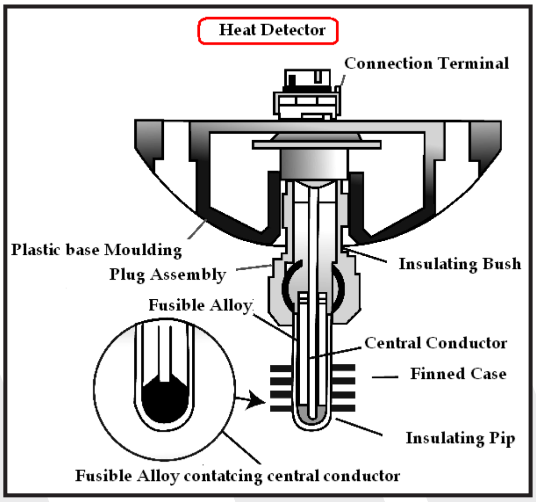
- Heat detectors are certified to operate before the temperature exceeds 78ºC but not until the temperature exceeds 54ºC, when the temperature is raised to those limits at a rate less than 1ºC per min, when tested according to certain standards. Note that the operation temperature of heat detectors in drying rooms and similar spaces of a normal high ambient temperature may be up to 130ºC, and up to 140ºC in saunas.

a) Fixed temperature detectors

- **Bimetal type:** uses two metals with different coefficient of expansion. When both these metals are bonded together and heated, the metal with the higher expansion rate bends or flexes towards the metal having the lower expansion rate. This action closes the open circuit giving an alarm.

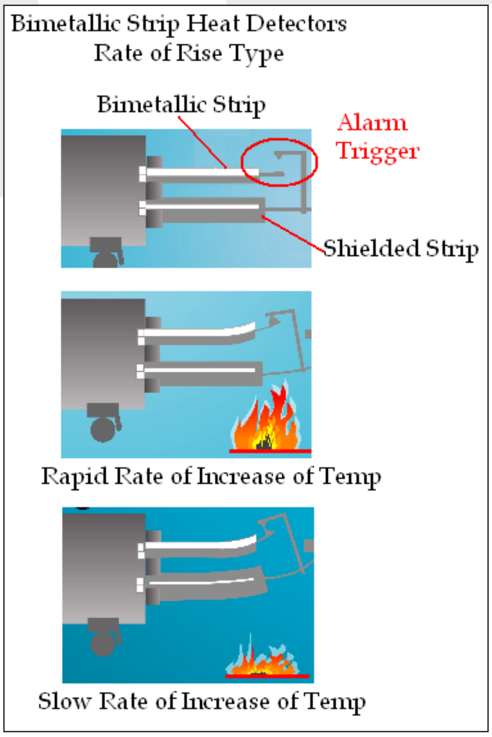
- **Fusible link type:** uses the fact that certain metal-alloys melt at relatively low temperature. The general range available is from 55ºC to 180ºC. In this type the detector consists of a fixed contact blade and a pair of spring contact held under tension by a fusible alloy link. In this condition the electrical circuit is open and the alarm will not sound. When the temperature of the surrounding air reaches the melting point of the fusible link, the spring contact separate and makes contact with the fixed contact blade, completing the electrical circuit and alarm is sounded.

- **Fusible alloy type:** This detector comprises a thin walled metal case fitted with heat collecting fins at its lower end. A conductor extends through the core and the metal casing is lined with fusible alloy that acts as a second conductor. Heat from a fire will melt the fusible alloy at the predetermined temperature and cause it to make contact. This completes the electrical circuit and an alarm is sounded. The range of operating temperature for this detector is 57ºC to 102ºC. Fusible detectors are not self-righting, meaning that once the detector has been operated the link or fusible alloy needs replacing although in most cases this is a reasonably straight forward operation. Remember that the detector is ineffective until replacement takes place after operation.



b) Rate of rise type detectors

These detectors are actuated when the temperature increases faster than the pre-set value. The advantage of this type of detector over the fixed temperature sensor is that these detectors sense the temperature change instead of actually waiting for the temperature to go up to a predetermined level prior to activating the alarm. There are two types of rate of rise detectors - one using bimetallic strips and other using the property of expansion of gases.



- **Rate of rise type using bi-metallic strips**

- Two similar composition bi-metal strips are used in this type of detector. One is shielded and protected to reduce its rate of expansion and another strip lies in open condition. If there is a rapid rise in temperature, the strip which is not shielded will expand faster than the strip which is shielded and will make close the electrical circuit thereby triggering the alarm.

- In some places, due the nature of that area, there may be slight increase in temperature not necessarily due to fire. In such places, due to slow rate of increase in temperature, both the bimetallic strip will maintain the same distance apart and hence there will not be an alarm.

- This property may be disadvantageous due to slow burning fires and hence a fixed temperature device is also fitted in this rate of rise type detectors.

❖ **Rate of rise type using expansion of gases**

- This type of detector is also known as the pneumatic detector as the gas used inside the chamber is usually air. The detector consists of a chamber filled with air and a flexible diaphragm. When subject to heat the air in the chamber expands and applies pressure to the flexible diaphragm. This gradually pushes the diaphragm up until it meets the electrical contact, thereby completing the circuit and the alarm is raised.

> In case of a slow burning fire and the rate of rise element may not detect the slow rise in temperature.

- A small compensating vent in the side of chamber is provided as a rate-of-rise element. The compensating vent will allow a certain amount of expanding air to escape; it will be carefully calibrated so as to compensate only for expansion caused by the normal and legitimate increases in the ambient temperature.

- When there is a rapid rise in temperature the air in the chamber expands much more rapidly than the compensating vent can release it and as a result the expanding air pushes the diaphragm against the electrical contact on the base of the rate of rise adjustment screw. This completes the electrical circuit and the alarm is raised.

3) Smoke detectors

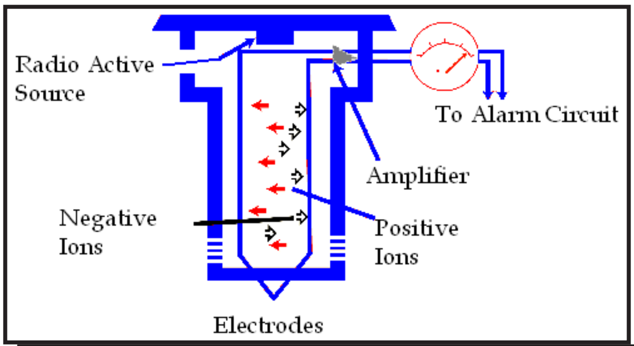
Smoke detectors sense smoke produced by combustion and operate on various principles, including ionization of smoke particles, photo-electric light obscuration or light scattering, electrical resistance changes in an air chamber and optical scanning of a cloud chamber. These detect fires more rapidly than heat detectors. The most common types are ionization types and photoelectric types. Smoke detectors are best suited to protect confined spaces. These should be installed either according to prevailing air current conditions or on a grid layout.

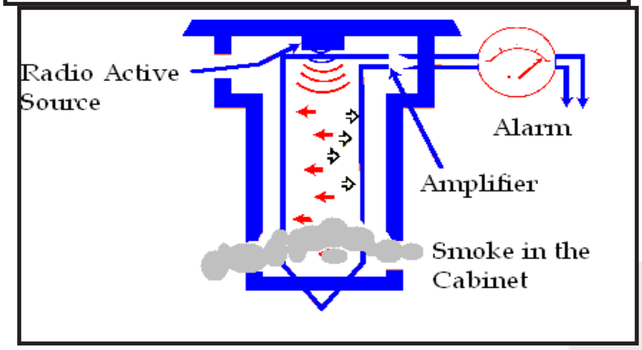
a) Ionization smoke detector

❖ Detectors operating on the ionization principle respond very fast to high-energy (open flaming) fires since these produce large numbers of the smaller smoke particles. These are spot type of detectors having a small amount of radioactive material inside the sensing chamber. The radioactive element ionizes the air in the sensing chamber, rendering it conductive and permitting a current flow through the air between the charged electrodes.

❖ When smoke particles enter the ionization area, they decrease the conductance of the air by attaining themselves to the ions, causing a reduction in mobility. The reduction in conductance lesser than the predetermined level triggers the fire alarm.

❖ These types of detectors find practical use in accommodation spaces and store rooms, except spaces where presence of smoke or fumes triggers off the device unnecessarily. Ionization smoke detectors are useful where flaming fires would be expected.





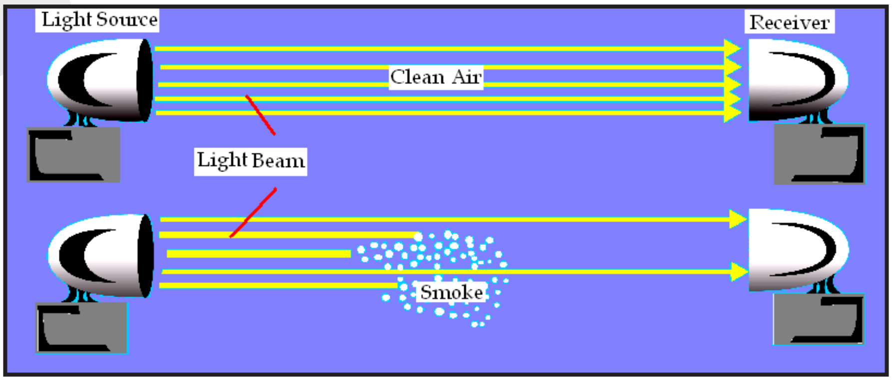
b) Photoelectric smoke detectors

Photoelectric smoke detectors are best used in places where smoldering fires, or fires involving low temperature pyrolysis, may be expected. These types of detectors operate on two principles namely

- ❖ Obscuring of light intensity over beam path,
- ❖ Scattering of light beam

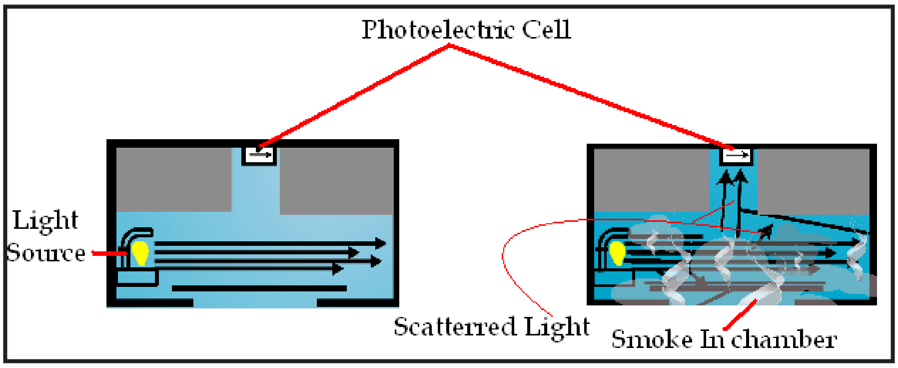
❖ Light obscuring principle

Detectors operating on photoelectric principle respond faster to smoke generated by low energy fires (smoldering) as these fires generally produce larger smoke particles. The detector consists of a light source, a light beam collimating system and a photosensitive device. When smoke particles enter the light beam the light reaching the photosensitive device is reduced, initiating the alarm.



❖ Light scattering type

This type of detector makes use of the principle of light scattering. The detector contains a light source and a photosensitive device so arranged that the light rays do not normally fall on the photosensitive device. When smoke particles enter the light path, the light strikes the particles and is scattered onto the photosensitive device, causing the detector to respond. This type of detector finds an application in cabins, cable ducts, ro-ro cargo spaces and electronic equipment cabinets.



4) Flame detectors

- ❖ Flame detectors are optical detection devices that respond to optical radiant energy emitted by fire. Flame detectors responsive to infra-red or ultraviolet radiation are available, but ultraviolet sensitive detectors are generally preferred. This type of detectors finds their use in very limited areas on board the ship where the area of coverage is limited and quick detection is important. Their sensitivity is a function of flame size and distance from the detector.
- ❖ A flame consists of three parts: visible flame, ultra violet rays and infra red rays. The visible flame is not used to detect the presence of fire because the detector will not be able to differentiate between ordinary light and light emitted from the flame. Infra red light and ultra violet rays have a particular frequency. The filter unit of the detector allows only infrared or ultraviolet rays to pass through and focus on the photo electric cell.
- ❖ This signal from the cell goes to the amplifier unit and time delay unit before passing to the alarm circuit. The time delay unit minimizes the incidence of false alarms due to heating elements and other naked flames like from matches or lighting of torches for firing boilers, or flames from blow lamps.
- ❖ These detectors must see the flame or fire to raise an alarm. These detectors are very useful in open spaces where the combustion products may not reach the detector. However, the presence of smoke can reduce the effectiveness of these detectors as smoke gives a mask over the flame. Flame detectors offer extremely fast response.

5) Sample extraction smoke detection systems

- ➢ The main components of a sample extraction smoke detection system are
  - ❖ Smoke accumulators – These are air collection devices installed at the open ends of the sampling pipes in each cargo hold that perform the physical function of collecting air samples for transmission to the control panel through the sampling pipes.
  - ❖ Sampling pipes - The piping network that connects the smoke accumulators to the control panel, arranged in sections to allow the location of the fire to be readily identified. These sampling pipes are also used as discharge nozzles for the fixed-gas fire-extinguishing system.
  - ❖ Three-way valves - If the system is interconnected to a fixed-gas fire-extinguishing system, three-way valves are used to normally align the sampling pipes to the control panel and, if a fire is detected, the three-way valves are re-aligned to connect the sampling pipes to the fire-extinguishing system discharge manifold and isolate the control panel.

- Control panel - The main element of the system which provides continuous monitoring of the protected spaces for indication of smoke. It typically may include a viewing chamber or smoke sensing units.

- Extracted air from the protected spaces is drawn through the smoke accumulators and sampling pipes to the viewing chamber, and then to the smoke sensing chamber where the airstream is monitored by electrical smoke detectors. If smoke is sensed, the repeater panel (normally on the bridge) automatically sounds an alarm (not localized). The crews can then determine, at the smoke sensing unit, which cargo hold is on fire and operate the pertinent three-way valve for discharge of the extinguishing agent.

- This is the most common type of fire detection equipment to be found in cargo holds of a ship that is protected by a CO_2 flooding system. This sample extraction system is basically a modification over the smoke detectors that have been explained earlier.

- The smoke from the cargo holds and other spaces protected by this system is brought to the detecting cabinet by means of pumps, extracting samples from these spaces through sampling pipes. Usually these systems are fitted with at least 2 sampling fans so that they can be used alternatively and the spaces could be sampled continuously. Samples of the hold atmosphere are drawn continuously from each protected hold in the ship and passed through a dark chamber that is traversed by light from hidden sources. This light is not visible, but serves to strongly illuminate any smoke arising from the holds. Each sampling pipe is labeled and hence smoking hold is easily and quickly identified. There is no possibility of a false alarm in this case. An audible alarm based on the principle of light scatter type (described earlier in this module) is also incorporated so as to give an audible alarm when fire or smoke is detected from a particular hold. In some cases the exhaust of the detecting cabinet is also led into the bridge so that any smoke emanating from the hold can be smelled on the bridge.

- The functioning and testing of the system is discussed under task 3.1.18 in detail which shall be referred to.

Apply Your Knowledge

1. Locate the types of fire detectors installed on board your vessel alongwith the location. Discuss the effectiveness of the detector type with reference to likely fire hazard in the area.

Function: Controlling the operation of the ship and care for persons on board

Competence: Prevent, control and fight fires on board

Task number: C3.1

Sub task Reference number: C3.1.9, C3.1.9.1, C3.1.9.2, C3.1.9.3, C3.1.9.4, C3.1.10, C3.1.13

Topic: Operation and maintenance of fire fighting appliances (FFA)

Task Heading

- Assist the safety officer in the inspection and maintenance, and understand the use of:
  - Portable foam extinguisher
  - Portable CO_2 extinguisher
  - Portable dry powder extinguisher
  - Portable water extinguisher.
- Assist in the maintenance of fire hoses, nozzles and couplings.
- Assist with re-charging of portable extinguishers.

Objectives

- Understand the use, maintenance and care of portable fire extinguishers, fire hose, and nozzles

Index

1) Fire extinguishers
    a) Water type extinguishers
    b) Foam type portable extinguishers
        i. Mechanical foam extinguisher
        ii. Chemical foam extinguishers
        iii. AFFF (Aqueous Film Forming Foam) extinguishers
    c) Portable CO_2 extinguishers
    d) Portable dry powder/dry chemical fire extinguishers
    e) Portable wet chemical fire extinguishers
2) Periodical inspections and maintenance of portable extinguishers
3) Maintenance and Inspection of fire hoses, nozzles and couplings
    a) Fire hoses
    b) Fire hose couplings
    c) Fire hose nozzles
    d) International shore connection

Description

1) Fire extinguishers

- A fire extinguisher is an appliance containing a fire extinguishing medium, which is expelled by the action of internal pressure within the container of the extinguisher. This pressure may be achieved by filling the unit under pressure or be obtained by release of gas from a cartridge within the container. Portable extinguisher is an extinguisher designed to be carried and operated by hand, and which in working order has a total weight of 23 kg or less.

- The mass or volume of the extinguishing medium contained in the extinguisher is called the charge of the extinguisher. The quantity of the charge of water or foam extinguishers is normally expressed in volume (litres) and that of other types of extinguishers in mass (kilograms).

- Extinguishers are classified on the basis of extinguishing medium they contain. These are as follows:
- Water (or water with additives) type extinguishers – suitable for fire involving wood, paper, textiles and similar materials

- ❖ Foam type extinguishers – suitable for fire involving wood, paper, textiles and flammable liquids
- ❖ Dry powder/dry chemical (multiple or general purpose/classes A, B, C) type extinguishers – suitable for fire involving wood, paper, textiles, flammable liquids, electrical equipment and flammable gases
- ❖ Dry powder/ dry chemical (metal) type extinguishers – suitable for fire involving combustible metals
- ❖ Carbon dioxide type extinguishers – suitable for fire involving flammable liquids and electrical equipment
- ❖ Wet chemical for class F or K type extinguishers – suitable for fire involving cooking grease, fats or oil fires

a) Water type extinguishers

- ❖ Water is an excellent cooling agent. It has a high thermal capacity and absorbs more heat for a given increase of temperature than the same mass of almost any other substance. Furthermore, at near freezing water absorbs over five times as much heat is extracted in converting the water into steam than is absorbed in the process of raising the temperature of the water from freezing point to boiling point. Additionally, steam so formed has a smothering effect assisting in the fire extinguishing process.

- ❖ However, when used on burning oil, the water spray may tend to sink under the oil so causing the fire to erupt. Also it reacts dangerously with Class D substances and substances such as acids and carbides. Water cannot be used on electrical fires as it is a good conductor of electricity. Water may damage electrical equipment or cargo as it soaks them and may make them beyond use.

❖ Based on its properties, water extinguishers are most suitable for Class A fires, such as carbonaceous fires in accommodation involving wood, paper and furnishings.

❖ **Working principle**

- In water type extinguishers, water is released in the form of jet by means of gas pressure in the upper part of the container. The gas pressure is induced by mechanical means. Water is stored in the extinguisher container and a CO_2 cartridge is attached to the top assembly. Such extinguishers are commonly called water/CO_2 type extinguishers. By hitting the knob on top, the plunger pierces the CO_2 cartridge and CO_2 is released under pressure. This increased pressure causes the water to be propelled out from the nozzle with pressure.

- Older types of water type extinguishers, also called "soda/acid" type extinguisher used a chemical reaction between sulphuric acid and sodium bicarbonate solution which released carbon dioxide building up pressure within the extinguisher container. The acid vial was broken by hitting the plunger. However these types are no longer in use.

❖ **Method of operation**

- Remove the safety pin and the guard cap and strike the plunger piercing the CO_2 cartridge.
- Direct the jet emerging from the nozzle to the base of the fire, keeping it directed there until the extinguisher is completely discharged.

❖ **Care and maintenance**

- On a regular basis check nozzle outlet and vent holes on threaded portion.
- Check whether the plunger is fully extended and whether the safety pin is in place.
- Every three months dismantle the cover components, check for damage, clean and grease them as required (avoid over greasing), top up the water quantity to required level.
- Ensure that the CO_2 cartridge is intact. The gas cartridge is weighed annually.
- At least once a year, operate the extinguisher to ensure it is functions properly. This must be jet length of 6 metres for at least 60 seconds.

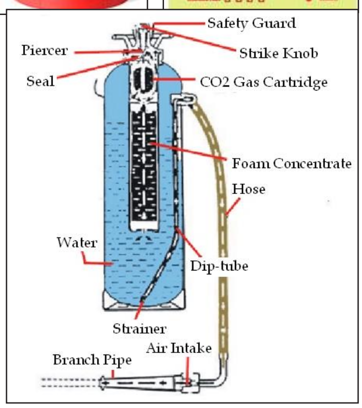
- Pressure tests the extinguisher every five years according to the manufacturer's instructions (usually done to 17.5 kg/cm^2).
- Ship's PMS procedures shall be followed.

b) Foam type portable extinguishers

❖ These are particularly used for extinguishing fires of Class 'B' types involving inflammable liquids but are also safe for extinguishing fires of Class 'A' types involving wood, paper & fabric fires.

❖ Three types of foam type extinguishers are available

i. Mechanical foam
ii. Chemical foam
iii. Aqueous film forming foam (AFFF)



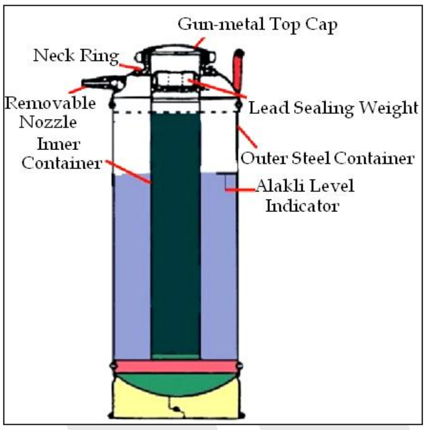
i. Mechanical foam extinguishers

- Has a plastic bag filled with foam concentrate over a gas cartridge.
- The outer container contains water.
- When the seal is pierced by striking the knob, the CO_2 is released which ruptures the plastic bag.
- The water and the foam concentrate are mixed and the foam solution is driven by the pressure of gas up the tube

into the nozzle where it is aerated into air foam.
- This extinguisher can be charged on board. Separate foam concentrate packets and gas cartridge are available along with instructions on how to recharge the extinguisher. Ensure that the foam concentrate and gas cartridge used are meant for that size of the extinguisher.

ii. Chemical foam extinguishers

- This type contains two containers - outer container and inner container.
- The inner container has a solution of aluminium sulphate.
- The outer container has a solution of sodium bicarbonate.



- The extinguisher is always placed in upright position.
- To prevent any accidental mixing of the liquids in the container, a knob attached to a sealing lead weight which is kept locked there by closing the opening of the inner container.
- When the extinguisher is to be used, the knob is turned to open position and the extinguisher is turned upside down permitting both the solutions to mix.
- A chemical reaction produces foam and carbon dioxide gas. The chemical foam is released through the nozzle provided.
- This extinguisher can be charged on board and the charging procedure for the extinguisher is as follows:
- After discharging the extinguisher, open the extinguisher from the top knob, clean both the inner and the outer containers with fresh water.
- The charge for the extinguishers comes in packets containing aluminium sulphate and sodium bicarbonate powders clearly marked "A" and "B". Each charge has both the packets needed for the extinguisher.
- A note giving instructions on how to fill is also present.
- Fill water in the outer container to the mark provided in the body of the extinguisher. Empty that measured water into a clean bucket. Empty the packet containing sodium bicarbonate into the bucket of water and stir it well until all the powder has dissolved. Fill the sodium bicarbonate solution in to the outer container.
- Similarly measure the water required for the inner container, dissolve the aluminium sulphate powder and fill the inner container with the solution.
- Place the inner container into the extinguisher body taking care that both the solutions do not mix.
- Screw in the cap having the lead sealing weight and knob should be turned to close position.
- Now the extinguisher is ready for use. The extinguisher should be kept vertical and should be placed in the stand provided.

iii. AFFF (Aqueous Film Forming Foam) extinguishers

- Aqueous film forming foam is a synthetic, non-toxic, amber coloured foam-forming liquid concentrate. It is scientifically designed product based on fluoro-chemical wetting agents and its unique action is connected with its ability to make water float on flammable fuels which normally float on water.
- The foam is formed by mixing the water/concentrate solution with air. It is deposited on the surface of the fuel as a thick rapidly spreading flame quenching

blanket, resisting mechanical disruption and heat.

- When the foam hits the fuel surface the water-floating action begins. The water dropping out of the foam bubbles floats on top of the fuel as a thin film preventing reflash or burning back of the extinguished surface.
- The water from the foam is not lost and goes where its cooling surface filming effects can do the most good. AFFF has proved to the most effective foaming type agent and shows speed and efficiencies of 300-400% better than protein type air/foam concentrates.

❖ **Advantages of mechanical foam extinguishers over chemical foam extinguishers**

- Mechanical foam extinguishers can be operated keeping the extinguisher upright whereas chemical foam extinguisher has to be operated keeping the extinguisher inverted.
- Since there is no chemical reaction taking place in the mechanical foam extinguishers, they are more reliable and there is no delay waiting for the chemical reaction to build up pressure. The foam comes out instantly.
- They are easier to recharge.

> **Note**
> 1. Foam extinguishers should not be used on electrical fires.
> 2. When using on oil fires, the nozzle should not be directed into the fire as this will cause the fire to spread. The nozzle should be directed onto a bulkhead above the burning surface to permit the foam to build up a blanket which will flow over the burning liquid and extinguish the fire by smothering.

❖ **Care and maintenance**

- The extinguishers shall be maintained in accordance with vessel's planned maintenance schedule.
- At least once a week, clean the exterior body, check nozzle outlet and vent holes and ensure that the plunger is clean and fully extended.
- Every quarter - check the internals, the gas cartridge in case of mechanical foam and stir the solutions in both the containers. Ensure that there is no sediment.
- Operate the extinguisher once every year in fixed short bursts and monitor its performance. It should project the foam a distance of 6m for a period of 30 seconds.
- Pressure test the extinguisher every 2 years to manufacturer's stated pressure (usually 17.5 kg/cm2 for 2.5 minutes).

c) Portable CO_2 extinguishers

❖ These are most suitable for fires involving electrical appliances and inflammable liquid and in places where foam, water or dry chemical powder can damage the equipment.

❖ The carbon dioxide is kept in liquid form under 51 bars pressure at about 15ºC.The top of the extinguisher incorporates a plunger mechanism to pierce the seal when the extinguisher has to be used. A control valve controls the discharge of the CO_2. This is locked in position by means of a safety pin which is removed prior to using the extinguisher.

❖ At the outlet there is a flexible high pressure hose attached to a handle and a discharging horn.

❖ Wear proper hand gloves and personal clothing like a full sleeve boiler suit before using the extinguisher.

❖ The fire is extinguished by sweeping the discharge horn across the surface of the burning material.

> When handling the carbon dioxide extinguisher care must be taken to hold the hose only at the insulated handle provided for that purpose. If the extinguisher is held at the hose or at the discharging horn – the person is likely to get cold burns as the liquid carbon dioxide expands to gaseous state. Also, as intense cold is generated on discharge, the gas should not be directed on the exposed parts of the body.

❖ The fire is extinguished by virtue of CO_2 occupying the air space thus excluding oxygen. This condition starves the fire and as CO_2 being heavier than air settles down displacing the air.

❖ **Drawbacks of the extinguisher**

- Although CO_2 is non-toxic, it can suffocate a person nearby and being heavier than air will settle down.
- If the extinguisher is not used correctly it could cause cold burns.
- Carbon dioxide issues out a dense vapour, which in confined spaces would impair visibility.
- The sealing disc orifice may freeze after the initial start thereby hindering the flow of gas to the discharging horn. In such a case shut the valve or release the lever and start up again.
- This extinguisher cannot be recharged as easily as the foam type on board. It is usually recharged ashore.

❖ **Care and maintenance**

- Check the nozzle outlet is free.
- Ensure that the safety pin is in place and secured and the release lever is not depressed.
- Weigh the extinguisher at least once every month and if there is a reduction of 10% or more in weight then recharge the extinguisher.
- The extinguisher should be pressure tested before every recharge.

d) Portable dry powder/dry chemical fire extinguishers

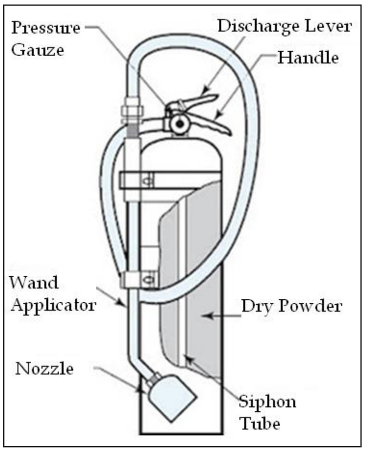
❖ Dry powder/dry chemical fire extinguishers are extremely versatile, as they can be used on Class A, B, C fires and D fires. As well as being suitable for use with flammable liquids, they can also be used on flammable gases, and the non-conductivity of the dry powder makes them safe on electrical fires too.

❖ There are three different types of dry powder/dry chemical portable fire extinguishers:

- standard- used to extinguish fires of classes B, C,
- the multiple or general purpose- used to extinguish fires of classes A, B, C and
- to extinguish fires for class D

For Class A fires - the powder is usually ammonium phosphate based
For Class B fires - the powder has a potassium bicarbonate based
For Class D fires - the powder is a combination of sodium potassium and barium chlorides

Only dry powder fire extinguishers are used on Class D or combustible metal fires. It extinguishes fire by isolating the fuel element from the oxygen element or by removing the heat element of the fire triangle.



❖ **Dry chemical fire extinguishers**

- Dry chemical powder extinguishers (usually known as DCP extinguishers) are suitable for fighting Class B fires involving inflammable liquids and for electrical fires. They are also suitable for Class C and Class D fires and to a lesser extent on small Class A fires. They are unsuited for deep seated Class A fires as they do not have the cooling effect.
- As mentioned earlier, as this extinguisher is used mainly for Class B fires, the base is usually potassium

bicarbonate. The extinguisher is clearly marked for which class of fire it is suitable.

- The powder by interfering with the chemical chain reactions occurring in the flames extinguishes the fire. The bicarbonate decomposes into water and carbon dioxide. This decomposition forms a catalytically active surface, which destroys the free radicals propagating the flame reactions.
- The extinguisher body contains a receptacle holding the powder. Attached to cap of the extinguisher top is a carbon dioxide cartridge under high pressure, which is screwed into it attached with a piercing mechanism.
- Accidental piercing of the CO_2 cartridge is prevented by a safety pin, which should only be removed when the extinguisher needs to be discharged.
- Here again there are some types of DCP extinguisher which do not have a CO_2 cartridge, instead the extinguisher receptacle itself is pressurized using CO_2. This is usually done ashore and there is a pressure gauge on the extinguisher where the bottle pressure can be read off. The charging should be done according to the manufacturer's instructions.
- The outlet is connected to a high pressure discharge hose, at the end of which is attached a squeeze grip - to control the discharge of the DCP. This squeeze grip mechanism also gives the flexibility in tackling numerous small fires.

❖ **Method of operation**

- Carry the extinguisher to the place of use.
- Remove the safety pin and strike the knob provided to pierce the CO_2 gas cartridge.
- Direct the stream of powder to the base of the fire.
- Progress forward moving the nozzle rapidly with a side to side sweeping motion.
- On outdoor locations operate extinguisher from upwind side of fire to extend effective range of spray.

❖ **Care and maintenance**

- Check that the nozzle and the vent holes are clear on a weekly basis.
- Check that the plunger is clean and fully extended.
- Every quarter check the following:
- Weigh the CO_2 cartridge if fitted and replace it if it is 90% or less than its original weight.
- The piercing mechanism should be free.
- The dry chemical powder should be free of caking and granulation.
- Discharge the extinguisher at least at an interval of one year to check its performance. Extinguishers can be discharged on a rotating basis.
- If unable to do so - all extinguishers must be recharged after every two years.
- All DCP extinguishers should be sent ashore to be pressure tested hydraulically every 3rd year.

e) Portable wet chemical fire extinguishers

❖ The wet chemical fire extinguisher was developed specifically to deal with deep fat cooking fires. They are a relatively recent development.

❖ The wet chemical fire extinguisher is the only type of fire extinguisher that should be used on burning cooking oil. Other types cannot deal with the extremely high temperatures at which oil burns, and the failure to effectively cool the oil can cause flashbacks.

❖ The wet chemical fire extinguisher works by using a process called saponification, whereby a chemical additive reacts with the oil to form a thick soapy substance. This soapy layer puts a non-combustible seal between the oil and the oxygen it needs to burn, and so extinguishes the fire and prevents re-ignition. The saponification process is endothermic, meaning that it absorbs heat, so the process of creating the soapy layer also takes heat out of the oil and cools it down. The cooling process is not a particularly dramatic effect so should be given time to allow it to happen.

- Wet chemical fire extinguishers are also safe to use on Class A fires, which are normal combustible materials such as paper, wood, etc. They are not designed for use on electrical fires, but most will be safe if accidentally sprayed on nearby electrical equipment.
- The specific use and purpose of wet chemical fire extinguishers means that the usual place to deploy them is in a commercial kitchen environment where grease and deep fat fryers are common.

- **Operation**
  In the case of the wet chemical fire extinguisher, the main factor is cutting off the fuel (oil) from the oxygen supply (the air) by putting a non-combustible layer of soapy chemical between them. It also has a cooling effect on the fuel, which helps to prevent re-ignition. Like most fire extinguishers, wet chemical fire extinguishers are available in two main types, stored pressure or cartridge operated. The commonest is the stored pressure type, where the pressurized gas is in the main chamber with the chemical. The cartridge operated type has a separate gas cartridge inside the main extinguisher cylinder, making it easier to recharge the extinguisher after use. Every wet chemical fire extinguisher comes with a long applicator or lance, making it easy to apply the chemical to the burning oil. This should be done in slow circular motions.

2) Periodical inspections and maintenance of portable extinguishers

- Ship's PMS shall be followed for inspection and maintenance of the extinguishers. Extinguishers are subject to periodical inspections in accordance with the manufacturer's instructions and are serviced at intervals of one year or lesser. All extinguishers together with propellant cartridges are hydraulically tested in accordance with the recognized standard or the manufacturer's instruction at intervals not exceeding ten years.

- At least one extinguisher of each type manufactured in the same year and kept on board a ship should be test discharged at five yearly intervals (as part of a fire drill). Service and inspection should only be undertaken by approved agencies.

- Records of inspections should be maintained. The records should show the date of inspection, the type of maintenance carried out and whether or not a pressure test was performed.

- Extinguishers should be provided with a visual indication of discharge. Instructions for recharging extinguishers should be supplied by the manufacturer and be available for use on board.

- Location
  - Fire extinguishers shall be checked in position as per the fire plan.
  - Stowage number of the extinguisher should be marked on the extinguisher and on the bulkhead near the extinguisher.

- Cradle or mounting of the extinguisher
  - The extinguisher shall be firmly secured on its cradle
  - The extinguisher shall be easily removable from the cradle without use of tools.
  - No rope or temporary wire securing shall be carried out.
  - Cradle shall be checked for corrosion or damages.

- Visual inspection of the extinguisher
  - The hose and nozzle shall be firmly secured and shall be in good condition.
  - Safety lock pin shall be checked in position.
  - Extinguisher shall be checked for signs of corrosion or damage.
  - The DCP type extinguishers shall be lifted and shaken vigorously to loosen the caked powder.
  - Non-portable fire extinguishers have a hose reel. Hose must be opened and condition of hose and nozzle checked.

- Markings on fire extinguishers
  Each extinguisher should be clearly marked with the following minimum information:

- name of the manufacturer
- types of fire and rating for which the extinguisher is suitable
- type and quantity of extinguishing medium
- approval details
- instructions for use and recharge, in pictorial form in addition to explanatory text
- year of manufacture
- temperature range over which the extinguisher will operate satisfactorily
- test pressure

- Colour coding for all type of extinguishers, if used, should remain same throughout the ship. Normally different types of extinguishers on board are colour coded in the following manner:
- Water type - Red,
- Foam type – Beige (off white),
- Dry powder type - Blue,
- Wet chemical type - Yellow
- CO_2 type - Black.

- Ensure that each extinguisher has an inspection tag on the extinguisher, which should be filled every month. Date of last service or recharge should be marked.
- Ensure all manufacturers' markings are clearly visible. While painting an extinguisher, care should be to avoid painting over the manufacturer's markings.
- Stowage number of extinguisher should be painted in a conspicuous on the extinguisher and near its location.
- Extinguishers should be clearly marked, for type of fires they can be used upon
- Labels should be placed on extinguishers to warn also e.g. foam extinguisher should have a label 'Not to be used on Electrical Fire' etc. Replace torn or damaged labels.

- Spares & recharging
- Chemical spare charges which are liable to deteriorate should have a date of packaging / date of expiry marked on them
- Any extinguisher which is used should be recharged immediately, or a spare extinguisher is put in place till recharge is complete.
- Spare charges shall be provided for 100% of the first 10 extinguishers and 50% of the remaining fire extinguishers capable of being recharged on board. Not more than 60 total spare charges are required. Instructions for recharging shall be carried on board.
- For fire extinguishers which cannot be recharged onboard, additional portable fire extinguishers of the same quantity, type, capacity and number as required above shall be provided in lieu of spare charges.

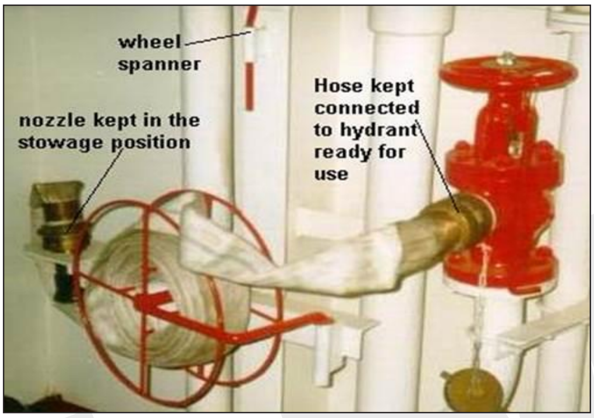
- Service / recharging duration
- Check that each fire extinguisher including the non-portable extinguishers onboard have been either serviced or recharged within last one year.
- Certain flag states require that servicing should be done by shore based agencies, every alternate year.
- Annual servicing may be carried out on board, by ship's personnel.

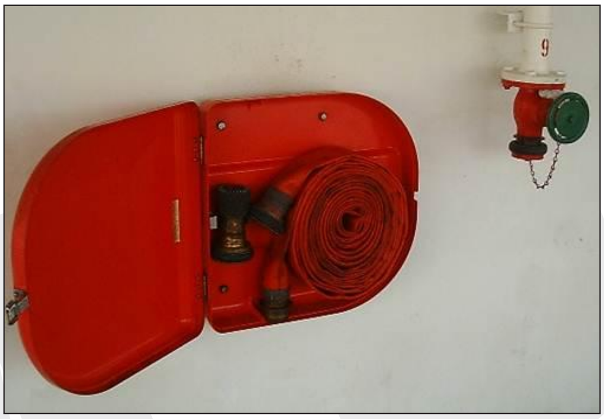
- Instructions on servicing
- Great care must be taken when opening an extinguisher that use gas cartridges in case of pressure build up.
- Check condition of hose, nozzle, strainer, together with external condition of extinguisher.
- For cylinders with gas cartridges, check mass of gas cartridge. If the net loss of mass is more than 10%, the cartridge is to be renewed.
- CO_2 extinguishers to be weighed as per manufacturer's instructions. If loss of charge is more than 10%, extinguisher is to be recharged.
- For pressurized extinguishers, check manometer reading against manufacturers specification (if provided else ensure indication is in the green zone. If in doubt about manometer reading, insert extinguisher in hot water (maximum 55 deg C) and check that the gauge moves.

- Check the contents of the extinguisher-
  - Liquid level correct.
  - Acid bottle not damaged.
  - Dry powder not caked.

- Hydraulic pressure testing of extinguishers
- Hydraulic testing of all fire extinguishers except fire extinguishers must be carried out at intervals laid down by the flag state.
- UK MSA requirements are all extinguishers (except CO2 extinguishers) to be pressure tested every 4 years, and CO2 extinguishers every 10 years.
- Liberian requirements are for all extinguishers to be pressure tested every 10 years.
- Hydraulic testing should be carried out by a recognized service station. Certificates and records of all hydraulic pressure testing must be kept on board.
- If flag state requirements are more stringent, they shall be followed.

3) Maintenance and Inspection of fire hoses, nozzles and couplings





- The fire pumps supply water to different locations on the ships by means of fire hydrants fixed on the fire lines. The fire hoses are connected to the hydrants by means of either quick acting couplings or by screwed couplings and the water is directed into the fire by means of nozzles. For the system to function well all these equipments need to be maintained well.

a) Fire hoses

SOLAS requirements

- The fire hoses are made of non-perishable material approved by the administration.

- The length of fire hose shall be sufficient to project a jet of water into any of the spaces where they may be required to be used. Fire hoses shall have a length of at least 10 m, but not more than:
  - 15 m in machinery spaces;
  - 20 m in other spaces and open decks; and
  - 25 m for open decks on ships with a maximum breadth in excess of 30 m.

- On cargo ships of 1000 gross tonnage and upwards the number of hoses to be provided shall be one for each 30 metres length of the ship and one spare but in no case less than five in all. This number does not include any hoses required in any engine or boiler room. The administration may increase the number of hoses required so as to ensure that hoses in sufficient number are available and accessible at all times, having regard to the type of ship and the nature of trade in which the ship is employed.

- **Care of fire hoses**

- Modern fire hoses are made of fire resistant plastic reinforced canvas material which does not get damaged and is not easily subjected to rot. However, paint solvents, caustic or some chemicals could cause damage to the material of the hose and hence if the hoses come in contact with any of these, they should be washed and rinsed thoroughly and dried. Strong soda solution shall never be used to wash the hose.
- Hoses should be kept clean of oil and grease. The hoses should be dried out before being stowed. If stowed wet these are likely to rot.
- Avoid dragging hoses and couplings on deck especially when they have kinks.
- To expel water from a hose it should not be walked-on along the deck, but should be under-run at shoulder height.
- Abrasion and shock are the main causes of hose failure and these should be avoided.
- When hoses are to be coiled, the hose is first folded into two with both couplings on one side and then rolled in such a way that the couplings of both the ends remain on the outside. By coiling this way - it would be very easy to unlay the hose during an emergency. Just connect one coupling to the hydrant and the other to the nozzle and roll out the hose.
- Hoses and couplings including nozzles should never be painted.

Inspection of fire hoses

- Range out the fire hoses and check for any apparent damage.
- Check the couplings are attached firmly to the fire hoses by Copper seizing wire. Jubilee clips should not be used to fasten the coupling. Fastening should be renewed if same is damaged or corroded.
- Check and grease edges and moving parts of the coupling.
- Ensure washers are fitted correctly inside the couplings. Replace the worn out / hardened or missing washer.

Testing of fire hoses

- Fire hoses are pressure tested for any leaks.
- Hoses can be attached to each other and laid straight on deck. One end is sealed using a attaching a shut off type nozzle and other is attached to the hydrant.
- Hoses are pressurized to full pressure of the fire line by opening the hydrant and shutting of the nozzle slowly. If hydrant is opened suddenly, when nozzle is shut it will cause hammering damage to the hose.

> The fresh water hose and deck washing hose with nozzle should be separate from the fire hoses & nozzles.
> Under No Circumstances, an operational fire hose should be used for any other purpose. Crew must be instructed accordingly.

- Any leaks near the couplings should be rectified or hose should be renewed.
- Hoses must be dry and coiled before they are placed back in their respective boxes
- A condemned hose should be destroyed and disposed of ashore.

b) Fire hose couplings

- The instantaneous type couplings facilitate easy connection and disconnection of hoses without having to waste any time and hence are common in use onboard. Some of the older ships may have couplings, which are screwed type.
- Each fire hose is attached to a male coupling on one end and female coupling on one end by means of a seizing wire. Jubilee clips instead of seizing wire is not acceptable. Couplings should be so well secured that they should withstand the maximum working pressure of the fire line. Once the couplings are attached - the hoses and couplings should be tested.
- The male coupling is connected to the fire hydrant and the nozzle is connected to the female coupling. In case more than one hose has to be used - the male coupling of the second hose is connected to the female coupling of the first hose.

- The joints in the couplings are made watertight with rubber washers. These should be inspected on a regular basis and maintained in good order. Sufficient spare rubber washers should be carried on board.
- Ensure that the locking lugs on the female coupling are free - so that the male coupling connects easily. A small amount of grease may be used on the outside of the female coupling on the locking levers to keep them free.
- Do not use the coupling as a hammering tool and never drag the coupling along deck.

c) Fire hose nozzles

- The standard sizes of nozzles shall be 12mm, 16mm or 19mm. Any deviation from this shall not be permitted unless approved by the administration. All nozzles are required be of an approved dual-purpose type (spray/jet type) incorporating a shutoff. For accommodation and service spaces, a nozzle size greater than 12mm need not be used.
- For machinery spaces and exterior locations, the nozzle size shall be such as to obtain the maximum discharge possible from two jets for which the following minimum pressures shall be maintained at all hydrants:
  - **For passenger ships:**
    4,000 gross tonnage and upwards 0.40 N/mm²
    less than 4,000 gross tonnage 0.30 N/mm²
  - **For cargo ships:**
    6,000 gross tonnage and upwards 0.27 N/mm²
    less than 6,000 gross tonnage 0.25 N/mm² and
- The maximum pressure at any hydrant shall not exceed that at which the effective control of a fire hose can be demonstrated. This has to be achieved from the smallest pump, provided that a nozzle size greater than 19 mm need not be used.

- **Care and maintenance of nozzles**
  - As mentioned - all nozzles on board should be of the dual purpose type incorporating both jet and spray. The operation shall be checked.
  - Two types of nozzles as shown are available on board. In one type the lever has to be moved to jet or spray position to achieve the desired requirement. This nozzle can be shut off when not in use.
  - The second type has an adjustable rotate sleeve on top. The sleeve can be rotated to get either, a solid jet, a 30º spray or a 180º water wall. It also incorporates a shut off.
  - Nozzles should be handled carefully and should not be dropped.
  - Ensure that the adjusting lever or the sleeve is free to rotate.
  - Some of the nozzles incorporate twist-type couplings which have rubber washers. Ensure that the rubber washers are in good condition and have sufficient spares on board to replace damaged ones.
  - Do not paint nozzles.
  - Ensure that the water jet spray holes are clear.

- **Inspection of fire nozzles**
  - Check the nozzles carefully for any damage.
  - Test the nozzle for free movement. Lightly grease the moving parts.
  - Test the nozzle under operating condition.

d) International shore connection

- Ships of 500 gross tonnage and are provided with one 'International Shore Connection'.
- It is provided on ships to enable water for fire-fighting to be supplied from another ship or from shore to the fire main, every ship has at least one international shore connection stored together with a

gasket, four bolts and eight washers. Gaskets are made suitable to withstand pressure of 1 N/mm^2 (10 bars).

- Fixed provisions are made to enable such a connection to be used on both sides of the ship. The coupling has a flat flange on one side, and to the other have a permanently attached coupling that will fit the ship's hydrant and hoses.

- The standard dimension of the flange of the International Shore Connection is as follows:

Description	Dimension
Outside diameter	178 mm
Inside diameter	64 mm
Bolt circle diameter	132 mm
Slots in flange	4 holes 19 mm in diameter spaced equidistantly on a bolt circle of the above diameter, slotted to the flange periphery
Flange thickness	14.5 mm minimum
Bolts and nuts	4, each of 16 mm diameter, 50 mm in length

- **Maintenance and inspection**
- Sight that international shore connection is kept in its designated location with required 4 bolts, washers and gasket.
- Ensure that the location of the international shore connection is clearly marked.
- Check that the securing nuts and bolts are free and the threads are lightly greased.
- Check that the gasket is in good condition.

Apply Your Knowledge

1. Check the types of portable fire extinguishers provided on board your vessel and relate its type to usage in the area nominated.
2. Discuss when and where were the fire extinguishers on board your vessel pressure tested last.

Function: Controlling the operation of the ship and care for persons on board

Competence: Prevent, control and fight fires on board

Task number: C3.1

Sub task Reference number: C3.1.11, C3.1.12 & C3.1.16

Topic: Operation and maintenance of fire fighting appliances (FFA)

Task Heading

- Assist in taking inventory of the safety locker.
- Take inventory of all the emergency equipment in the emergency headquarters (fire station room).
- Locate all fire line isolation valves on board and understand their use

Objectives

- Understand the items usually stored in the EHQ.
- Understand the purpose, use, importance and precautions that need to be exercised with respect to fire line isolation valves.

Index

1) Equipments in EHQ
2) Fire line isolation valves

Description

1) Equipments in EHQ

- Designated "Emergency Headquarters" (EHQ) / fire station room is a place where a quantity of fire fighting and emergency equipment is kept in readiness for an emergency response and which also forms a focal point for mustering emergency teams. The statutory fire fighting and life saving requirements in emergency headquarters/ fire station room are maintained as indicated on the fire control and safety plan, usually stocked with an entirely additional set of equipment. Most of the times if a separate safety locker is not provided on the ship then the EHQ would have some extra fire hoses, hose nozzles, fire extinguishers and usually an air compressor for the re-filling of breathing apparatus (B.A) air cylinders.

- As per SOLAS regulations, all ships are required to carry at least two fire-fighter's outfits. In passenger ships, for every 80 m, or part thereof, of the aggregate of the lengths of all passenger spaces and service spaces on the deck which carries such spaces or, if there is more than one such deck, on the deck which has the largest aggregate of such lengths, two fire-fighter's outfits and, in addition, two sets of personal equipment, each set comprising the items stipulated in the ‘Fire Safety Systems’ code. In passenger ships carrying more than 36 passengers, two additional fire-fighter's outfits shall be provided for each main vertical zone; and on ships carrying more than 36 passengers, for each pair of breathing apparatus, one water fog applicator which shall be stored adjacent to such apparatus. In tankers, two additional fire-fighter's outfits shall be provided, total amounting to at least four.

- Each required breathing apparatus shall be provided with two spare charges. Passenger ships carrying not more than 36 passengers and cargo ships that are equipped with suitably located means for fully recharging the air cylinders free from contamination need carry only one spare charge for each required apparatus. In passenger ships carrying more than 36 passengers, at least two spare charges for each breathing apparatus shall be provided.

- A fire-fighter's outfit consists of a set of personal equipment and a breathing apparatus. This includes
  - Protective clothing of material to protect the skin from the heat radiating from the fire and from burns and scalding by steam. The outer surface of this coat is water-resistant.
  - Boots of rubber or other electrically non-conducting material
  - Rigid helmet providing effective protection against impact
  - Electric safety lamp (hand lantern) of an approved type with a minimum burning period of 3 h. Electric safety lamps on tankers and those intended to be used in hazardous areas shall be of an explosion-proof type. Safety lamps may be either the hand lamp or cap-lamp type. The batteries must be re-chargeable and the hand lamps must be fitted with means for easy attachment of the lamp to the user at about waist level.
  - Axe with a handle provided with high-voltage insulation
  - Self-contained compressed air-operated breathing apparatus for which the volume of air contained in the cylinders shall be at least 1,200 ltr, or which shall be capable of functioning for at least 30 min. All air cylinders for breathing apparatus shall be interchangeable.
  - Fireproof lifeline of at least 30 m in length one for each breathing apparatus, capable of being attached by means of a snap-hook to the harness of the apparatus or to a separate belt; (The lifeline shall successfully pass an approval test by statical load of 3.5 kN for 5 min without failure.)







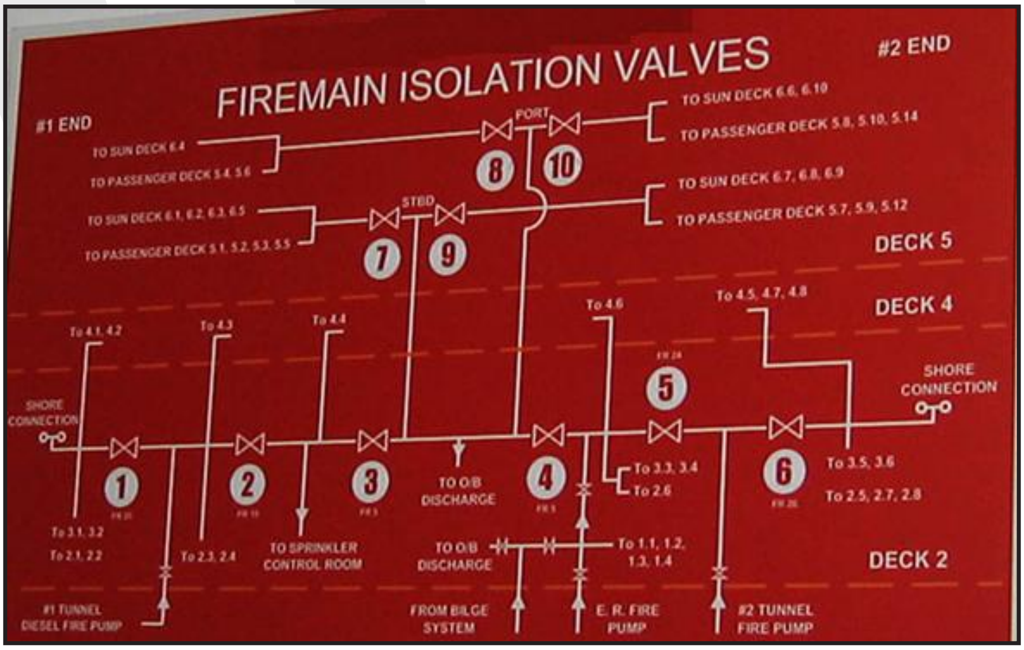
- Storage of fire-fighter's outfits - The fire-fighter's outfits or sets of personal equipment is maintained in a ready for use condition, in a permanently/ clearly marked easily accessible location. Where more than one fire-fighter's outfit or more than one set of personal equipment is carried, they shall be stored in widely separated positions. The firemen's outfits are stowed in readily accessible positions which are not likely to be easily cut off by fire. The position of storage is specified in the FFA plan of the vessel.

- Inventory
  The items required at fire control station are checked against the FFA plan of the vessel. The safety locker in addition carries the spares for which an inventory shall be

maintained. While taking inventory the products shall be correctly identified. The list of products is maintained in a tabular form mentioning the name of the product, quantity and expiry dates where applicable. The quantity consumed during the month is recorded, further mentioning the remaining on board. The items consumed are replenished by fresh supplies.

2) Fire line isolation valves

- As the name suggests, Isolating valves are provided to isolate a given section of the fire main from the rest of the fire main. The reason being, the fire line runs across the vessel from engine room to main deck and to various decks in accommodation. The fire pumps provided on vessel are designed to provide a pre-specified pressure for two jets of water running simultaneously. This is achieved by having only two hydrants open and rest all closed. The fact remains that hydrants can be closed manually; however, in case the fire line is ruptured due to some reasons, the fire pump will not be able to deliver the required pressure for two water jets to be effective. Hence, it is usual to find atleast two isolating valves on each ship, one for isolating the main deck, named as 'deck isolation valve' and another for engine room. Further isolation valves may be found to isolate the sections of fire line serving various decks.
- The isolation valves on fire line are always kept open and are closed ONLY when required for specific reasons.
- The location of isolating valves is marked on the FFA plan and these valves shall be prominently marked at the location. The isolating valves are provided in easily accessible locations.
- The isolation valves fitting, labeling and working are checked during on board initial surveys and their accessibility, maintenance and working during re-survey by vessel's classification society.
- Regular testing of all isolating valves should be carried out as stated in the company's PMS for ease of operation by fully closing and then opening. The valves should be greased or the spindle to be oiled.
- On most of the port state control inspections, the inspectors generally look and confirm whether the Isolating valves of the fire main are marked, maintained and easily operable. These are also one of the usual items to check in the concentrated inspection campaign (CIC) of various PSC.



Apply Your Knowledge

1. Make a list of all the emergency items kept in the EHQ (Emergency Headquarters) on your ship.
2. Locate the fire main isolation valves provided on board your vessel. Check the area served by emergency fire pump with the deck isolation valve shut.
3. Locate the fireman’s outfit on board your vessel and check when the batteries for the safety lamps charged last.

I M U

Function: Controlling the operation of the ship and care for persons on board

Competence: Prevent, control and fight fires on board

Task number: C3.1

Sub task Reference number: C3.1.14

Topic: Operation and maintenance of fire fighting appliances (FFA)

Task Heading

- Demonstrate understanding of the safety precautions and procedures required prior to operating the fixed fire fighting system.

Objectives

- Understand the safety precautions and procedures required prior to operating the fixed fire fighting system

Index

1) Introduction
2) General precautions
3) Sample check-list for CO_2 flooding of engine room
4) Properties and personal hazards of the extinguishing mediums

Description

1) Introduction

- The fixed firefighting systems on board are used for bulk flooding of a compartment o fire with the extinguishing medium. The spaces include engine room, cargo hold, cargo pump room etc. The fire extinguishing systems include
  - Carbon dioxide systems
  - Halon systems
  - Dry powder extinguishing system
  - High expansion foam systems
  - Water mist or spray systems
- The fixed fire fighting installations use the extinguishing medium in bulk, released in the compartment on fire. While the systems are effective in case of major fires, the personnel involved in the operation shall be safeguarded against the risks the systems pose. The procedures involve safety precautions to be observed while a compartment is flooded, with special reference to properties of the extinguishing medium.

2) General precautions

For the use of fixed fire extinguishing systems, the following precautions are recommended:

- The decision regarding use of fixed extinguishing system is taken by the master. The operation shall be headed by the person designated in the emergency procedures.
- All personnel, including casualties must be evacuated from the compartment and head count taken before the medium is released into the compartment.
- Alarm must be sounded for a period long enough giving sufficient time for personnel from the machinery spaces to evacuate the area.
- The compartment needs to be effectively sealed. All skylights and ventilators must be closed and fans and fuel pumps must be stopped before release of the medium as these are one shot systems. No chances to be taken of the medium being dispersed or re-ignition taking place.
- The amount of medium to be released shall be as per the table provided for that fire zone only. If the medium is allowed to escape to the adjacent zones, it will not be sufficient to extinguish the fire.

- ❖ It must be borne in mind that any fixed fire gas extinguishing system can be used only once. Take sufficient time before re-opening any space after the fire is extinguished.
- ❖ Be aware that, once air has been re-introduced into the space, re-ignition of the fire might be possible.
- ❖ Boundary cooling of the compartment on fire is a must to arrest the spread of fire.
- ❖ Engines, generators, machinery, fuel oil pumps, cargo pumps etc. shall be stopped. The supply of fuel to fire, by means of cargo lines or engine room fuel oil lines shall be cutoff.
- ❖ Emergency checklists enlisting the procedures for the use of system shall be followed.

3) Sample check-list for CO_2 flooding of engine room

In case of a large fire in the engine room & inability to contain and extinguish locally, CO_2 flooding may be necessary. In such a situation:

1.	Chief Engineer to take charge of operation.
2.	Electrical Officer to isolate all electrical circuits from Emergency Switch Board to Engine Room before starting and taking the Emergency Generator on load. Electrical Officer to then start Emergency Generator put it on load and double check that all electrical circuits to Engine Room from Emergency Switch Board are isolate.
3.	Activate CO_2 release alarm by opening the control box door.
4.	All persons report to Emergency Head Quarters. Ensure all Engine Room entrances are shut while leaving Engine Room and also on all decks in accommodation.
5.	Take a head count and ensure all present or accounted for.
6.	Confirm E/Room ventilation tripped.
7.	Confirm remote stops activated.
8.	2nd Engineer to trip all Quick Closing Valves.
9.	3rd Engineer to proceed to Steering. Flat and start Emergency Fire Pump and ensure proper operation and standby Emergency Fire Pump. Confirm isolating V/V to E/R shut.
10.	Support squad to close all blower flaps, funnel flaps, all Engine Room and funnel doors. (A list to be kept handy to ensure all openings has been closed).
11.	Emergency squad to start boundary cooling as required.
12.	Confirm Engine Room is sealed & final head count.
13.	Request permission from Master to discharge CO_2.
14.	Release CO_2 as per vessel's specifications. While operating the system ensure that the correct discharging procedure is followed. Unless otherwise required by the maker's operating instruction, the Master valve to be operated last to ensure that pressure operated "Gas Approach Alarm" sounds before the gas is released into the Engine Room.
15.	Continue boundary cooling and take all necessary steps to avoid spread of fire to accommodation. Constantly monitor Engine Room boundary temperature.

4) Properties and personal hazards of the extinguishing medium

➢ **Carbon di-oxide**

- ❖ Exposure to vapor at high concentrations may have the effects such as light headedness, dizziness, difficulty with breathing, drowsiness, nausea, mental confusion, increased blood pressure, increased respiratory rate, loss of consciousness which may prove fatal due to suffocation as it displaces oxygen. Individuals with pre-existing disease will be at increased risk.

- ❖ Direct contact with the cold gas or liquid can cause freezing of exposed tissues, with pain, redness, burns and corneal damage. Moisture in the air can react to form carbonic acid which causes eye irritation. Direct contact with the cold gas or liquid can cause freezing of exposed tissues.

- ❖ Wear full protective clothing and self-contained breathing apparatus. Remove leaking cylinder to a safe place. Ventilate the area. Vapors can accumulate in low areas. Leaks inside confined spaces may cause suffocation as oxygen is displaced and should not be entered without a self-contained breathing apparatus.

Acute health effects of high concentrations of carbon dioxide

Concentration (% Carbon Dioxide/Air)	Time	Effects
2%	Several hours	Headache, dyspnea upon mild exertion.
3%	1 hour	Dilation of cerebral blood vessels, increased pulmonary ventilation, and increased oxygen delivery to the tissues.
4 – 5%	Within a few minutes	Mild headache, sweating and dyspnea at rest.
6%	1 – 2 minutes <16 minutes Several hours	Hearing and visual disturbances Headache and dyspnea Tremors
7 – 10%	Few minutes 1.5 minutes – 1 hour	Unconsciousness or near unconsciousness. Headache, increased heart rate, shortness of breath, dizziness, sweating, rapid breathing.
10 - 15%	1+ minute	Dizziness, drowsiness, severe muscle twitching and unconsciousness.
17 – 30%	< 1 minute	Loss of controlled and purposeful activity, unconsciousness, convulsions, coma and death.

- ➢ **HALON**

- ❖ Exposure to HALON vapor at high concentrations are likely to have effects such as light headedness, dizziness, difficulty with breathing, drowsiness, nausea mental confusion, increased blood pressure, increased respiratory rate and loss of consciousness.

- ❖ Exposure at high concentrations may also cause temporary alteration of the heart's electrical activity with irregular pulse, palpitations or inadequate circulation. Individuals with preexisting diseases of the cardiovascular system or nervous system may have increased susceptibility from excessive exposures.

- ❖ Direct contact with the cold gas or liquid can cause freezing of exposed tissues, with pain, redness, burns and corneal damage. Direct contact with the cold gas or liquid can cause freezing of exposed tissues.

- ❖ Keep halon containers and surroundings cool with water spray as containers may rupture or burst in the heat of a fire.

- ➢ **Dry chemical powder**

- ❖ Pressurized extinguishers should be properly stored and secured to prevent falling or being knocked over. Pressurized extinguishers and surroundings shall be kept cool with water spray as they may rupture or burst in the heat of a fire.

- ❖ Contact with eyes and skin for short periods of time may cause irritation. Inhalation may irritate the respiratory tract and cause transient cough and shortness of breath.

- ➢ **AFFF foam solution**

- ❖ Contact may cause slight irritation. Repeated or prolonged contact may produce de-fatting of the skin leading to irritation and dermatitis.

- ➢ **Water mist and spray**

- ❖ Water mist and spray does not involve any direct personal hazard except the hazard of electrocution. The electricity supply to the compartment shall be completely cut-off prior the system is put in operation.

Apply Your Knowledge

1. Discuss the associated precautions relating to the use of the fixed fire extinguishing system provided on board your vessel.
2. Discuss the activation process of CO_2 release system in engine room if applicable.

I M U

Function: Controlling the operation of the ship and care for persons on board

Competence: Prevent, control and fight fires on board

Task number: C3.1

Sub task Reference number: C3.1.15

Topic: Operation and maintenance of fire fighting appliances (FFA)

Task Heading

- Use a breathing apparatus record/control board during a fire drill

Objectives

- Understand use of a breathing apparatus record/control board

Index

1) Breathing apparatus duration
2) Breathing apparatus (BA) boards

Description

1) Breathing apparatus duration

- A breathing apparatus record/control board, also called as entry control board, is a board provided to keep a check on safety of wearer of SCBA to ensure sufficient supply of breathing air is available to the wearer throughout as long as the set is put on. The intention is to keep a record of what is the available duration for which the SCBA set has sufficient air, when was the set donned by the wearer and what is the alarming time when the person shall be called out.

TECHNICAL DATA	
Composite Cylinders	
Water Capacity (litres)	4.7
Free Air Capacity (litres)	1274
Working Duration (minutes)	32
Nominal Duration (minutes)	22
Service Pressure (bar)	300
Weight (kg)	2.80
Diameter (mm)	137
Length (mm)	480
Design Life (years)	15
Thread	M18 x 1.5
Certification	EN 12245:2002

- Technical data of SCBA air bottle specify the water capacity, free air capacity, working duration, and service pressure etc, most of which is ,marked on the bottle itself. The important once are
    - Full duration
    - Working/nominal/normal duration
    - Safety margin

- Duration tables are provided as a guide specifying the average duration of a BA cylinder, based on the amount of air likely to be used by a BA wearer at a given incident type (i.e. normal fire service operations, or complex and/or strenuous BA wear involving sustained increased physical activity). The duration tables attached to the BA board are based on a rough guide. It is assumed that a trained wearer in fit condition and working reasonably hard will consume about 40 litres of free air per minute. These tables are based on an experiment conducted in 1912 and approximates to a wearer walking at a speed of 6 km/hour.

Approximate Consumption/ duration table:

Degrees of work	Air consumption (Ltrs/minute)	Duration of cylinder having 1200 ltrs capacity (minutes)	Duration of cylinder having 1800 ltrs capacity (minutes)
Resting	8 – 12	150 – 100	225 - 150
Light Work	12 – 20	100 – 60	150 – 90
Moderate Work	20 – 40	60 – 30	90 – 45
Heavy Work	40 – 60	30 – 20	45 – 30

- The working duration, as defined above, of a SCBA set varies from one wearer to another and depends on the amount of effort being expended. Inexperienced people can easily double the rate of air consumption.

- Compressed air cylinders are of various sizes, usually of either 9 or 6 litre water capacity. The fully charged pressure of cylinders also varies. Some types are charged to as high as 300 bars but 200 bars / atmospheres/ Kg/cm^2 is more common for shipboard use. The maximum charging pressure is always stamped on either the neck or the shoulder of a cylinder.

- To obtain the approximate quantity of free air in a cylinder, the water capacity in liters' marked on the bottle is multiplied by the pressure in bars.
  For example, a 6 litres cylinder charged to 200 bars -
  6 ltrs x 200 bar = 1200 liters (approximately)

  - However, types of cylinder are available which, whilst they may have identical maximum working pressure, have different capacities at this pressure. Care should be taken to ensure that duration tables are used and the correct table for the cylinder capacity to be used is consulted.
  - The average rate of consumption for compressed air BA sets is assumed to be 40 litres per minute. When a wearer undertakes exceptionally heavy work the rate may well be higher and the duration correspondingly less.
  - The safety margin recommended for all types of BA is 10 minutes.
  - In order to calculate approximate duration for the SCBA bottle, the total air quantity is divided by the average consumption. Subtracting the safety margin from this gives the working duration for the bottle.
  - For example, on the basis of a consumption of 40 liters /minute the rated full duration of such a cylinder would be –
    1200/40 = 30 minutes
  - Applying the 10 minute safety margin:
  - Working/ Normal Duration of such a cylinder would be
    30 min – 10 min = 20 minutes

- In accordance with SOLAS and FSS code, the volume of air contained in the SCBA cylinders should be at least 1,200 litres.

- Air cylinders most commonly used for marine applications are manufactured from steel and have a working pressure of 200 or 300 bar. The label on the cylinder displays vital safety information and should be clearly legible.

- Where in any ship breathing apparatus cylinders are carried having different working pressures, in addition to the normal marking on the cylinder the working pressure should be prominently marked on the cylinder.

> Don't expect to obtain the full rated service life from the cylinder on each use – the service life may be shorter than indicated, possibly as short as one-half the rated time. The time remaining after the alarm actuates will be similarly reduced.

- The service life of the cylinder is affected by:
- The degree of physical activity of the user
- The physical condition of the user
- The degree to which the user's breathing is affected by excitement, fear or other emotional factors

- ❖ The degree of training or experience which the user has with this or similar equipment
- ❖ Whether or not the cylinder is fully charged at the start of the work period

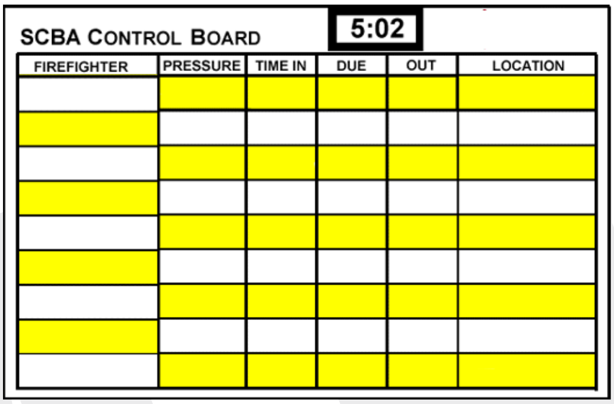
2) Breathing apparatus (BA) boards

- ➢ A typical BA board on board contains
- ❖ The names of the wearer
- ❖ Present bottle pressure mentioned adjacent to their names
- ❖ Time of entry (time In)
- ❖ Time due

  The person handling the BA board needs to calculate the duration time for the individual wearer and write it down adjacent to his name as time for coming out (time due), by which the party should have come back. Only after this is briefed to the wearer, he should be allowed to proceed to attend the fire.

- ❖ Time out

  The time when the emergency squad comes out should also be on the board and in order to have control of the situation and not lose the orientation, preferably the location (this will assist in rescue, if needed).



- ➢ The on scene coordinator (OSC) should ensure BA wearers are appropriately pre-briefed prior to entry to the risk area. To restrict the length of exposure in difficult or strenuous conditions the emergency squad (SCBA wearer) must be advised to withdraw from the risk area at a predetermined pressure gauge reading.

- ➢ A pouch may be attached to the board to house items such as a watch (this could be an analogue or digital), suitable waterproof marker, pen(s) and notebook. The board may be provided with a stand or other means of support.

- ➢ Prior to using the board, it should be ensured that
  - ❖ clean and with no previous entries displayed
  - ❖ free from damage or signs of excessive wear
  - ❖ provided with a suitable waterproof marker
  - ❖ fitted/ has a clock which is functioning and indicating the correct time
  - ❖ stowed on the appropriate appliance

Apply Your Knowledge

1. Locate the SCBA bottles provided on board your vessel and check the following details:
   - ➢ Charging pressure
   - ➢ Work duration

Function: Controlling the operation of the ship and care for persons on board

Competence: Prevent, control and fight fires on board

Task number: C3.1

Sub task Reference number: C3.1.17

Topic: Operation and maintenance of fire fighting appliances (FFA)

Task Heading

- Assist in starting and operating emergency generator.

Objectives

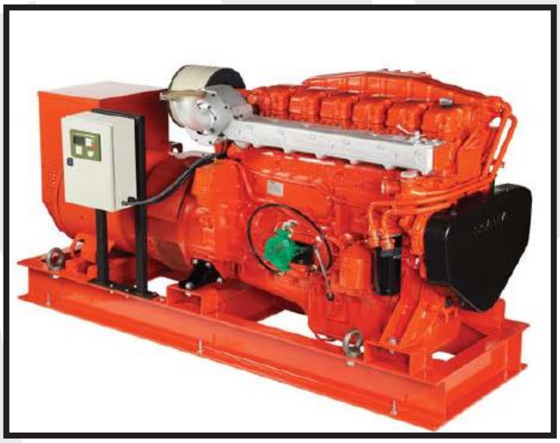
- Understand the procedure of starting and operating emergency generator

Index

1) Emergency generator
2) Starting of emergency generator
3) Testing and inspection of emergency generator and fittings

Description

1) Emergency generator



- An emergency power system on ship provides an uninterrupted supply of power for all emergency conditions. The emergency source of electrical power may be either a generator or an accumulator battery. Emergency generator on ship provides power in case the main generators of the ship fails and creates a “dead or blackout condition”. SOLAS chapter II-1 regulation 42 and 43 defines the carriage requirements for the emergency source of power supply on board passenger ships and cargo ships.
- The emergency generator and other means needed to restore the propulsion are required to have a capacity such that the necessary propulsion starting energy is available within 30 minutes of blackout/dead ship condition. Emergency generator stored starting energy is not to be directly used for starting the propulsion plant, the main source of electrical power and/or other essential auxiliaries (emergency generator excluded).

- In case of blackout there should be an alternate source of power available and which should come on load automatically. Alternate source of power are taken from batteries and emergency generators to provide power to critical equipments. As batteries cannot provide power for a longer period of time, emergency generator is preferred.
- A placard(s)/ checklist(s) is usually posted nearby the set which explains the procedure for starting the emergency generator set of that ship, again, remember every ship could have a complete

different marine diesel emergency generator set, it is extremely important to be completely familiarized and well trained to an extent that in case asked by any shore officials, the crew member should be able to demonstrate the same.

2) Starting of emergency generator

- **Procedure for battery start**
- Go to the emergency generator room and find the panel for emergency generator.
- Check the fuel oil and lubricating oil levels.
- Put the switch on the test mode from automatic mode. The generator will start automatically but will not come on load.
- Check voltage and frequency in the meter.
- Keep the generator running for 10-15 min and check the exhaust temp and other parameters.
- Check the sump level.
- For stopping the generator, put the switch in manual and then stop the generator.

- **Hydraulic starters**
- Hydraulic system for starting works on the principle of hydraulic and pneumatic, in which, the energy is first stored and then supplied or released for the starting of the engine. In the case of hydraulic starters the energy is stored in the form of hydraulic fluid under pressure inside an accumulator. This energy is provided via a manual hand pump or a power driven recharge pump, which in turn can be released via a valve to turn the hydraulic starter motor.

- **Procedure for hydraulic start**
- ✓ Put the switch in manual mode as stated in the battery start operation and check the pressure gauge for sufficient oil pressure.
- ✓ Open the valve from accumulator to generator.
- ✓ Push the spring loaded valve, the generator should start.
- ✓ Check voltage and frequency.
- ✓ Keep the generator running for 10-15 min and check the exhaust temp and other parameters.
- ✓ Check the sump level
- ✓ For stopping, use the manual stop button from the panel.
- ✓ After stopping the generator, pressurize the hydraulic accumulator to desired pressure.
- ✓ Close the valve from accumulator to generator.

- **Starting by manual cranking**

  Manual cranking level and assembly is also provided as a backup arrangement in order start the generator manually in case the battery start or automatic start operations fail. The fuel and lubricating oil levels are checked. The shaft is cranked manually further to set the generator on. Hard turns are required on the shaft for starting the generator manually. Once on, the generator is gradually put to load.
- The emergency generator is tried out every month or as required by shipboard PMS to ensure that it is working fine. Every month automatic start of generator is also done to check its automatic operation and to see whether it comes on load.

3) Testing and inspection of emergency generator and fittings

- The testing of ship's emergency generator is done every week (as part of weekly checks) by running it unloaded to check if it starts on battery mode. All parameters such as fuel oil level (the fuel tank should always have fuel to provide full load requirements for at least 18 hours), lube oil level, water level in radiator etc are to be noted and monitored.

Apply Your Knowledge

1. Locate the emergency generator on board your vessel and discuss the checks prior starting the same.

Function: Controlling the operation of the ship and care for persons on board

Competence: Prevent, control and fight fires on board

Task number: C3.2

Sub task Reference number: C3.2.3

Topic: Fire fighting

Task Heading

- Participate in a fire drill at sea and in port.

Objectives

- Understand the procedure and conduct of fire drill at sea and in port.

Please read this task in conjunction with task A5.2.5

Index

1) Fire drill – general requirements
2) Fire drills at sea
3) Fire drills while in port

Description

1) Fire drill – general requirements

The purpose of drills, apart from being a mandatory SOLAS requirement, is to periodically evaluate the performance of crew members assigned to fire-fighting duties and identify areas that require improvement, to ensure that competency in fire-fighting skills and the operational readiness of the fire-fighting organization is maintained.

- Every crew member with assigned emergency duties should be familiar with these duties before the voyage begins including the methods of various alarms likely to be used during emergency.
- Every crew member is required to participate in at least one fire drill every month. On passenger ships, an abandon ship drill and fire drill are required to take place weekly. The same shall be recorded adequately. The drills of the crew are required to take place within 24 hrs of the ship leaving a port if more than 25% of the crew has not participated in abandon ship and fire drills on board that particular ship in the previous month.

The equipments used during drills should immediately be brought back to its fully operational condition and any faults and defects discovered during the drills should be rectified as soon as possible.

- Drills should as far as practicable be conducted as if there were an actual emergency.
- The type and position of the fire scenario should be varied in various drills, so that most parts of the ship, likely types of fires and all types of fire-fighting are covered.
- Each fire drill should include
  - ❖ reporting procedures to stations and preparing for the duties described in the muster list
  - ❖ starting of a fire pump, using at least the two required jets of water to show that the system is in proper working order

- ❖ checking of fireman's outfit and other personal rescue equipment
- ❖ testing of relevant communication equipment
- ❖ checking the operation of watertight doors, fire doors, fire dampers and main inlets and outlets of ventilation systems in the drill area
- ❖ checking the necessary arrangements for subsequent abandoning of the ship

2) Fire drills at sea

Shipboard Emergency procedures shall be followed during a fire emergency on board. Sample checklists are as follows:

➢ **Fire including release of CO_2 fixed fire fighting installation**

Initial Action: (By person detecting the fire)

- ❖ Raise the alarm – Use nearest manual fire alarm in alleyways.
- ❖ Shout "Fire, Fire".
- ❖ Inform bridge / duty officer /duty engineer giving location of fire and his name.
- ❖ If the fire is small, attempt to extinguish it with a fire extinguisher.
- ❖ If the 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.

Bridge team

- ❖ Sound general emergency alarm (internal and external). Announce location and nature of fire on public address system.
- ❖ Put main engine on standby
- ❖ Steer vessel away from traffic, coast or shallow depths prior stopping, if possible
- ❖ Adjust ships course and speed to minimize wind effect.
- ❖ Place vessel in most advantageous position with regards to weather and traffic.
- ❖ Confirm head count is taken and all accounted for.
- ❖ Trip accommodation, cargo hold, engine room vents / fans, as appropriate
- ❖ Hoist appropriate "NOT UNDER COMMAND SIGNAL"
- ❖ Liaise with on scene coordinator
- ❖ Decide quickly if CO_2 or other fixed firefighting system needs to be released.
- ❖ Check location of dangerous cargo around compartment on fire, also check other cargo.
- ❖ Send urgency message, if necessary
- ❖ Update position on GMDSS console
- ❖ Note down the time of CO_2 release (required for evidence)

Duty engineer /Engine team

- ❖ Transfer main engine control from bridge to engine control room.
- ❖ Slow down / stop engines in consultation with bridge team. Activate fuel trips, emergency stops, etc., as required.
- ❖ Switch off engine room blowers in case of engine room fire.
- ❖ Check fire pumps are running
- ❖ Additionally, keep emergency fire pump ready
- ❖ Start additional generator for power, if necessary

Emergency team

Make quick assessment and verify following (as applicable)

- ❖ Gravity of the situation?
- ❖ Any risk of explosion or spread of fire?
- ❖ Any personnel trapped?
- ❖ Is rescue a problem?
- ❖ Any toxic fumes or vapours present?
- ❖ Does it pose a threat?
- ❖ Any inflammable substance?
- ❖ Can it be removed? or
- ❖ Will it support spread of fire?
- ❖ Any dangerous cargo present? Details from IMDG – Emergency Schedule.
- ❖ Container on fire?

- ❖ Any risk to adjacent boxes

Based on above results plan fire fighting

- ❖ One Officer and A.B. to don fire suit, harness and SCBA.
- ❖ Make entry into compartment with charged hose and nozzle set to water spray. (Pressure on SCBA checked and logged)
- ❖ If cargo hold fire confirm with “on scene coordinator” whether it is safe to use water or CO_2 should be released.
- ❖ 2nd team to don Fire suit, harness, SCBA and be ready for entry
- ❖ If necessary 2nd team makes an entry.

Support team

- ❖ Shut all ventilators, doors, openings, booby hatches etc. Advise bridge which ventilators have been closed.
- ❖ Prepare as back up team and be ready with fireman suit and SCBA to make entry if necessary, to assist emergency team.
- ❖ Assist as required

Additionally:

- ❖ **Engine room fire**
- ✓ Shut all blower flaps, funnel dampers, funnel doors and entrances to engine room
- ✓ Start emergency fire pump
- ✓ Shut the fire line isolating valves
- ✓ All emergency exits from engine room to be shut
- ✓ Check for hot spots on all sides

- ❖ **Cargo spaces fire**
- ✓ Shut all vent flaps
- ✓ Place canvas covers, if available, over vent openings and wet them at frequent intervals. If smoke is seen coming out from around the hatch, seal the area with duct seal, sealing tape or cement.
- ✓ Oil tanks adjacent to cargo holds on fire shall not be drained. Drained tanks are quickly heated up and will thus represent an explosion hazard. Filled tanks are slowly heated and are less likely to ignite.
- ✓ Check for hot spots
- ✓ Flooding tanks adjacent to cargo hold on fire with seawater can efficiently cool down essential structures
- ✓ Adjacent containers to any container on fire should be continuously sprayed with copious quantity of water to prevent spread of fire.
- ✓ Any smoke emitting from engine room or hold will give an indication that some opening is still left open.

Special duty team

- ❖ Shut all electrical power to the compartment or area on fire
- ❖ On scene coordinator:
    - ✓ Monitor fire fighter’s progress and update bridge team
    - ✓ Maintain communication between all the teams.
- ❖ Advise emergency and other teams at the scene of emergency as required.
- ❖ Engine room fire - Start emergency generator and take it on load and isolate all electrical circuits from emergency switch board to engine room
- ❖ Cargo space fire - Cut off electrical supply to the cargo space, mechanical ventilators.

Medical team

- ❖ Bring stretcher, First aid kit to the point of entry or exit used by fire fighters.
- ❖ Remove casualty to safety and give First aid.
- ❖ Assist as required.

IMU

3) Fire drills while in port

- The procedures for fire fighting remain the same while the vessel is at sea or at port. The variables that affect the procedures while the ship is in port are the availability of shore based support and reduced number of shipboard personnel as discussed under task A5.2.5.
- Irrespective of the availability of shore support vessel shall be manned suitably while the vessel is in port so as to deal effectively with any emergency situation.
- Companies may restrict the number of people going on shore leave such as only 50% from each department should be allowed to go ashore at any one time.
- Effectiveness of emergency teams shall be checked by conducting fire drills in while the ship is in port with reduced manpower.
- Procedures to avail shore based support for fire fighting shall be discussed. Readiness of international shore connection and fire wallet shall be checked simultaneously. Fire wallets carry
- A copy of ships updated fire control plan.
- Cargo and stability Information
- An up to date crew list

Apply Your Knowledge

1. Discuss the duties of your team in case of a fire emergency on board.
2. Discuss the constraints imposed by reduced manpower in case of an emergency while the ship is in port.

I M U

Function: Controlling the operation of the ship and care for persons on board

Competence: Operate life saving appliances

Task number: C4.1

Sub task Reference number: C4.1.8, C4.1.9, C4.1.10, C4.1.11, C4.1.11.1, C4.1.11.2, C4.1.11.3, C4.1.12

Topic: Life saving appliances (LSA)

Task Heading

- Identify the permanent markings required on the survival craft (lifeboat, rescue boat and liferaft).
- Assist with weekly 'moving' of lifeboats and record same.
- Assist with monthly 'turning out' of lifeboats and record same.
- Demonstrate ability to use and maintain LSA equipment, including:
    - Life jackets
    - Immersion suits, thermal protective aids
    - Lifebuoys, self igniting lights, man overboard markers.
- Locate and demonstrate understanding of the operation of all pyrotechnics carried on board and in lifeboats, and the procedure for disposal of out of date pyrotechnics

Objectives

- Familiarize with the permanent markings required on the survival craft (lifeboat, rescue boat and liferaft).
- Understand the requirement, importance and procedure of weekly 'moving' of lifeboats and recording same.
- Understand the requirement, importance and procedure of monthly 'turning out' of lifeboats and recording same.
    - Lifebuoys, self igniting lights, man overboard markers
    - Familiarise with the maintenance procedures of Life jackets, Immersion suits, thermal protective aids
- Familiarise with the operation of all pyrotechnics carried on board and in lifeboats, and the procedure for disposal of out of date pyrotechnics

Please read this task in conjunction with task C4.1.6

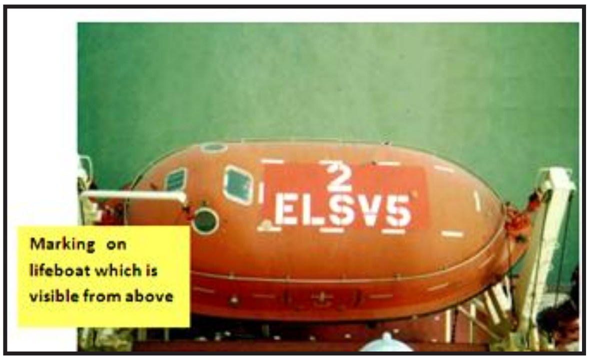
Index

1) Lifeboat markings
2) Markings on liferafts
3) Operational readiness of lifeboats
4) Maintenance procedures
    a) Lifebuoys
    b) Lifejackets
    c) Immersion suits
    d) TPA
5) Ship's pyrotechnics
    a) Rocket parachute signals
    b) Hand flares
    c) Buoyant smoke floats
    d) Lifebuoy self- activating man overboard smoke signal
    e) Line throwing apparatus
6) Disposal of out of date pyrotechnics

Description

1) Lifeboat markings

- The following marking, in block capital letters of the roman alphabet, should be marked on each side of the lifeboat's bow:
  a) Number of person's lifeboat is approved to carry.
  b) Name & port of registry of the ship.
  c) Number of lifeboat.



- Means of identifying the ship to which the lifeboat belongs and the number of the lifeboat shall be marked in such a way that they are visible from above.

  As a guidance the markings could be of a letter size of about 10 to 12cms thick, to be clearly visible from above, marked on top of life boat casing / canopy or on the thwart.
  a) Ship's call letters
  b) Lifeboat number

Lifeboat certificate of approval (identity plate)

Each lifeboat is fitted with certificate of approval (an identity plate) endorsed by the Administration, containing the following items:

1. Manufacturer's name and address;
2. Lifeboat model and serial number;
3. Month and year of manufacture;
4. Number of persons the lifeboat is approved to carry; and
5. The approval information

In addition, for free fall lifeboats, the certificate of approval also states:

1. Free-fall certification height
2. Required launching ramp length; and
3. Launching ramp angle for free-fall certification height.

The above certificate (identity plate) should not be painted over. To protect the markings from wearing out, the certificate can be coated with varnish etc.

- In addition to the items mentioned above, the following markings should also be checked:
- ❖ Lifeboat release gear marked in a colour that contrasts with its surroundings with an arrow indicating direction of movement for release.
- ❖ Seating arrangement inside the lifeboat.
- ❖ Following markings are required for lifeboat equipments:
  - Location of plug or plugs.

- Small gear locker.
- Fuel tank with open / shut marking on fuel valve.
- Fresh water tank & provisions locker.
- Pyrotechnics.

➢ Other markings

❖ Lifeboat lowering and embarkation instructions, using IMO symbols, should be posted near the life boats and their launching controls in such a way that they are visible under emergency lighting. If the boat can be remotely launched from inside the boat (remote operation), Lifeboat lowering instructions shall also be posted inside the boat.

❖ In boats fitted with disengaging gear, the position of the emergency hand release should be clearly marked.

❖ Manufacturer’s instructions regarding operation and maintenance of release gear must be strictly followed and should be CLEARLY DISPLAYED in the lifeboat.

❖ Instructions should be provided at the helmsman’s position indicating the means of starting and controlling the engine and the use of the emergency tiller.

❖ Controls provided in the lifeboat for the operation of the air supply, water sprinkler system and to close ventilators should be provided with clear and conspicuous notices regarding their use at the operating position and the helmsman’s position.

❖ Renewal date of lifeboat falls should be stencilled near the lifeboat.

❖ Date of load testing of lifeboat release gear and davits should be stencilled near the lifeboat.

❖ Date of inspection of lifeboat brakes should be stencilled near the lifeboat winch.

2) Markings on liferafts

➢ **Markings on the containers for inflatable liferafts**

The container is marked with:

❖ Maker's name or trade mark;

❖ Serial number;

❖ Name of approving authority and the number of persons it is permitted to carry;

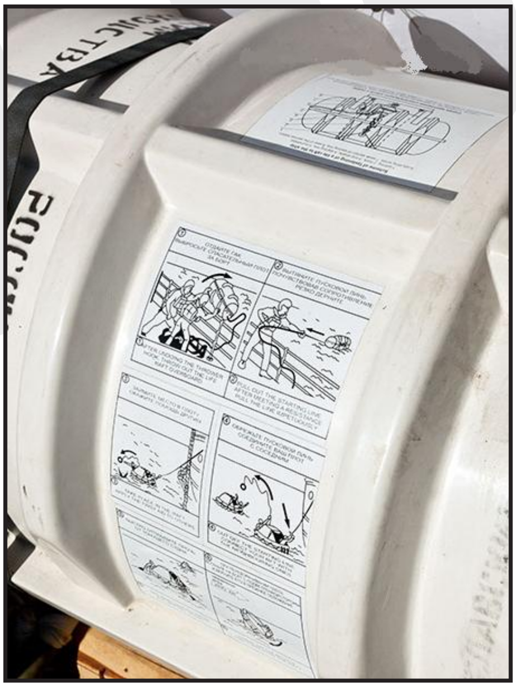
❖ SOLAS type of emergency pack enclosed;

❖ Date when last serviced;

❖ Length of painter;

❖ Maximum permitted height of stowage above waterline (depending on drop-test height and length of painter); and

❖ Launching instructions.



The ship’s name & port of registry are also marked on these containers; however it is not a SOLAS requirement.

➢ **Markings on inflatable liferafts**

The inflatable liferaft is marked with

❖ Maker's name or trade mark;

❖ Serial number;

❖ Date of manufacture (month and year);

❖ Name of approving authority;

❖ Name and place of servicing station where it was last serviced; and

❖ Number of persons it is permitted to accommodate over each entrance in characters not less than 100 mm in height of a colour contrasting with that of the liferaft.

Provisions are made for marking each liferaft with the name and port of registry of the ship to which it is to be fitted, in such a form that the ship identification can be changed at any time without opening the container.

➢ **Markings on rigid liferafts**

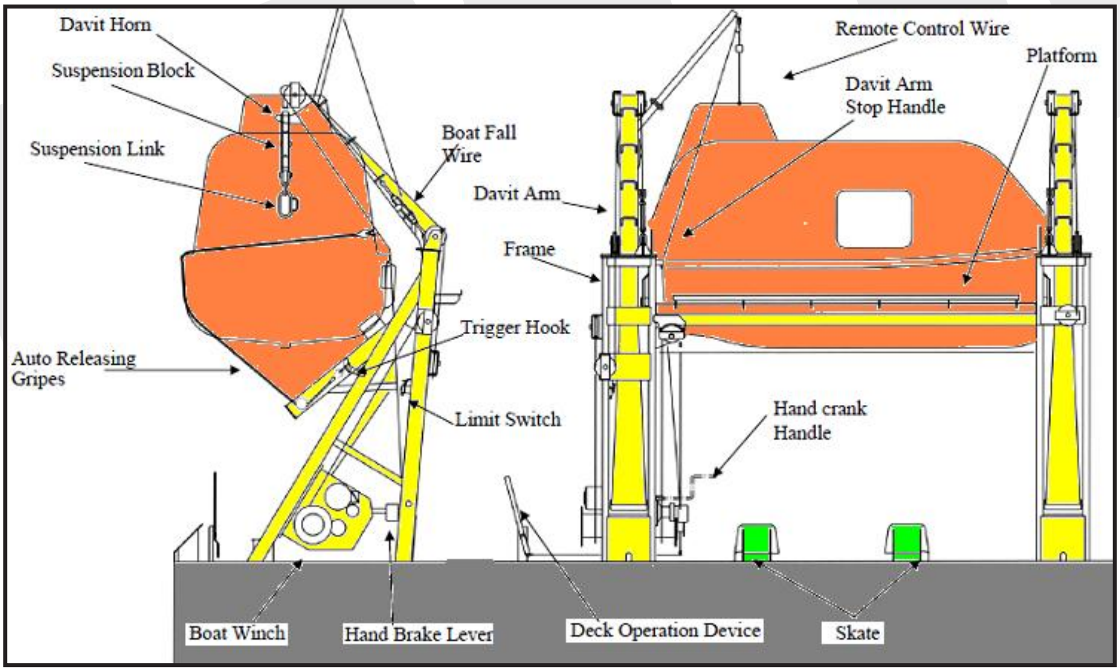
The rigid liferaft is marked with

- ❖ Name and port of registry of the ship to which it belongs;
- ❖ Maker's name or trade mark;
- ❖ Serial number;
- ❖ Name of approving authority;
- ❖ Number of persons it is permitted to accommodate over each entrance in characters not less than 100 mm in height of a colour contrasting with that of the liferaft;
- ❖ SOLAS type of emergency pack enclosed;
- ❖ Length of painter;
- ❖ Maximum permitted height of stowage above waterline (drop test height); and
- ❖ Launching instructions.

3) Operational readiness of lifeboats

➢ **Weekly 'moving' and monthly 'turning out' of lifeboats**

- ❖ The launching procedures of life boats are discussed in detail in the C4.1.6 which shall be referred to. SOLAS chapter III regulation 20 specifies that to ensure operational readiness, lifeboats, except free-fall lifeboats, on cargo ships shall be moved from their stowed position, without any persons on board, to the extent necessary to demonstrate satisfactory operation of launching appliances on a weekly basis, if weather and sea conditions so allow for. Further, all lifeboats, except free-fall lifeboats, shall be turned out from their stowed position, without any persons on board monthly if weather and sea conditions so allow. The point to note is that these procedures are conducted without any person being on board the craft.



- ❖ The procedure of moving the lifeboats, without any persons on board, would be similar as launching, except the operation could be stopped the moment the davit arm has moved from its stowage position to a reasonable extent necessary to demonstrate satisfactory operation of launching and then the boat can be brought back to its stowage position using the motor and hand crank handle, and then secured.
- ❖ The procedure of turning out the lifeboats from their stowed position, without any persons on board, would be similar as launching, except the operation would be stopped the moment the lifeboat reaches the embarkation deck and then the boat can be hoisted back to its stowage position using the motor and when the limit switch gets activated,

using the hand crank handle to get the boat back into its stowage position and then secured.

- ❖ For both the inspections, records shall be maintained in the log-book.


Lifeboat stowed


Lifeboat turned out

4) Maintenance procedures

Ship specific planned maintenance schedule mentions the maintenance procedures which shall be followed for maintenance of LSA. The general procedures are as follows:

a) Lifebuoys

❖ **Monthly inspection routine**

Location & condition of life buoy
- ✓ Life buoys must be placed as per the LSA Plan.
- ✓ Check the condition of the buoy for any damage or deterioration especially at the seams for any opening or cracks, which may allow ingress of water.
- ✓ Ensure line becketed outside the buoy is at least of 9.5 mm diameter and the length is not less than four times the outer diameter of the life buoy.
- ✓ Check condition of becketed line for strong attachment and deterioration. Renew the line, if required.

Life buoy cradle
- ✓ Check the lifebuoy cradles, S.I. light and man-overboard marker cradles for corrosion and paint as required.
- ✓ Ensure that buoys are always kept only in their designated cradle.
- ✓ Check that cradle is in good condition and secured firmly to ship's structure.
- ✓ ENSURE that life buoy is free in its cradle.
- ✓ If life buoy bracket has a securing pin or any other arrangement to prevent the life buoy getting lost at sea inadvertently, then ensure that the securing pin is free and the buoy can be released instantly.
- ✓ Grease the moving parts and safety pins of the bracket, once every month

Life-buoy markings
- ✓ Markings must be clearly marked and should always be clearly visible. Markings should in black or white paint.
- ✓ Marking should be on both sides of the buoy.
- ✓ Usually polyurethane buoys are not required to be painted 'Orange', it is best to remove the old marking and re-paint just the markings.
- ✓ The markings on a life buoy consist of the following (in uppercase alphabets and size of letters 50mm):
- Ship's name.
- Port of registry.

- **Retro reflective tapes**
  - ✓ Check that retro-reflective tape at least 5cm wide is applied around or on both sides of the body of the lifebuoy at four evenly-spaced points.

- **Self igniting light - dry cell type**
  - ✓ Test dry cell type S.I. lights for operation, every month.
  - ✓ Ensure that there is no ingress of water in the S.I. light.
  - ✓ Ensure that light is firmly secured in its stand and is available for immediate use.
  - ✓ The S.I. light must be connected to the lifebuoy by means of a lanyard. Twist the lanyard against the lay to check for rotting.

- **Self igniting light - sea water activation type**
  - ✓ Ensure that light is firmly secured in its stand and is available for immediate use.
  - ✓ Check that water inlet ports of sea water activated S.I. light remain sealed. If holes are found open then battery must be checked as per manufacturer's instructions and will require renewal if water has already entered.
  - ✓ Check expiry dates and indent as required

- **Buoyant line**
  - ✓ Buoyant line should be buoyant and of bright orange colour with minimum diameter of 8 mm and breaking stress of at least 5 kN.
  - ✓ Ensure that length of buoyant line is at least 30m or twice the height between stow position and water line at lightest draft, which ever is greater.
  - ✓ Ensure that buoyant line and self igniting light are not fitted to a same life buoy.
  - ✓ Ensure that buoyant line is coiled in such a manner that it can be opened easily in an emergency and is not secured in any way.
  - ✓ Ensure that buoyant line is attached firmly to the buoy and is not used for any other purpose except rescue.
  - ✓ Check condition of buoyant line for rot, chaffing or weathering. Renew the line, if required.

- **Man overboard markers & fittings**
  - ✓ For life buoys placed on bridge wings, ensure that the quick release method is other than lifting the life buoy and throwing it overboard.
  - ✓ These must be fitted as per manufacturer's instructions. Usually at least a free fall distance of 2 meters is required, hence a rope, at least 2 meter long, is attached between MOB marker and the life buoy. The life buoy must weigh at least 4 kg.
  - ✓ The buoys should be so positioned that it falls clear of the ship's side upon release.
  - ✓ Check that rope is attached between buoy and the marker is in good condition. Renew the rope, if required.
  - ✓ Ensure MOB is ready for an immediate use. Check release pin for the buoy is free in its socket. Grease the release pin for the buoy, once every month
  - ✓ Ensure that the MOB marker stand has not weakened due to corrosion.

❖ **Six monthly inspection routine**

- **Performance test of retro-reflective tapes**

  Check performance of Retro reflective tapes in the following manner, once every 6 months or when in doubt:
  - Place a new piece of same material adjacent to the material fitted and pour water over both pieces of material.
  - Using a powerful torch held at eye level, compare the performance of the two pieces from a distance of 10 meters.
  - If a noticeable deterioration in performance is observed or if tapes are worn / damaged then the retro-reflective material should be replaced.

- **Self igniting light - dry cell type**

  Renew battery of dry cell type S.I. lights every 6 months

- **Self igniting light - sea water activation type**
  - ✓ Sea water activated S.I. light bulbs should tested by applying 1.5V to 3V from external supply to the bulb terminals. If the bulb does not light, it should be replaced.
  - ✓ The plastic dome should then be screwed back tightly on to the rubber washer.

b) Lifejackets

❖ **Monthly inspection routine**

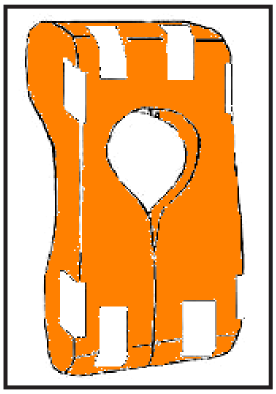
- **Condition of life jackets**

a. All lifejackets including the spare life jackets must be checked.
b. Check that all life jackets on board is approved type and has all necessary attachments such as whistle, light, markings etc.
c. Check that all lifejackets are provided with a releasable buoyant line or other means to secure it to a lifejacket worn by another person in the water. (See remark below)
d. Check that all lifejackets are provided with a suitable means to allow a rescuer to lift the wearer from the water into a survival craft or rescue boat. (See remark below)
e. Check general condition of life jacket for any damage, torn edges or deterioration.
f. Check condition of life jacket straps for strong attachment and / or deterioration.
g. Life jackets must be repaired or recovered only by the manufacturer and each repaired life jacket should be stamped ‘Repaired by …..’ and dated.

Remark: Above items c & d are applicable to all lifejackets provided on board ships constructed (having their keel laid) on or after 1 July 2010 and when providing new lifejackets to vessels with a keel laying date before 1 July 2010.

- **Lifejacket markings**

The markings on a life jacket consist of the following:
- ✓ Ship’s name.
- ✓ Port of registry.
- ✓ Life jacket number (Recommended).
- ✓ Markings must be clearly marked and should always be clearly visible.
- ✓ Markings should in black or white paint.
- ✓ If the paint is flaking or peeling off, then it must be removed and painted again.



In addition to the above markings, an infant or child lifejacket shall be marked with:
a) The size range in accordance with the table mentioned above; and
b) An “infant” or “child” symbol as shown in the “infant’s lifejacket” or “child’s lifejacket” symbol adopted by the organization.

- **Retro – reflective tape**
  Lifejackets are fitted with patches of retro reflective tape with a total area of at least 400cm^2 distributed so as to be useful for search from air and surface craft from all directions. In the case of a reversible lifejacket, the arrangement should be complied with no matter which way the lifejacket is put on. Such material should be placed as high up on the lifejacket as possible.

- **Self igniting light**
  - ✓ Each life jacket must have an approved type light.
  - ✓ Ensure that light is firmly secured to life jacket by a lanyard of length not less than 500mm.
  - ✓ Check that water inlet holes of Sea water activated S.I. light, remain sealed. If holes are found open then battery must be checked as per manufacturer's instructions and will require renewal if water has already entered.
  - ✓ Check that battery of none of the life jacket lights have expired. Renew light prior expiry.

- **Whistle**
  - ✓ Each life jacket must have an approved type whistle
  - ✓ Whistle must be firmly secured to the life jacket
  - ✓ Check condition of lanyard attached to the whistle.

- **Life jacket donning instructions**

  Instruction for wearing of all types of life jackets being used on board must be clearly displayed in the living quarters on both officers and crew decks.

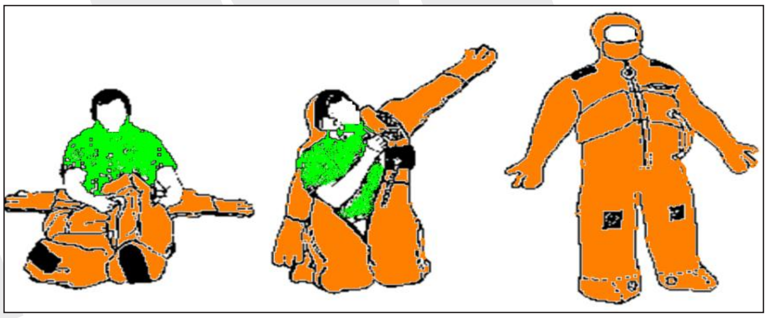
- **Six monthly inspection routine**
  - ✓ All inflatable life jackets must be serviced every year.
  - ✓ Condition of retro reflective tape shall be checked as discussed above.

c) Immersion suits

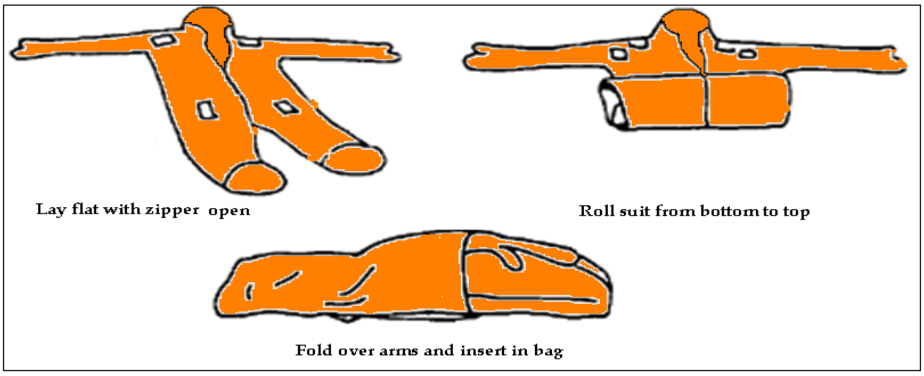
- **Monthly inspection routine**

- **Immersion suits donning instructions**

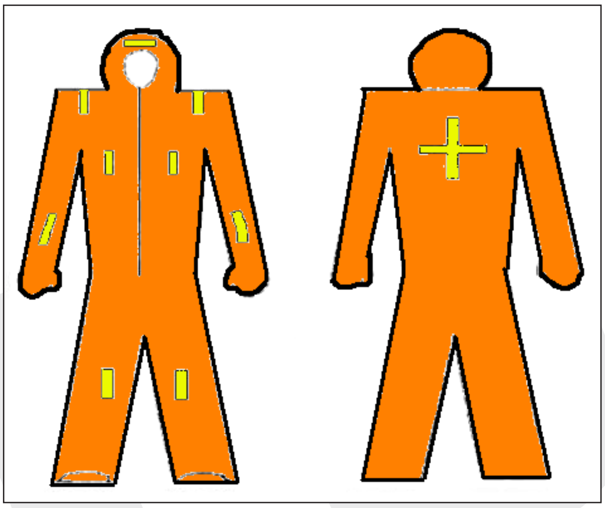
  Instructions for wearing of all types of Immersion Suits being used on board must be clearly displayed in the living quarters. Donning instructions must be displayed near the muster lists. Donning instructions are to be supplied with each suit. If immersion suits are to be worn with life jacket, it must be clearly mentioned.



- **Stowage**
  - ✓ Lay the suit on a clean, flat surface. Make sure the suit is dry inside and out. Check immersion suits for any damage or tear.
  - ✓ Check inflatable head support and buoyancy ring for damage and ensure that it is properly attached. Check inflation hose for deterioration. The head support / buoyancy ring should be inflated and tested for leaks
  - ✓ All repairs to immersion suit can be carried out only by the manufacturer or their authorized agent.



Zipper of immersion suit



- ✓ It is the most important part of the suit; unless the zipper is closed properly the suit will be completely ineffective in giving any protection.
- ✓ Check the zipper closely for damage to any tooth or any foreign particle obstructing the zipper.
- ✓ Zipper must be operated fully once in a month. Always store the zipper in unzipped position, ready for use.
- ✓ Zipper must be greased with its special grease as required.

Retro - reflective tape

Immersion suits should be fitted with patches of retro-reflective material with a total area of at least 400cm^2 distributed so as to be useful for search from air and surface craft from all directions. For an immersion suit that does not automatically turn the wearer face up, the back of the suit should be fitted with retro-reflective material with a total area of at least 100cm^2.

Self igniting light

- ✓ Each immersion suit to be worn without lifejacket must have an approved type light.
- ✓ Ensure that light is firmly secured to immersion suits and the procedure to use same is known to all persons on board.
- ✓ Check that water inlet holes of sea water activated S.I. light, remain sealed. If holes are found open then battery must be checked as per manufacturer's instructions and will require renewal if water has already entered.
- ✓ Check that battery of none of the immersion suits lights have expired.

Whistle

- ✓ Each immersion suit to be worn without life jacket must have an approved type whistle
- ✓ Whistle must be firmly secured to the immersion suits

Six monthly inspection

The retro reflective tapes shall be checked as discussed above.

Three yearly inspection routine

Pressure test

Each suit shall be subject to an air pressure test as follows

- ✓ A suitable head piece, fitted with a means to inject air into the suit, is inserted into the face orifice of the suit and secured so as to minimize leakage around the face seal. A low-pressure monitoring device, either integral to the fitting for air injection or as a separate device, is also inserted. If the suit is fitted with detachable gloves and/or boots, the wrists and/or cuffs should be sealed by inserting a short length of suitable diameter plastic pipe and securing the gloves and/or boots with suitable wire ties or hose clamps.

The zipper is then fully zipped, and any face flap closed. The suit is then inflated to a pressure of 0.7 to 1.4 kPa (0.1 to 0.2 psi). If an auxiliary inflatable means of buoyancy is provided, it should be inflated through the oral valve to a pressure of 0.7 kPa (0.1 psi) or until firm to the touch.

- ✓ Each seam and closure of the suit - and each seam, oral tube and attachment points and joint or valve of any auxiliary inflatable means of buoyancy - is then be covered with a soapy water solution containing enough soap to produce bubbles (if leakage is noted at a foot valve to the extent that air pressure cannot be maintained, the valves should be sealed for the test).
- ✓ If leaks are revealed by the propagation of bubbles at seams or closures, the leaking areas are marked and, after cleaning the suit thoroughly with fresh water and drying it, repaired in accordance with the suit manufacturer's recommendations.
- ✓ The air pressure test shall preferably be performed at a suitable shore-based facility equipped to make any necessary repairs in accordance with the manufacturer's recommendations. In view of the wide variety of materials and adhesives used in immersion suits and anti-exposure suits, it is strongly recommended that any repairs to a suit be carried out by a facility which has access to the original manufacturer's recommended servicing instructions, parts and adhesives, and suitably trained personnel. The air pressure test may be carried out on board ship provided suitable equipment is available on board.

d) Thermal protective aids

❖ **Monthly inspection routine**

Location

Thermal protective aids should be kept in a place which is easily accessible in an emergency or in the life boats. In case the TPA is kept outside the lifeboat, a person is to be designated to bring them into each lifeboat in an emergency.

Condition of thermal protective aids

- ✓ TPA’s are usually in a sealed packet, which must not be opened unless required.
- ✓ Check that seal packets are intact. In case seal is broken, then check opened thermal protective aids for any damage or tear and reseal.

Thermal protective aids donning instructions

- ✓ Preferably all thermal protective aids on board should be similar type.
- ✓ Instruction for wearing of all types of thermal protective aids being used on board must be clearly displayed in the living quarters.

5) Ship’s pyrotechnics

Pyrotechnics are provided for use in an emergency both for survival craft use and for use on board the ship. It shall be noted that pyrotechnic distress signals cannot be tested on board. They come manufactured with an expiry date on them. On expiry the pyrotechnics need to be replaced. This holds good for all pyrotechnics carried on board and they are only to be used in case of emergency only and not for any demonstration.

Pyrotechnics that are required to be carried on board a ship:

➢ **On the navigation bridge**

❖ 12 Rocket parachute flares

❖ Line throwing apparatus

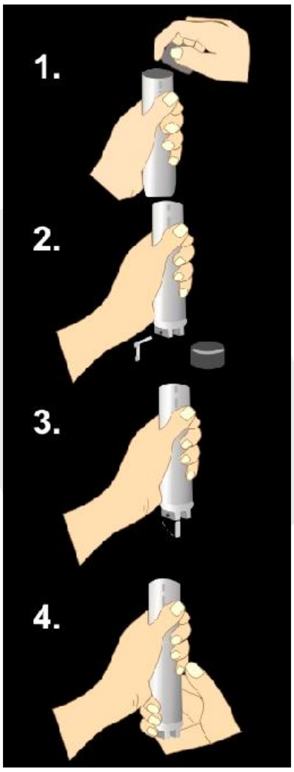
➢ **In each lifeboat and liferaft on board:**
❖ 4 Rocket parachute flares
❖ 6 Hand flares
❖ 2 Buoyant smoke signals.

➢ Apart from these on each side of the bridge wing, there is a man over-board emergency lifebuoy marker.

a) Rocket parachute flares

❖ **Requirements**

- The rocket parachute flare shall:
  - ✓ be contained in a water-resistant casing;
  - ✓ have brief instructions or diagrams clearly illustrating the use of the rocket parachute flare printed on its casing;
  - ✓ have integral means of ignition;
  - ✓ be so designed as not to cause discomfort to the person holding the casing when used in accordance with the manufacturer's operating instructions.



- The rocket shall, when fired vertically, reach an altitude of not less than 300 m. At or near the top of its trajectory, the rocket shall eject a parachute flare, which shall:
  - ✓ burn with a bright red colour;
  - ✓ burn uniformly with an average luminous intensity of not less than 30,000 cd;
  - ✓ have a burning period of not less than 40 s;
  - ✓ have rate of descent of not more than 5 metres per second;
  - ✓ not damage its parachute or attachments while burning.

❖ **Operation**

To illustrate the operation of rocket parachute flares we have used the operation instruction PARA RED MK3 rocket manufactured by PAINS-WESSEX. For rockets of other manufacturer, the instructions are normally given on the parachute flare itself. Look at the figure that is given showing the operation of the parachute rocket.

- ✓ Remove top cap
- ✓ Remove bottom cap and safety pin.
- ✓ Hold the signal vertical ready for ignition.
- ✓ Squeeze trigger against outside tube until rocket shots out. In strong wind fire down-wind.

b) Hand flares

❖ **Requirements**

- The hand flare shall
  - ✓ be contained in a water-resistant casing;
  - ✓ have brief instruction or diagrams clearly illustrating the use of the hand flare printed on its casing;
  - ✓ have a self-contained means of ignition;
  - ✓ be so designed as not to cause discomfort to the person holding the casing and not endanger the survival craft by burning or glowing residues when used in accordance with the manufacturer's operating instructions.

- The hand flare shall
  - ✓ burn with a bright red colour;
  - ✓ burn uniformly with an average luminous intensity of not less than 15,000 cd;
  - ✓ have a burning period of not less than 1 min;
  - ✓ continue to burn after having been immersed for a period of 10 seconds under 100 mm of water.

❖ **Operation**

To illustrate the operation of hand flares we have used the operation instructions for the RED MK 6 HANDFLARE manufactured by PAINS-WESSEX. For hand flares of other manufacturer, the instructions are normally given on the flare itself.

- ✓ Point downwind. Hold by red handle only. Pull handle base downwards.
- ✓ Twist handle until stopped and arrow marks align.
- ✓ Strike base of handle sharply with palm of hand or on hard surface

c) Buoyant smoke signals

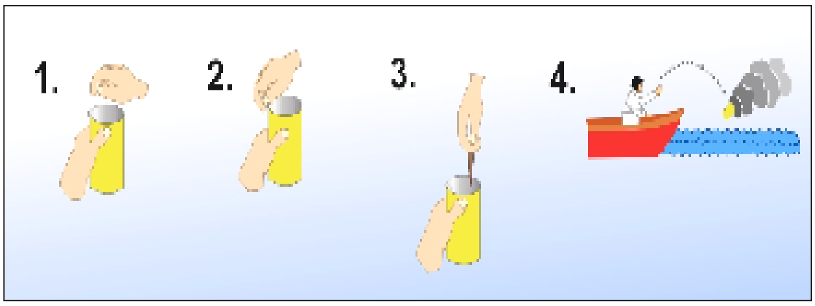
❖ **Requirements**

- The buoyant smoke signal shall:
  - ✓ be contained in a water-resistant casing;
  - ✓ not ignite explosively when used in accordance with the manufacturer's operating instructions;
  - ✓ have brief instructions or diagrams clearly illustrating the use of the buoyant smoke signal printed on its casing.
- The buoyant smoke signal shall:
  - ✓ emit smoke of a highly visible colour at a uniform rate for a period of not less than 3 minutes when floating in calm water;
  - ✓ not emit any flame during the entire emission time;
  - ✓ not be swamped in a seaway;
  - ✓ continue to emit smoke when submerged in water for a period of 10 seconds under 100 mm of water.

❖ **Operation**

To illustrate the operation of buoyant smoke signal we have used the instruction for the LIFESMOKE MK3 manufactured by PAINS-WESSEX. For smoke signal of other manufacturer, the instructions are normally given on the signal itself. Look at the diagram showing the operation of daylight buoyant smoke signal.

- ✓ Remove top cap
- ✓ Remove the sealing
- ✓ Pull ignition cord
- ✓ Throw smoke signal overboard



d) Lifebuoy self activating man overboard smoke signal

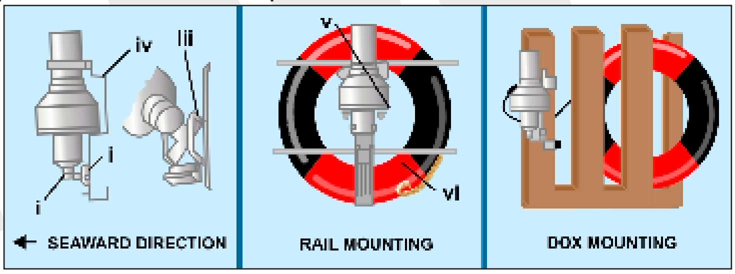
When discussing shipboard pyrotechnics we must not forget the man overboard smoke signal marker which is attached to the lifebuoy on either side of the bridge wing, and is explained below

❖ **Requirements**

✓ emit smoke of a highly visible colour at a uniform rate for a period of at least 15 minutes when floating in calm water;
✓ not ignite explosively or emit any flame during the entire smoke emission time of the signal;
✓ not be swamped in a seaway;
✓ continue to emit smoke when fully submerged in water for a period of at least 10 seconds;
✓ be constructed to withstand a drop into the water from the height at which it is stowed above the waterline in the lightest seagoing condition or 30m, whichever is greater, without impairing either its operating capability or that of its attached components;

❖ **General Information and fixing requirements**

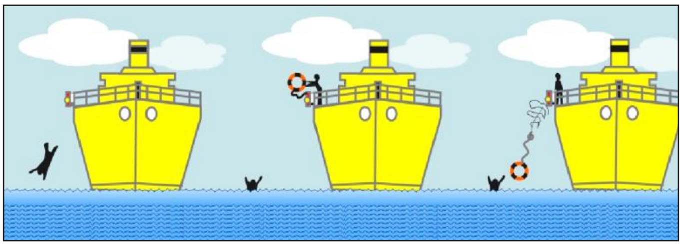
✓ To comply with SOLAS, two signals must be mounted vertically facing seaward, one on the port and one on the starboard side of the bridge, using brackets supplied as required.
✓ These signals should be mounted a minimum of 5 metres above waterline. This may not be possible on smaller vessel in which case the signal should be mounted inboard on the wheelhouse bulkhead and should be operated and launched manually.
✓ Ensure the signal has a clear, unobstructed drop to the sea.
✓ It is designed for use with a lifebuoy weighing 4.3 kg minimum, attached by a 4mm diameter line 4 metres long.
✓ As the signal is normally mounted on the bridge wing, it is exposed to extreme conditions during the ship's service. Hence the mounting bracket should be replaced with the signal after 3 years.
✓ The signal must be positioned either behind or directly to the side of the lifebuoy.
✓ The signal has a usable product life of 3 years, indicated by the date stamp on the signal, after which it must be replaced.
✓ When the smoke signal is fitted with light, the requirements under SOLAS are that the light will operate for a minimum period of 2 hours.



Stowage of man overboard marker

❖ **Instruction for use of the MOB light and smoke signal**

The lifebuoy attached to the man overboard light and smoke signal is normally mounted in a bracket having a slant base on the outside of the bridge wing. The lifebuoy is usually held in place with a locking pin passed through the wing bulkhead and the bracket. This locking pin holds the lifebuoy in place. The locking pin can be easily removed and once it is removed the lifebuoy is released.



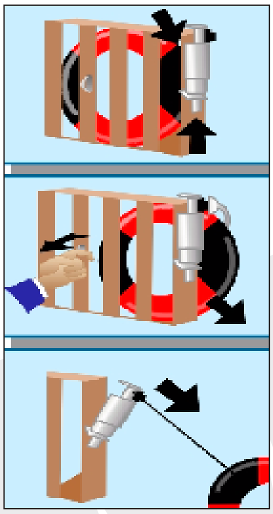
❖ **Using man overboard buoy with marker**

Step-by-step operation for automatic release of the lifebuoy is detailed here:

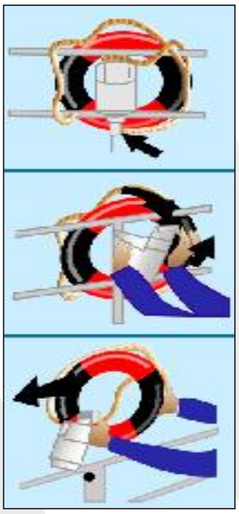
- ✓ Signal and lifebuoy stored in their brackets.
- ✓ Pull out the lock pin.
- ✓ Lifebuoy pulls MOB-signal with it. The light is automatically switched on and the smoke is ignited.

In the case of some ships (smaller ones) the lifebuoy attached to the MOB marker has to be released manually and in that case these are the instructions:

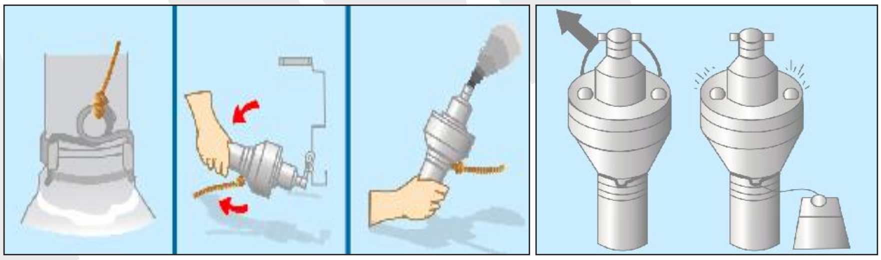
- ✓ Remove the MOB-signal from the attachment and make sure the line is running clear to the lifebuoy.
- ✓ Throw lifebuoy and MOB-signal overboard. The light is automatically switched on and the smoke is ignited.



Automatic operation of MOB buoy



Manual operation of MOB marker



Operation of man overboard marker

Testing of Pyrotechnics

None of the pyrotechnics can be tested on board. All pyrotechnics come stamped with an expiry date until which they are valid. Pyrotechnics should be replaced once it is expired or the expiry date has passed.
The pyrotechnics on board shall be checked fro their apparent condition and expiry date. In the situation where the expiry date is during the voyage or the ship is expected to be at sea - new pyrotechnics should be procured in the previous port so that they can replace the expired ones on board.

e) Line Throwing Apparatus (LTA)

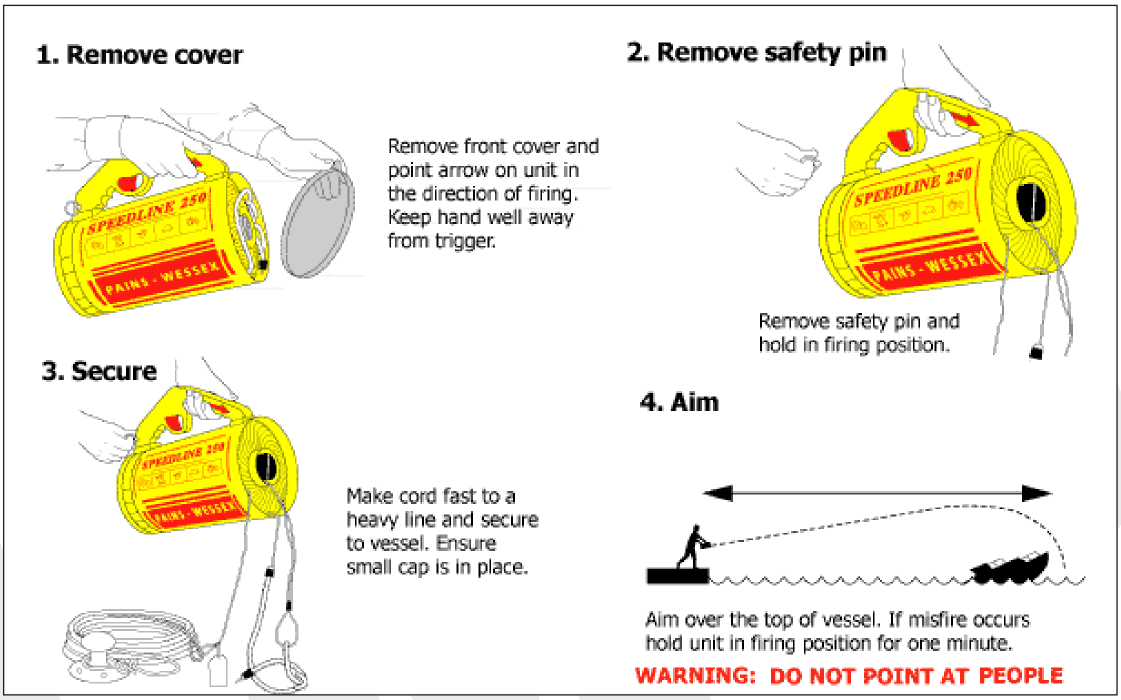
❖ **Checks**

- ✓ Check condition of rope of the line throwing apparatus. In case the line gets uncoiled in an integrated LTA, the LTA will have to be sent ashore to a service station approved by the manufacturer for recoiling and stacking into the container.

- ✓ Replace rocket and striker cartridge prior to the expiry date. In case there is no expiry date mentioned, replace within 4 years from date of manufacture.
- ✓ The striker cartridge must be replaced at the same time as the rocket.
- ✓ While replacing rocket / striker cartridge, exercise caution, as the rocket could accidentally fire or the cartridge could give out igniting sparks. Follow manufacturer's instructions. In case no instructions from the manufacturer are available, remove the cartridge, replace the rocket and then put back / replace the cartridge.

❖ **Operation**

The operation for 'Speed-line (Pains Wessex)' make is described as follows. Individual ship specific equipment instructions shall be referred to specific operating instructions.



6) Disposal of out of date pyrotechnics

Disposal of pyrotechnics at sea is PROHIBITED. All pyrotechnics are counted as dangerous goods and their disposal should be in accordance to the IMDG code.

- ✓ Return them to the supplier directly or via the local representative.
- ✓ Request a life raft service station to accept any of the ship's out-of-date pyrotechnics when life rafts are being sent ashore for servicing. Many life raft service stations deal with the disposal of the expired pyrotechnics on a regular basis and have arrangements locally to do this.
- ✓ Contact the local coastguard or police who may be able to arrange disposal through a military establishment.

❖ If the pyrotechnics cannot be sent ashore immediately, then they should be kept onboard (clearly marked as out-of-date) until they are landed ashore.

❖ Upon disposal ashore it is important to obtain a receipt/certificate which states that the pyrotechnic has been landed ashore for safe destruction. A log entry should be made in both the deck log book and official log book on disposal ashore.

❖ Any firing of distress signals in any situation other than distress is an offence.

❖ Expired pyrotechnics should never be used at sea for testing or practice purposes or used on land as fireworks. The chemicals may have deteriorated and cause an unpredictable reaction upon ignition.

- They should be landed ashore as soon as possible after their date of expiry.

Apply Your Knowledge

1. Refer to the ship's training manual and PMS and mention the following details regarding the following:

Name	Make	Quantity	Location on board	Weekly maintenance procedures
Lifejackets				
Immersion Suits				
Rocket Parachutes				

2. Discuss the safety precautions to be observed during monthly turning out of lifeboats.

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Function: Controlling the operation of the ship and care for persons on board

Competence: Operate life saving appliances

Task number: C4.1

Sub task Reference number: C4.1.13, C4.1.13.1, C4.1.13.2, C4.1.13.3, C4.1.13.4

Topic: Life saving appliances (LSA)

Task Heading

- Assist the crew with the maintenance of survival craft and equipment, including:
  - Lifeboats and rescue boats
  - Lifeboat equipment and provisions
  - Launching davits and gear
  - Lifeboat falls

Objectives

- Familiarize with the procedure of carrying out maintenance of survival craft and equipment, including:
  - Lifeboats and rescue boats
  - Lifeboat equipment and provisions
  - Launching davits and gear
  - Lifeboat falls

> Please read this task in conjunction with tasks C4.1.8, C4.1.11, C4.1.12, C4.1.21 and C4.1.22.

Index

1. Maintenance of lifeboats, rescue boats, equipments, fittings and provisions
   a) Monthly inspection routine
   b) Quarterly inspection routine
   c) Six monthly inspection routine
   d) Five yearly inspection routine (carried out by shore workshop)
2. Lifeboats and rescue boats davits, launching and recovery arrangements
   a) Weekly inspection routine
   b) Monthly inspection routine
   c) Quarterly inspection routine
   d) Six monthly inspection routine

Description

1) Maintenance of lifeboats, rescue boats, equipments, fittings and provisions

Ship's planned maintenance schedule shall be followed for maintenance of lifeboats, rescue boats, equipment and provisions. The procedures in general are as follows:

a) Monthly inspection routine

I. Life boat hull

- ✓ It is recommended to wash the lifeboats (especially open lifeboats) with soap and fresh water once in month. Clean the bilges thoroughly especially under the engine.
- ✓ GRP lifeboats have laminated outer shell for reducing water resistance. It cannot be painted onboard as the curing temperature of up to 70 degrees centigrade may be required.
- ✓ If repair kits are supplied they must have expiry date. All repairs must be carried out as recommended by the manufacturer and to the satisfaction of the surveyor. Extensive repairs may require a 25% overload strength test, on completion.
- ✓ A thorough inspection must be carried out every month:
  - Check lifeboat outer and inner hull for any damage, doublers, cracks, corrosion, chafing etc.
  - Check inner body for separation from the hull or exposure of buoyancy tanks.

- Check any horizontal / vertical cracks on sides of buoyancy tanks especially at one-quarter length from bow or stern.
- Check the metal parts for any rusting.
- Check the complete hook assembly for signs of wastage & corrosion
- Check the condition of seals at the embarkation hatch.

II. Life boat fittings

i. Rudder & tiller

- ✓ Check that tiller fits properly into the rudder stock. It is recommended the tiller is kept attached to the boat with a long lanyard.
- ✓ Check the ends of a metal tiller are covered with an insulated material to protect helmsman's hands in freezing condition.
- ✓ Check rudder and tiller for corrosion. Check for wear & tear on hinge bar of the rudder, pintle pins and gudgeon.
- ✓ Check the emergency tiller for operation.

ii. Becketed ropes or lifelines

- ✓ A buoyant lifeline should be becketed all-round the lifeboat except in vicinity of rudder and propeller.
- ✓ Line should be of 16 mm diameter and the loops must reach within 76 mm of the load water line.
- ✓ Becketed ropes must either be made of approved type buoyant synthetic ropes or floats are attached to make them float.
- ✓ Check the lifeline for chaff or weathering. It should be checked for rot by twisting the rope against the lay, powdering is a sign of rot. Check attachment points for corrosion or damage.

iii. Grab lines, grab rails & bilge rails

- ✓ Ensure that not less than 3 grab lines of 16 mm diameter rope are fitted on a non self righting boat. Grab lines should be attached to strong points in the boats and run from gunwale to gunwale without going across the inner hull of the boat. The sheep shank under the keel should give good grip, required to bring the boat upright.
- ✓ Check condition of cordage for rot, chaff or weathering.
- ✓ Non self righting boats should have rails on underside (Bilge rails) attached to body in such a way that they can break away without damaging the boat. Check condition of bilge rails for corrosion or firm attachment.
- ✓ Grab rails are provided on upper part of the enclosed lifeboat. Check condition for corrosion and firm attachment.

iv. Life boat skates

- ✓ Check that skates are firmly secured and tightly held against the hull. Check condition of skates for any damage. In case of metal skates, there is a non-chafe packing between the skates and the fibreglass hull. Check the condition of the packing for damage.
- ✓ Check wire securing and attachments, if fitted, are in good condition. Wire attachments, which run across the boat from gunwale to gunwale, are not acceptable; they should end at the outboard gunwale.
- ✓ Check if skates can be jettisoned easily once lifeboat is afloat and the locking pin is free for easy removal. It is recommended that skates are attached by a lanyard to the boat so that they are not lost accidentally during a drill.

v. Miscellaneous

- ✓ Check external and internal lighting for operation.
- ✓ Ensure the forward and aft view is not obstructed or reduced due to painting etc. on the view screens.
- ✓ Ensure entrance hatches can be closed securely and opened, from both outside and inside. Ensure that ventilators will close automatically in event of capsizing.

vi. Enclosed / free-fall life boats safety belts & head bands

- ✓ Check that safety belts are fitted in such a way that the largest person can be accommodate while wearing the lifejacket.
- ✓ Check the head protection is provided at each seat position; this may include a 50 mm polyethylene foam pad with a flame retardant cover.
- ✓ Check condition of safety belts and head restraining straps for any wear and tear.

vii. Embarkation ladder & access gates

- ✓ Keep ladder covered to prolong its life and to protect it from weathering.
- ✓ Check the access gates / removable railings. Locking pins must be fitted in closed position. Grease the hinges and pins of the access gates / removable railings.

viii. Enclosed lifeboat self-contained air support systems

- ✓ Check the compressed air bottle pressures; supply should be sufficient for 10 minutes.
- ✓ Ensure that procedure to operate the system is displayed clearly within the lifeboat.
- ✓ Check condition of air bottles, visual pressure indicators, air connectors and bottle securing arrangement.

ix. Lifeboat emergency water spray equipment

- ✓ Instructions to operate the system must be posted clearly within the life boat.
- ✓ If the system is air pressure type then check the condition and pressure of cylinders.

x. Lifeboat equipment's & lockers:

- ✓ Ensure that inventory of all equipments is correct and they are stored within the lifeboat, in clean and dry condition.
- ✓ Check all small gear lockers including food and water lockers are secured and are water tight
- ✓ Check that all equipment except the boat hook, are firmly secured by lanyard in the boat. Equipments should not get lost at sea, if the boat capsizes.
- ✓ In a free fall boat equipments should be firmly secured to avoid getting the occupants hit by free falling objects during launching. Boat hooks and oars are not provided in a free fall lifeboat to avoid such a mishap.

xi. Manual bilge pump

- ✓ Check the pump for cracked hose, loose connection of hoses etc. Ensure that pump suction has a strainer or a strum box.
- ✓ Try out the pump every month by pumping out water from a bucket.
- ✓ In case bilge pump is used for clearing the bilge, it should be flushed with fresh water.

III. Lifeboat equipments

i. Lamp, lamp oil and safety matches

- ✓ Check the lamp oil; it should be sufficient for 12 hours of use. Normally about 4.5 liters of oil is sufficient. Ensure the lamp oil can is clearly marked 'Lamp Oil'.
- ✓ Check lamp by opening the oil container and by moving the wick.
- ✓ Check that wind proof matches are kept in a water tight container and are free of dampness

ii. Lifeboat oars, thole pins or crutches
- ✓ Check lifeboat oars for cracks in the wood or rotten wood.
- ✓ Ensure that oars are only varnished or treated with linseed oil. Oars must never be painted as paint will hide the cracks. Sometimes the blades of steering oar are painted white for ease of identification.
- ✓ Oars are kept with blades facing forward except steering oar which is kept with blades facing aft.
- ✓ Check crutches for ease of movement and any damage to the housing.

iii. Boat hooks
- ✓ Ensure that boat hooks are never kept lashed; they should be readily available for fending off the boat.
- ✓ Check boat hooks for any cracks in the wood and hook must be well secured to the wood spar.
- ✓ Boat hooks may be painted with black and white alternate one foot high stripes, to use for sounding during beaching.

iv. Life boat boarding ladder
- ✓ Check the steps and side ropes of the ladder, for wear & tear or weathering.

v. Life boat plugs
- ✓ Clean and apply grease on threads of the drain and plug. Debris around the automatic plugs must be removed.

vi. Bailer & buckets
- ✓ Check buckets and bailer for corrosion damages and leaks.

vii. Survival manual
- ✓ It should be either made of water proof material or kept in water proof casing. Survival manual contains information from 'Personal survival at sea' and 'A Pocket guide to cold water survival' as per IMO resolution A.656(16)

viii. Compass in binnacle
- ✓ Check that Compass is moving freely in the binnacle.
- ✓ Check compass for any bubbles. All air bubbles must be removed by adding distilled water.
- ✓ In an open lifeboat, compass shall be provided with a suitable means of illumination. If an oil fired wick lamp is provided, check condition of lamp and wick.

ix. Sea anchors
- ✓ In an open lifeboat, keep the sea anchor in a water proof bag to prevent rotting of canvas due to exposure to sea water and sun. Plastic bags are not suitable for this purpose as the canvas will rot due to trapped moisture.
- ✓ Check condition of swivel fitted on the sea anchor, grease it every month.

x. Storm oil & oil bag

This equipment is required only as an attachment to the sea anchor in an open lifeboat:
- ✓ Ensure that oil container is clearly marked 'Storm' and is filled with 4.5 litres of vegetable or animal oil.
- ✓ Check the oil bag or any other arrangement for distribution of storm oil, which can be attached to the sea anchor.
- ✓ Oil bags are normally filled with oakum or other oil absorbent material and are porous to disperse the oil evenly on the sea surface.
- ✓ Check condition of endless line provided with the oil bag by twisting against the lay.

xi. Painters
- ✓ Check that painter's quick release arrangement is in good condition. It usually consists of toggle and strop on the painter.
- ✓ Ensure that the second painter is permanently attached to the boat at or near the bows.
- ✓ Check the condition of the painters and / or tripping line by twisting against the lay.

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- ✓ All painters should be flaked out and aired once in a month.

xii. Hatchet or axes
- ✓ Ensure hatchets are stowed, one at each end of the lifeboat.
- ✓ Sharpen the blades of hatchets, if required. Blades should be coated with grease and covered with plastic or canvas to prevent corrosion.
- ✓ Check that hatchet heads are fitting firmly to their handles.

xiii. Fresh water
- ✓ Check that boat has 3 litres of fresh water for every person boat is certified to carry. A desalting apparatus may substitute for 1 litre of FW for every person.
- ✓ Check fresh water containers for leaks, corrosion damages etc.
- ✓ Portable fresh water tanks should have a dipper secured with lanyard inside the larger of the two caps.
- ✓ Check that one rust proof graduated drinking vessel has been provided.
- ✓ The containers / tanks shall be with only 2/3rd capacity when transiting sub zero temperatures.

xiv. Lifeboat rations
- ✓ Rations should be aired once in a month. Always keep lifeboat rations in clean and dry condition Damaged or rotten packets of rations must be replaced. It is recommended to use paper lining in the provision box, which besides soaking the water will indicate any leak in the box. Alternatively, cover the rations in a plastic bag to protect from condensation inside the provision compartment.
- ✓ Check the compartment for water tightness.
- ✓ Expiry dates must be valid and visible on provision packets.

xv. Pyrotechnics
- ✓ Keep all pyrotechnics in dry and water proof container. The IMO pyrotechnics symbol must be clearly visible on the container.
- ✓ Check that none of the pyrotechnics have expired.
- ✓ Task 4.1.12 shall be referred to for additional details.

xvi. Electric torch
- ✓ Check torch for operation, water leaks etc.

xvii. Daylight signalling mirror
- ✓ Ensure instructions for using the mirror are visible and the size of mirror is not less than 100 mm square.
- ✓ Check whether reflecting properties of the mirror are intact.
- ✓ Store the mirror in a protective pouch.

xviii. Life saving signal table & whistle
- ✓ Life saving signal table as per regulation SOLAS V/8 should be provided, on a water proof card or in a water proof container,
- ✓ One whistle should be provided. It should have an attached lanyard

xix. First aid outfit
- ✓ Check the expiry date on the first aid kit. Renew it, if required.
- ✓ The kit should be sealed with masking tape to protect from misuse.

xx. Anti- seasickness pills & sea-sickness bags
- ✓ Check expiry date of the pills.
- ✓ Check sea sickness bags are dry and intact in a sealed pouch.

xxi. Jack knife & tin openers
- ✓ Check jack knife for ease of opening. Sharpen and apply grease on the edges if required.
- ✓ Check tin openers for rusted edges.
- ✓ Place in sealed plastic pouches.

xxii. Buoyant rescue quoits

- ✓ Check condition of quoits and line for wear & tear, cracks and brittleness and their buoyant properties.

xxiii. Fishing tackles

- ✓ One set of fishing tackle should be provided.
- ✓ Ensure fishing line is about 12 m in length and fitted with fishing hooks and coloured lures spaced 300 to 460 mm apart. Check the suspended weight of the tackle.
- ✓ Place in a sealed plastic pouch.

xxiv. Fire extinguisher

- ✓ Check location of fire extinguisher and condition of bracket.
- ✓ Fire extinguisher must be serviced annually and checked as per instructions given under fire extinguishers maintenance section.

xxv. Radar reflector

- ✓ Ensure radar reflector is in good condition and can be easily installed.
- ✓ Keep covered in a polythene bag.

xxvi. Thermal protective aids

- ✓ Task 4.1.11 shall be referred to.

xxvii. Mast with wire stays and sail

- ✓ Check mast for cracks and ensure that mast bands are firmly in place. Painting of mast should be avoided, as it will hide the cracks. Treat mast with linseed oil or varnish.
- ✓ Check mast housing for corrosion or damage. Coat the wire stays with grease and inspect for corrosion damage regularly.
- ✓ Check sails for damages, even small holes must be repaired.

xxviii. Exposure cover / canopy

- ✓ Exposure cover has an arrangement for rigging usually consisting of a set of stiffener spars, awning stanchions etc. Ensure that these are marked according to their fitting locations on the boat, serial number or colour coding can be used.
- ✓ Ensure that the stiffening spars, awning stanchions etc are painted orange and corrosion free.
- ✓ Check that exposure cover has the ‘Call sign letters” with retro reflective tapes marked on exposed side. The top of the cover should also have retro-reflective tape fitted as mentioned in the previous task covering permanent markings on survival craft
- ✓ Ensure canopy is kept in its protective bag.

xxix. Lifeboat markings

- ✓ Lifeboat markings as discussed in task C4.1.8 shall be checked.

b) Quarterly Inspection Routine

i. Embarkation ladder & access gates

The ladder should be lowered / stretched once every 3 months and checked for following:

- Check securing point connection of ladder including eyebolts and joining shackles, for corrosion.
- Check side ropes of the ladder by twisting against the lay for signs of rot, chaffing or weathering.
- Check ladder steps are sitting firmly and are free of cracks. Check condition of whippings.

ii. Lifeboat emergency water spray equipment

Test the equipment once every 3 months when boats are lowered into water. Ensure that all spray heads are clear and rotating freely. The system must give protection from continuous fire for at least 8 minutes. On completion of check, drain the water from pump and pipe lines and flush it with fresh water.

iii. **Sea anchors**
- ✓ Flake out and air the sea anchor every 3 months.
- ✓ Check and clean the sea anchor (using soap water, if required), every 3 months.

iv. **Fresh water**
- ✓ Empty and flush clean the FW tanks once every 3 months. Check all securing, internal / external condition, condition of cap washers etc. Fill the tanks with clean FW.
- ✓ If temperatures are expected to fall below freezing, then level of fresh water tanks must be reduced to allow for expansion due to freezing.

v. Lifeboat Engine
Task 4.1.21 shall be referred to for details.

c) **Six monthly inspection routine**

i. **Performance test of retro-reflective tapes**
Check performance of retro reflective tapes in the following manner, once every 6 months or when in doubt:
- Place a new piece of same material adjacent to the material fitted and Pour water over both pieces of material.
- Using a powerful torch held at eye level, compare the performance of the two pieces from a distance of 10 meters.
- If a noticeable deterioration in performance is observed or if tapes are worn / damaged then the retro-reflective material should be replaced.

ii. **Electric torch**
Renew the batteries in use every 6 months with fresh batteries, unless they deteriorate or expire earlier.

iii. **Mast with wire stays and sail**
- ✓ It is recommended that mast & sail are rigged and demonstrated to full crew, once every 6 months.
- ✓ Open and clean the sail thoroughly every 6 months.

iv. **Exposure cover / canopy**
- ✓ Open and clean the cover and inspect for wear & tear, once in 6 months.
- ✓ It is recommended that exposure cover is rigged and demonstrated to full crew, once every 6 months.

d) **Five yearly inspection routine (carried out by shore workshop)**

✓ **Enclosed lifeboat self-contained air support systems**
All air bottles should be hydraulic pressure tested every 5 years. The pipelines and pressure gauges of the air support systems are also to be pressure tested to 1.5 times the working pressure.

✓ **Lifeboat emergency water spray equipment**
Air bottles to be hydraulically pressure tested every 5 years.

2) **Lifeboats and rescue boats davits, launching and recovery arrangements**

a) **Weekly inspection routine**

Readiness for use:
- ✓ All lifeboats, rescue boats and launching appliance should be visually inspected to ensure that they are ready for immediate use. The inspection shall include, but is not limited to, the

condition of the hooks, their attachment to the lifeboat and the on-load release gear being properly and completely reset.

- ✓ Check that the lashings are taut but ready for quick release. Check the harbour safety pins for free movement. Additional lashings for survival craft should be avoided, unless they are fitted with quick release system.
- ✓ If weather conditions allow, all lifeboats, on cargo ships shall be moved from their stowed position, without any persons on board, to the extent necessary to demonstrate satisfactory operation of launching appliances. (Not applicable to free-fall boats)
- ✓ The lifeboats and rescue boat should be capable of being launched in less than 5 minutes by two crewmembers.
- ✓ All LSA should be in working order and ready for immediate use before ship leaves port.

b) Monthly inspection routine

i. Turning out lifeboats

- ✓ If weather and sea conditions so allow, all lifeboats, shall be turned out from their stowed position, without any persons on board. (Not applicable to free-fall boats)

ii. Lifeboat gripes / lashings

- ✓ Check if gripes can be removed easily and quickly. Grease all parts of gripes for ease of movement, including the bottle screws and safety pins
- ✓ Check wire condition and attachments of gripes. Ensure that gripes are not chafing the edges of lifeboat. The areas where gripes run over the boat sides should be parcelled.
- ✓ Check condition of rope lanyard. Can it be cut in an emergency? Renew the rope as and when required

iii. Tricing pennant

- ✓ Check condition slip arrangement for tricing pennant. It should be operating freely. Ensure that there is no fitting on the gunwale in line with the falls where the released tricing pendant may get fouled.
- ✓ Check condition of wire and attachment of tricing pendant.
- ✓ Check condition of rope lanyard; adjust it to bring the boat correctly on to the embarkation deck level. Renew it as required.
- ✓ Apply grease on slip arrangement and wires of tricing pendant

iv. Bowsing tackles

- ✓ For fully laden boats weighing under 10T, a two to one (luff) tackle with a 30 mm manila or 24 mm polypropylene is considered sufficient. The length of rope should be sufficient for easing the boat even if the vessel is listed up to 20 degrees.
- ✓ Check bowsing tackles for ease of movement. Check the sheaves for movement. Grease the sheaves of the tackles.
- ✓ Check condition of ropes, by twisting against the lay.
- ✓ The wooden blocks should be varnished or treated with linseed oil but should not be painted over.
- ✓ It is recommended that securing points for tackles are marked on davit and on the block, which is to be attached on davit, to ensure that the hauling part of the rope is in the boat. The securing point in lifeboat should also be marked.

v. Davit's span wire & lifeline

- ✓ At least two lifelines capable of reaching water level at lightest draft, adverse trim and 20 degrees adverse list, should be provided with partially enclosed / open lifeboat.
- ✓ The davit span wire should be at least of 20 mm diameter. The lifeline should be manila or approved synthetic rope of 20 to 24 mm diameter with knots at about 2 M distance.
- ✓ Check entire length of lifeline for chaff or weathering. It should be checked for rot by twisting the rope against the lay, powdering is a sign of rot.

- ✓ Check condition of span wires especially near the splices for signs of corrosion under the serving. Check securing arrangement of the span. Overhaul the shackles, if required.
- ✓ It is recommended to make canvas covers for lifelines to prevent exposure to sun, sea and ice etc.

vi. Lifeboat davits and winches foundation bolts

- ✓ Foundation bolts of lifeboat davits and winches should be inspected monthly for corrosion damage.

vii. Davit greasing

- ✓ All grease points of LR davit must be marked for identification with a circle around the grease nipple. A diagram of lubricating points with the recommended lubricants should be made available.
- ✓ The davits must be greased every month.

c) Quarterly inspection routine

i. Life boat launching / launching appliance, lifeboat release mechanism

- ✓ Launch lifeboats with its assigned operational crew aboard and operate the lifeboat release gear during boat drill, at an interval of not exceeding 3 months.
- ✓ In the case of a lifeboat arranged for free-fall launching, at least once every three months during an abandon ship drill the crew shall board the lifeboat, properly secure themselves in their seats and commence launch procedures up to but not including the actual release of the lifeboat (i.e., the release hook shall not be released). The lifeboat shall then either be free-fall launched with only the required operating crew on board, or lowered into the water by means of the secondary means of launching with or without the operating crew on board. In both cases the lifeboat shall thereafter be manoeuvred in the water by the operating crew.
- ✓ Check all sheaves are turning freely and harbour safety pins are free. If any grease nipple is broken or grease is not flowing then fault must be rectified immediately.
- ✓ It is recommended that chocks are covered with canvas etc., to avoid abrasion damage to GRP boats.
- ✓ A red band of 15 cm width on the LB davit indicates that davit is of insufficient strength and boat can be lowered or recovered only with a two man crew.
- ✓ Grease inner parts of release mechanism once boat is in water. Check the half-moon sections of on-load release gear for wear and tear or for any play in the system.
- ✓ Grease the release mechanism operating cables and replace cable wire if necessary.

ii. Life boat davit winch brakes

- ✓ Check while lowering / hoisting the boat, that the brakes will hold the boat at any stage. The operation of brake must be smooth.

iii. Lifeboat winches & winch motor

- ✓ Lifeboat winch and motor should be maintained as per the manufacturer's instructions. Greasing of winch and motor should be carried out every three months.
- ✓ While greasing the winch, use of pneumatic guns should be avoided and attention must be paid so that grease does not enter the brake compartment. Only light greasing to assist easy movement and prevent onset of corrosion, is required.
- ✓ The level of oil in the oil bath, in oil lubricated winches, should be checked.

iv. Lifeboat davit limit switches

- ✓ Davit limit switch should be set in way to stop inward movement of davit arms, when it is 300 mm from the stowed position.
- ✓ Check levers of limit switch for free movement and grease them when boats are lowered.
- ✓ Check these switches for operation, on each arm of the davit, by activating them when boats are being hoisted back.

v. Lifeboat winch safety switch

- ✓ The manual handle for LB winch should not rotate while lowering or hoisting by power.
- ✓ LB winches having independent sockets for fitting the manual handles are fitted with safety devices to block the fitting or operation of the motor whenever manual handle is fitted.
- ✓ Check this switch for free movement and grease regularly.
- ✓ Check this device for operation, by activating it while using the LB winch motor or as per manufacturer's instructions.

vi. Lifeboat falls

- ✓ Length of falls should be sufficient to reach water when ship is at the lightest draft and with 20 degrees adverse list.
- ✓ Lifeboat falls must be inspected every 3 months for any damages, corrosion, kinks, broken strand etc. If more than 10% of wires are broken in any strand or if diameter of wire reduced by more than 7% of original diameter then the wire must be replaced.
- ✓ Check security of the attachment of ends of the lifeboat falls.
- ✓ Life boat falls are to be oiled / greased once every 3 months, to prevent corrosion damage. They must never be left dry.
- ✓ While hoisting the lifeboats Life boat falls must always be coiled properly otherwise wires will get damaged and the boat may also not sit properly.

vii. Lifeboat remote lowering wire

- ✓ Length of remote lowering wire should be sufficient to reach water when ship is at the lightest draft and with 20 degrees adverse list.
- ✓ The remote lowering wire is so designed that when the boat is lowered to the water, this wire is paid out at a slightly faster rate than the falls. This causes the brakes to drop gradually and slows down the lowering of the boat when it gets close to the water. Ensure that the distance of the weight on the remote lowering wire from the lifeboat is sufficient to keep the brakes lifted when the ship is at the lightest draft and with 20 degrees adverse list. Length of wire is to be adjusted as per manufacturer's instructions.
- ✓ Lifeboat remote lowering wire must be inspected every 3 months for any damages, corrosion, kinks, broken strand etc.
- ✓ Check the leads of the remote lowering wire are clear and the sheaves on the leads are rotating freely.
- ✓ Check security of the attachment of ends of the lifeboat remote lowering wire.
- ✓ Life boat remote lowering wire and the sheaves on the leads (blocks) are to be oiled / greased once every 3 months, to prevent corrosion damage.

d) Six monthly inspection routine

i. **Lifeboat arranged for free-fall launching**

At intervals of not more than six months, the lifeboat shall either be launched by free-fall with only the operating crew on board, or a simulated launching shall be carried.

Winch brake checks and maintenance shall be carried out as discussed under task C4.1.22 which shall be referred to.

Apply Your Knowledge

1. Refer to the vessel's LSA maintenance records and check the following:
   - ✓ Date when the fresh water was changed and next due
   - ✓ Date of expiry of lifeboat provisions
   - ✓ Date Lifeboat last lowered in water and next due
   - ✓ Date the lifeboat falls were last renewed and when changed end to end
2. Locate the davit manual. Describe the maintenance required to be carried out on the davit including the davit winch as recommended by the manufacturer.

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: C5.1.3, C5.1.5 and C5.1.6

Topic: Practical application of medical guides and advice by radio and medical equipment on board.

Task Heading

- Identify the information required and procedures for requesting radio medical advice.
- Access the medical locker and locate various medicines and equipment.
- Assist in taking inventory of medical locker, including narcotics in Master's custody.

Objectives

- Identify the information required and familiarize with the procedures for requesting radio medical advice.
- Familiarize with the ship's medical chest requirement
- Identify the various medicines and equipments required by vessels
- Assist in taking inventory of medical locker, including 'controlled drugs / narcotics' in Master's custody.

Index

1. **Radio medical advice**
2. **Ship's medicine chest**

Description

1) **Radio medical advice**

- Radio medical advice is available by radio telegraphy or by direct contact with the doctor by radio telephony from a number of ports in all parts of the world. Details of worldwide services, M.R.C.C, including Tele-medical Advice Services (TMAS) can be found in ALRS Vol 1 and ITU – List of Coast Stations and Special Service Stations. Additionally, it may be obtained from other ships in the vicinity, which have a doctor on board. Coded messages offer a source of misunderstanding and should be avoided as far as possible. International Code of Signals may be used whenever required.

- It is very important that all the information possible is passed on to the doctor and that all his advice and instructions are clearly understood and fully recorded. A comprehensive set of notes should be ready to pass on to the doctor, preferably based on the appropriate format as mentioned in ship captain's medical guide.

- Medivac service by helicopter shall be asked only when the patient is in a serious situation and never for trivial illness or for convenience. Most helicopters are limited in range to about 200~300 nautical miles from coast and even these may not be available in all parts of the world. The procedure is mentioned in the 'Admiralty list of radio signals volume1'. IAMSAR procedures shall be followed while preparing for helicopter evacuation. Company specific guidelines shall be followed further.

- Reference should be made to the relevant chapters of "The ship captain's medical guide, and "The international medical guide for ships" for giving general advice on nursing the patient when obtaining radio medical advice or evacuating the patient. Reference should also be made to annexes of the guides which gives the names briefly of the main bones, muscles, etc and the position of the main organs and also to anatomical drawings.

- In case immediate medical evacuation is not required, master should seek radio medical advise by contacting MRCC and radio medical advice centres such as "The International Radio Medical Centre (C.I.R.M.)" for general medical advice with a copy to the company.

- **Use of 2-digit codes within the Inmarsat systems**
  A series of 2-digit service codes has been established within Inmarsat systems to make it faster for ships to make connections for a number of special purposes, both safety and routine. Of these, there are six (6) which are specifically for safety services and provide a rapid connection to an RCC, meteorological office, hydrographic office, ship reporting centre or **medical centre**.
  Note: - 2-digit codes are specifically for use only within the Inmarsat system.

Two-digit access codes for telex and telephone services (Inmarsat-A, B, C only)

Two digit Code	Service	Remarks
32	**Medical Advice**	used to obtain radio medical advice, Some LESOs have direct connections with the local hospitals for use with this code
38	**Medical Assistance**	used when the condition of ill/injured on board requires urgent evacuation or the services of a doctor onboard; the call is routed to the appropriate agency/ authority ashore to deal with the situation

Tele- medical assistance services (TMAS)

Given the international dimension of maritime navigation, a medical problem may occur on board a ship far from its country of origin. In such a case the master, normally calls his designated national TMAS, which can perform a tele-medical consultation in his language. In such cases, TMAS Medical information exchange form is requested from the Master to facilitate medical assistance at sea and if need be for medical evacuation (MEDEVAC).

TMAS Medical information exchange form - Sample

IDENTIFICATION OF THE REQUIRING TMAS:

Name: ....
Address: .... *Tel:* ....
.... *Fax:* ....
.... *E-mail:* ....

CONFIDENTIAL MEDICAL INFORMATION

MEDICAL ASSISTANCE AT SEA
TMAS - TMAS Medical Information Exchange Form

To: TMAS: ....
(via MRCC if necessary: ....)
Date: ..../......../........ Time: ....h...... Physician: Dr.....................

PATIENT

Surname: .... First Name: ....
Date of Birth: ....../....../...... Age: .... Sex: M ☐ F ☐
Nationality: .... Occupation on board: ....

MEDICAL CIRCUMSTANCES

☐ Ilness
☐ Accident
☐ Poisoning
Since: ....

Previous Medical History	Ongoing Treatments	Care on board before Teleconsultation
....	....	....

MEDICAL OBSERVATION

Pulse: ... ../ min	BP: .../...mmHg
BR: ... ../ min	T: ...... °C
Weight: ...... Kg Height: ...... m	

Diagnosis(es) given: ....

IDENTIFICATION OF THE REQUIRING TMAS:

Name: ....
Address:.. *Tel:* ....
.... *Fax:* ....
.... *E-mail:* ....

MEDICAL INSTRUCTIONS

....
....
....

MEDICAL ASSISTANCE REQUIRED

Medical Decision: ☐ Ship diversion to (Port): ....
☐ Ambulance
Medical Team: ☐ **Doctor** ☐ **Nurse** ☐ **Paramedic**

☐ Medical Evacuation
Medevac Time frame: ☐ **Immediate** ☐ **Daylight hours**
....
Medevac Method: ☐ **Land on** ☐ **Winch/stretcher** ☐ **Winch/Strop**
....
Medical Team: ☐ **Doctor** ☐ **Nurse** ☐ **Paramedic**

☐ Air Drop of supplies:
....
....

☐ Quarantine situation
....
....

SHIP

Ship Name: .... Call Sign: ....
Type: .... Flag: ....
Location: ....
Port of Origin: .... Departure/DTG: ....
Destination: .... ETA / DTG: ....
Contact: ....

Please send back all the available follow-up information to :

TMAS Name: ....
Address: .... *Tel:* ....
.... *Fax:* ....
.... *E-mail:* ....

- The minimum information of the ship and the casualty that should be ready when communicating with the CIRM is as mentioned below. Some countries may not be aware of the contents of your ship's medical chest and it will save time and bother if you have a list of drugs and appliances available. Detailed Information recommended in communicating to a doctor about a patient's illness (part A) or injury (part B)

(A) In the case of illness

i. Routine information about the ship
ii. Routine information about the patient
iii. Details of illness
iv. Results of examination of patient
v. Diagnosis
vi. Treatment
vii. Problems
viii. Other comments

A record of treatment given to any person on board, including the type and quantity of any medicines administered must be entered in

ix. Comments by the doctor

(B) In the case of injury

The information same as above is required except the history of illness is replaced by history of the injury or injuries.

If time permits, keep answers to the detailed questionnaire as given in the guides and appended below for reference ready

- ❖ It is very important that all the information possible is passed on to the doctor and that all his advice and instructions are clearly understood and fully recorded. A comprehensive set of notes should be ready to pass on to the doctor, preferably based on the appropriate format discussed above.
- ❖ Have a pencil and paper available to make notes and remember to transcribe these notes to the patient's and to the ships records after receiving them.
- ❖ It is a good idea to record the exchange of information by means of a tape recorder if one is available. This may then be played back to clarify written notes.

2) Ship's medicine chest

- ➢ The regulations require ships to have adequate medical supplies, which shall be kept in good condition ready for use. The ship's medicine chest holds a range of medicinal products needed for the most common medical emergencies likely to occur on board ship. The quantities to be provided on board will depend on the duration and destination of the voyage, the number of crew members, and the nature of the cargo. The medicine chest is inspected periodically inspected.
- ➢ Generally the requirements for medical stores and equipment are as per the categories of vessels and areas could as follows:

Category A	Seagoing or sea-fishing vessels with no limitation on length of trips.
Category B	Seagoing or sea-fishing vessels making trips of less than 150 nautical miles from the nearest port with adequate medical equipment; Category is extended to seagoing or sea-fishing vessels which make trips of less than 175 nautical miles from the nearest port that has adequate medical equipment and which remain continuously within range of helicopter rescue services.
Category C	Harbour vessels, boats and craft staying very close to shore or with no cabin accommodation other than a wheelhouse. Lifeboats and life-rafts are also required to carry Category C stores.

- ➢ The list of medicines and the medical equipment required on the basis of the above. The list is provided by the authorities of the country where the ship is registered. The responsibility of managing the medicine chest lies with the designated officer in accordance with the ship's SMS under the supervision of master.
- ➢ An inventory list of medicines and medical supplies is maintained on board. The list in addition to the quantity, should state storage conditions and expiry date.
- ➢ Medicines carried in the medicine chest are identified by their generic or approved name, as the local brand names are likely to vary from country to country. The box or package for every medicine should further be labeled with its generic name. The dose per tablet, capsule, or viallampoule, and the expiry date of each item should be clearly indicated on the package or container. A medicine with a

Expiry date

Corresponding to the average maximum shelf life for a medicine, given appropriate storage conditions, each medicine is marked by an expiry date. Expiry date shall be checked for each medicine and when due, the medicine shall be replaced. Considering long sailings or unavailability of suitable port for replenishment, it may require the missing or illegible label or with the contents opened should NOT be used at all and should be destroyed.

- Medicine shall be so stored, as can be easily identified keeping the same type or category of medicines together. This is particularly important for medicines and equipment used in emergencies.
- Medicines shall be stored in good condition protected against humidity and extreme temperatures. The recommended storage conditions for the medicines as mentioned on the pack shall be adhered to.
- The expired medicines shall be sent to a pharmacy through port authorities, coast guard, ship's agents or other suitable means for destroying. Certain types of medical equipment also have expiry dates. Some countries may impose fines on ships entering their territory with expired medicinal items on board.
- A separate record of controlled drugs is maintained with the master and this register must not be discarded before two years have elapsed after the date of the last entry. Controlled or scheduled drugs are those drugs that are subject to prescription requirements limiting their distribution and use, because of their liability to be abused. Controlled medicines must be kept apart in a locked compartment under the custody of master. List of narcotics and dangerous drugs in master's care is presented to the customs and Immigration officials, either prior or on arrival of the ship to a particular port. National authorities of most countries require a general declaration of medicines on board and a separate declaration of controlled drugs and to keep a drug register for two years after the date of the last entry in it.
- Supply of controlled drugs is available only through authorized pharmacists as regulated by national authorities against suitable documentation.
- Ships carrying dangerous goods have additional medicines, specific antidotes, and special equipment on board, as prescribed in the International Maritime Organization's 'Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG)'. These special items should be stored and registered together with the regular medicines and medical supplies carried on board.

Besides controlled drugs, there are some other medicines which should only be administered under

Apply Your Knowledge

1. What is the medical standard applicable to the medical locker on board your ship? Attach a certificate of the pharmacist certifying the medical locker. Which medicines are kept under lock and key and only to be administered under the direct orders of the Master?

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: C5.1.4

Topic: Practical application of medical guides and advice by radio and medical equipment on board.

Task Heading

- Use resuscitation equipment.

Objectives

- Familiarize with the use of resuscitation equipment.

Please read this task in conjunction with task C5.2.2

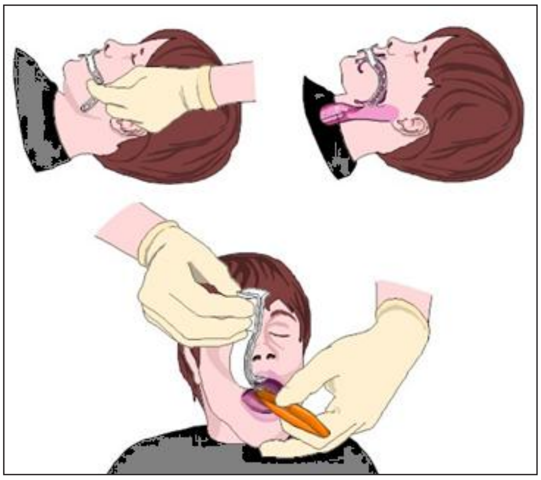
Index

1. Use of a bag and mask resuscitator
2. Oxygen resuscitators

Description

1) Use of a bag and mask resuscitator

- A bag and mask resuscitator can be used to replace mouth to- mouth or mouth-to-nose breathing while administering cardio pulmonary resuscitation as discussed under task C5.2.2. The advantages of a bag and mask resuscitator are that a rescuer can use it for longer before becoming exhausted, and oxygen tubing can be attached to the bag.



- To use a bag and mask resuscitator the patient shall be laid on his back. Mask size shall be for the right size for the patient face. A guedel airway shall be inserted as shown; this is in order to check the airway is clear. With one hand under the patient's neck, keep the patient's head tilted as far back as it will go - unless you suspect spinal injury, in which case use minimal tilt. Place the mask over the patient's nose and mouth. Hold the mask in place with your right hand, by clamping your thumb over the mask and using your fingers to hook under the patient's jaw and pull it up towards the mask. Using left hand the bag shall be compressed, forcing air into the patient's lungs. This shall be repeated at a rate of about 12 times per minute. Any leak around the face shall be checked with each breath. There is a valve which allows air to escape from the lungs when the bag is released, hence the mask shall not be removed off the patient's face between breaths.

2) Oxygen resuscitators

- The assigned medical officer on board is in charge of the resuscitator equipment. The instructions on the use of resuscitator are discussed during training sessions required on ships. Manufacturer's instructions shall be followed for the equipment of specific make.

- Ships mentioned under column A or B of the Medical first aid guide, for use in accidents involving dangerous goods (MFAG) appendix 14 – List of equipment, are required to carry a minimum of 44 litres/ 200 bar oxygen as follows:
  - One 40 litre/200 bar medical oxygen cylinder located in the ship's hospital, assembled for direct use, equipped with one flow meter unit (two ports) for supplying oxygen for two persons simultaneously; and
  - One complete portable set, ready for use, with a 2 litre/ 200 bar medical oxygen cylinder and a spare cylinder (also 2 litre/200 bar).
  - The single 40 litre/ 200 bar medical oxygen cylinder may be substituted with two 20 litre/ 200 bar cylinders or four 10 litre/ 200 bar cylinders, provided the equipment / flow meter units are arranged to supply oxygen to two persons simultaneously.

- The cylinders are hydrostatically tested every five years, or at an interval specified by the manufacturer, whichever occurs sooner. The contents of the cylinders are to be checked and changed as required according to manufacturer's requirements, or every 3 years, whichever occurs sooner. The entire system is to be inspected annually by a competent person in accordance with manufacturer's instructions

- **Method of administering oxygen to patient**

Oxygen is given to a patient who is breathing spontaneously but has difficulty breathing or has a disorder that impairs the uptake of oxygen into the lungs or the delivery of oxygen to the tissues. Oxygen delivered through valve and bag resuscitation kits - used primarily for victims who are not breathing - should be given only by trained personnel. Prior administering oxygen, the airway of the patient shall be checked clear. If the patient is unconscious, Guedel airway shall be used. Oxygen cylinder shall be checked not empty and that the regulator and flow meter are properly attached to the cylinder and turned off. The main oxygen cylinder valve is then turned fully on. The flow meter shall be set to the chosen rate as per manufacturer's instruction. Smoking, naked lights or fires must not be allowed where oxygen is being administered as the same is likely to cause spontaneous combustion. It is recommended to seek radio medical advice prior administering oxygen.

Apply Your Knowledge

1. Locate the resuscitator on board your vessel and practice its use in accordance with the manufacturer's instructions.

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: C6.1.3

Topic: Familiarize with various statutory regulations and requirements

Task Heading

- Identify the common port state control detainable deficiencies.

Objectives

- Understand the aims of port state control (PSC), the legal background of PSC and the terms deficiency & detention
- Identify the common detainable deficiency found by PSC inspectors

Index

1) Aims of PSC
2) Legal background
3) Deficiency
4) Detention
5) Common detainable deficiencies

Description

1) Aims of PSC

- All countries have the right to inspect ships of foreign flags visiting their ports to ensure that they meet IMO requirements regarding safety and marine pollution prevention standards. Thus port state control is intended as a tool for any country to control safety standards, safeguard the own territory against hazards to safety and the environment and keep substandard ships off their coast. Since 1982 various countries have agreed within certain areas in the world to co-operate with PSC and have signed an agreement called "memorandum of understanding on port state control".

2) Legal background

- The right to inspect ships by port states is laid down in various IMO Conventions including SOLAS, MARPOL, Loadline, STCW etc

3) Deficiency

- A deficiency is recorded when the condition of a ship's hull or its equipment does not conform to the requirements of the relevant IMO safety or pollution prevention conventions or where hazards to the health or safety of the crew exist which are considered to be in breach of Maritime Labour Convention (MLC) 2006.
- Deficiencies arise from
- ❖ the absence of either equipment or approved arrangements required by conventions;
- ❖ non-compliance of equipment or arrangements with the appropriate specifications of the relevant convention; and
- ❖ Substantial deterioration of the ship or its equipment, such as life-saving appliances, fire-fighting equipment or radio equipment.
- In principle, all deficiencies must be rectified before the departure of the ship concerned. In practice, the inspectors may allow a ship to put to sea, depending on the nature and risk impact of the deficiency given the assurance that the deficiency will be rectified as soon as possible.

4) Detention

- Detention is defined as intervention action taken by the port state when the condition of the ship or its crew does not correspond substantially with the applicable conventions to ensure that the ship will not sail until it can proceed to sea without presenting a danger to the ship or persons on board, or without presenting an unreasonable threat of harm to the marine environment.

- Grounds for detention
- Where deficiencies are clearly hazardous to health, safety or environment.
- Where deficiencies on a ship are so serious that they will have to be rectified before the ship sails.

5) Common detainable deficiencies

- For convenience the common detainable deficiencies found by PSC are provided below, area wise. Note these below mentioned deficiencies may differ from flag / class / country /company. Only an attempt has been made to provide a list which has been observed in various reports concerning PSC at the time of writing the tasks therefore it should not be treated as absolute but should be used for the sake of reference only.
- Examples of detainable deficiencies
- Failure of the main propulsion, electrical, pumping and steering systems
- Poor cleanliness of engine room
- Excessive amounts of oily-water in the bilges
- Engine room pipe work insulation contaminated by oil
- Poor condition of LSA/ FFA equipment
- Poor condition of equipment, ventilation valves, fire dampers and quick closing devices
- Poor condition of navigation lights, shapes and sound signaling appliances
- Failure of mandatory navigation systems and equipment
- Nautical charts and publications not up to date
- Failure or faulty radio communication systems
- Non compliance with safe manning certificate
- Insufficient crew member certificates/endorsements inadequate navigational or engineering watch arrangements/personnel
- Serious deficiency of crew's operational competence (not following standard procedures)
- Significant areas of damage or corrosion, or pitting of plating and associated stiffening in decks and hull effecting seaworthiness
- Insufficient stability or ability to calculate stability conditions, inability to read the draught marks
- Poor condition of hull closing devices such as hatch covers and watertight doors
- Overloading of vessel
- Poor condition or faulty oily-water filtering equipment, oil discharge monitoring and control systems and alarms
- Remaining capacity of slop and/or sludge tank insufficient for intended voyage
- Oil record book missing or inappropriate entries
- Crew member competency not adequate for the duties assigned for the safety of the ship and the prevention of pollution .insufficient rested crewmembers for first watch and relieving watch duties at the commencement of the voyage.
- Insufficient food or potable water for next voyage
- Unacceptable unsanitary conditions on board
- Excessive amount of garbage accumulated, passageways blocked

	
Fire Line Leaking	**Engine Room Damper Wasted / Not Operational**
	
Damaged / Missing Laggings On High Temperature Surfaces	**Poor Sanitary Facilities**
	
Quick Closing Valve Not Operational	**Defective air pipe**
	
Main Deck Holed / Excessive Structural Wastage	**Shipside Railing Missing**
	
Gangway Unattended (ISPS – Access Control)	

Apply Your Knowledge

1. Refer to your vessel port state inspection records and check any ten deficiencies pointed out. Discuss the hazards associated to the deficiencies pointed out.

IMU

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: C6.1.4

Topic: Familiarize with various statutory regulations and requirements

Task Heading

- Check the certificates and manuals issued under SOLAS, MARPOL, International Load Line, STCW Convention and other regulations.

Objectives

- Familiarize with the certificates and documents required to be carried on board ships

Index

I. Certificates and documents required to be carried on board ships

Description

1) **Certificates and documents required to be carried on board ships** (Note: All certificates to be carried on board must be originals)

I. **All ships to which the referenced convention applies**

- **SOLAS**
  - International tonnage certificate (1969)
  - International load line certificate
  - International load line exemption certificate
  - Coating technical file
  - Construction drawings
  - Ship construction File
  - Intact stability booklet
  - Damage control plans and booklets
  - Minimum safe manning document
  - Fire safety training manual
  - Fire control plan/booklet
  - Onboard training and drills record
  - Fire safety operational booklet
  - Maintenance plans
  - Training manual
  - Nautical charts and nautical publications
  - International code of signals and a copy of Volume III of IAMSAR manual
  - Records of navigational activities
  - Maneuvering booklet
  - Certificates for masters, officers or ratings
  - Records of hours of rest
  - Voyage data recorder system-certificate of compliance
  - Exemption certificate
  - LRIT conformance test report

- **SOLAS and ISM**
  - Cargo securing manual
  - Document of compliance (copy)
  - Safety management certificate

- **SOLAS and ISPS**
  - International ship security certificate (ISSC) or interim international ship security certificate
  - Ship security plan and associated records

- Continuous synopsis record (CSR)

- **MARPOL**
- International oil pollution prevention certificate
- Oil record book
- Shipboard oil pollution emergency plan
- International sewage pollution prevention certificate
- Garbage management plan
- Garbage record book
- International air pollution prevention certificate
- Ozone depleting substances record book
- Fuel oil changeover procedure and log-book (record of fuel changeover)
- Manufacturer's operating manual for incinerators
- Bunker delivery note and representative sample
- Technical file (as specified in paragraph 2.4.1 of the NOx technical code)
- Record book of engine parameters (in accordance with paragraph 6.2 of the NOx technical code)

- **AFS CONVENTION**
- International anti-fouling system certificate
- Declaration on anti-fouling system

II. In addition to the certificates listed in section I above, passenger ships shall carry:

- **SOLAS**
- Passenger ship safety certificate
- Special trade passenger ship safety certificate, special trade passenger ship space certificate
- search and rescue cooperation plan
- List of operational limitations
- Decision support system for masters

III. In addition to the certificates listed in section I above, cargo ships shall carry:

- **SOLAS**
- Cargo ship safety construction certificate
- Cargo ship safety equipment certificate
- Cargo ship safety radio certificate
- Cargo ship safety certificate
- Document of authorization for the carriage of grain
- Enhanced survey report file
- Cargo Information
- Ship structure access manual
- Bulk carrier booklet

- **MARPOL**
- Certificate of insurance or other financial security in respect of civil liability for oil pollution damage
- Certificate of insurance or other financial security in respect of civil liability for bunker oil pollution damage
- Certificate of insurance or other financial security in respect of civil liability for oil pollution damage
- Record of oil discharge monitoring and control system for the last ballast voyage
- Oil discharge monitoring and control (ODMC) operational manual
- Crude oil washing operation and equipment manual (COW manual)
- Condition assessment scheme (CAS) statement of compliance, CAS final report and review record
- Subdivision and stability information
- VOC management plan

IV. In addition to the certificates listed in sections I and III above, where appropriate, any ship carrying noxious liquid chemical substances in bulk shall carry:

- **MARPOL**
  - International pollution prevention certificate for the carriage of noxious liquid substances in bulk (NLS Certificate)
  - Cargo record book
  - Procedures and arrangements manual (P & A Manual)
  - Shipboard marine pollution emergency plan for noxious liquid substances

V. In addition to the certificates listed in sections I and III above, where applicable, any chemical tanker shall carry:

- Certificate of fitness for the carriage of dangerous chemicals in bulk
- International certificate of fitness for the carriage of dangerous chemicals in bulk

VI. In addition to the certificates listed in sections I and III above, where applicable, any gas carrier shall carry:

- Certificate of fitness for the carriage of liquefied gases in bulk
- international certificate of fitness for the carriage of liquefied gases in bulk

VII. In addition to the certificates listed in sections I, and II or III above, where applicable, any ship carrying dangerous goods shall carry:

- Document of compliance with the special requirements for ships carrying dangerous goods

VIII. In addition to the certificates listed in sections I, and II or III above, where applicable, any ship carrying dangerous goods in packaged form shall carry:

- Dangerous goods manifest or stowage plan

IX. In addition to the certificates listed in sections I, and II or III above, where applicable, any ship carrying INF cargo shall carry:

- International certificate of fitness for the carriage of INF cargo

Apply Your Knowledge

1. Discuss the occasions when the ship's certificates are inspected by external authorities.

IMU

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: C6.1.5, C6.1.6

Topic: Familiarize with various statutory regulations and requirements

Task Heading

- Locate the ballast water management plan on board and demonstrate understanding of its contents.
- Check ballast water exchange requirements and identify the methods of carrying out a ballast water exchange.

Objectives

- Familiarize with the ballast water management plan which is required to be carried on board ships and understand the contents of the ballast water management plan.
- Familiarize with ballast water exchange requirements and understand the methods of carrying out a ballast water exchange.

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7) Contents of ballast water management plan
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Description

1) Ballast water management

- Introduction of alien species through the discharge of ballast water is one of the largest threats to the world oceans. In order to reduce the harmful effects on the marine environment that are spread through aquatic micro organisms transferred from one area to another through ballasting operations of the ship, the International Maritime Organization (IMO) adopted a convention in order to control and manage ships ballast and sediments ion on 13th February 2004.

- Studies carried out in several countries and through the Globallast program (the joint initiative of IMO, UNDP and the Global Environment Facility (GEF) to address the issue of invasive species in ships' ballast water) have shown that many micro organisms including species of bacteria, plants and animals can survive in a viable form in the ballast water and sediment carried in ships, even after journeys of several weeks' duration.

- Subsequent discharge of ballast water or sediment into the waters of port states may result in the establishment of colonies of harmful species and pathogens which can seriously upset the existing ecological balance, in addition to affecting human health and economy.
- Although there are other means by which organisms are transferred between geographically separated sea areas, natural barriers restrict these transfers and hence, ballast water discharge from ships is considered to be a significant cause.

2) The GloBallast program

The potential for ballast water discharge to cause harm has been recognized not only by the IMO, but also by the 'United Nations Development Program' (UNDP) and the 'World Health Organization' (WHO) which is concerned about the role of ballast water as a medium for the spreading of epidemic disease bacteria. Some states have already established controls on the discharge of ship's ballast water that will minimize the potential for colonization of their rivers and estuaries by non-native species. Exchange of ballast water in deep seas is deemed as an acceptable method to reduce the spreading of harmful organisms. Deep ocean water contains few organisms, and these are unlikely to survive transfer to coastal and freshwater environments. Accordingly, the countries which were most concerned promulgated advice to ships for ballast water management, together with a request for their co-operation in applying the techniques voluntarily. Standard procedures were developed that were accepted by quarantine authorities as achieving the level of acceptability desired by the port state. Some countries made it mandatory to follow these procedures. The IMO, under Resolution A.868 (20), adopted on 27th November 1997, introduced the 'Guidelines for the control and management of ship's ballast water to minimize the transfer of harmful aquatic organisms and pathogens'.

- Further, in its International Conference on Ballast Water Management for ships, the IMO adopted the 'International Convention for the Control And Management of Ship's Ballast Water and Sediments', thereby introducing new regulations for the management of ship's ballast water.

3) Objectives of ballast water management plan

- The function of the ballast water management plan is to assist the ship's personnel in complying with the relevant regulations of the convention and other quarantine measures intended to minimize the risk of transplanting harmful aquatic organisms and pathogens from ship's ballast water and associated sediments into local waters, while at the same time maintaining ship safety.
- The plan gives guidance on methods to be used for safe exchange of ballast water, preferably to be carried out in as deep ocean waters as possible. The selected methods of ballast water management take into account the need to ensure that ballast water management practices used to comply with this convention do not cause greater harm than they prevent, to the environment, human health, property or resources of any states and to the safety of the ship.
- As part of this function the plan will provide information to quarantine officers who wish to learn about a ship's ballast handling system, or to confirm that ballast management has been effectively planned.

4) Reporting to port states

- Concerned countries have therefore introduced requirements which, though often differing in detail, generally call for ships to report in advance, to the national monitoring authority. The requirements for reporting to various port state administrations are mentioned in the ballast water management plan.

- The master is required to send information to the concerned authorities as and when required. In most cases it is mandatory to make the report, for the ballast water exchange in mid-ocean or any other ballast management procedure used. Irrespective of the above reporting, it is mandatory to maintain a record of the events in the ballast water record book.
- Port states that have issued ballast water guidelines require ships provide information in regards to its ballast water. Specifically, the origin of and the vessel's intent to discharge ballast water may be of primary concern. Each port the vessel may call in is listed with all pertinent information provided. This should include what information is required, any forms or permits are required and point of contact information.

5) Ballast water management options

a) Ballast water management systems

There are ballast water management systems installed on board ships, complying with the regulations of BWM convention, which have to be approved by the administration and must be safe in terms of the ship, its equipment and the crew. The use of such systems is detailed in the ship's ballast water management plan. All failures and malfunctions of the system are to be recorded in the ballast water record book.

- Ships can even discharge ballast water to a reception facility designed taking into account the guidelines developed by the organization for such facilities. Prototype ballast water treatment technologies can only be used as approved by the administration.

b) Ballast water exchange

Ballast water exchange is one of the options for ballast water management. There are certain requirements that have to be understood thoroughly prior conducting a ballast water exchange.

- A ship conducting ballast water exchange in accordance with BWM convention shall
  - whenever possible, conduct such ballast water exchange at least 200 nautical miles from the nearest land and in water at least 200 metres in depth, in accordance with IMO guidelines;
  - in cases where the ship is unable to conduct ballast water exchange as above, such ballast water exchange shall be conducted as far from the nearest land as possible, and in all cases at least 50 nautical miles from the nearest land and in water at least 200 metres in depth.
- A ship shall not be required to deviate from its intended voyage, or delay the voyage, in order to comply with above requirements.
- In sea areas where the distance from the nearest land or the depth does not meet the parameters described above, the port state may designate areas as appropriate, where a ship may conduct ballast water exchange.
- A ship may be exempted from conducting ballast water exchange if such exchange would threaten the safety or stability of the ship, its crew, or its passengers because of adverse weather, ship design or stress, equipment failure, or any other extraordinary condition.
- When a ship is required to conduct ballast water exchange and does not do so in accordance with this regulation, the reasons shall be entered in the ballast water record book.

Ballast Water exchange standard

Ships performing Ballast Water exchange shall do so with an efficiency of at least 95% volumetric exchange of Ballast Water.
For ships exchanging Ballast Water by the pumping-through method, pumping through three times the volume of each Ballast Water tank shall be considered to meet the standard. Pumping through less than three times the volume may be accepted provided the ship can demonstrate that at least 95 percent volumetric exchange is met.

c) Ballast water exchange methods

There are three methods of ballast water exchange which have been evaluated and accepted by the organization. The three methods are the sequential method, the flow-through method and the dilution method. The flow-through method and the dilution method are also called "pump through" methods.
The three accepted methods can be described as follows:

- **Sequential method**– a process by which a ballast tank intended for the carriage of ballast water is first emptied and then refilled with replacement ballast water to achieve at least a 95 per cent volumetric exchange.
- **Flow-through method**– a process by which replacement ballast water is pumped into a ballast tank intended for the carriage of ballast water, allowing water to flow through overflow or other arrangements.
- **Dilution method** – a process by which replacement ballast water is filled through the top of the ballast tank intended for the carriage of ballast water with simultaneous discharge from the bottom at the same flow rate and maintaining a constant level in the tank throughout the ballast exchange operation.

Ballast water is forced out an opening in flow-through exchange.

6) Safety precautions associated with ballast water exchange

- Each method of ballast water exchange has particular safety aspects associated with it that should be considered when selecting the method to be used on a particular ship. When identifying the ballast water exchange method(s) for the first time for a particular ship, an evaluation should be made which should include:
- the safety margins for stability and strength contained in allowable seagoing conditions and the envisaged ballast water exchange method or methods to be used;
- the ballast pumping and piping system taking account of the number of ballast pumps and their capacities, size and arrangements of ballast water tanks; and
- the availability and capacity of tank vents and over flow arrangements, for the flow through method, the availability and capacity of tank overflow points, prevention of under and over pressurization of the ballast tanks.

- Particular account should be taken of the following
- Stability to be maintained at all times and not less than those values recommended by the organization or required by the administration;
- Longitudinal and torsional stress values, not to exceed permitted values with regard to prevailing sea conditions;

- ❖ Exchange of ballast in tanks where significant structural loads may be generated by sloshing action in the partially filled tank to be carried out in favourable sea and swell conditions such that the risk of structural damage is minimized;
- ❖ Wave-induced hull vibrations when carrying out ballast water exchange;
- ❖ Limitations of the available methods of ballast water exchange in respect of sea and weather conditions;
- ❖ Forward and aft draughts and trim, with particular reference to bridge visibility, slamming, propeller immersion and minimum forward draft; and
- ❖ Additional workloads on the master and crew

- ➢ Having undertaken an evaluation for a particular ship and the exchange method or methods to be used, the ships are provided with ballast water management plan enlisting procedures, advice and information appropriate to the exchange method(s). These include procedures to
- ❖ avoid over and under-pressurization of ballast tanks;
- ❖ control free surface effects on stability and sloshing loads in tanks that may be slack at any one time;
- ❖ maintain adequate intact stability in accordance with an approved trim and stability booklet;
- ❖ control stresses within limits of shear forces, bending moments and torsional forces in accordance with an approved loading manual;
- ❖ control forward and aft draughts and trim, with particular reference to bridge visibility, propeller immersion and minimum forward draft;
- ❖ control wave-induced hull vibrations when performing ballast water exchange;

- ➢ BWM plan also gives details regarding
- ❖ watertight and weather tight closures (e.g. manholes) which may have to be opened during ballast exchange must be re-secured;
- ❖ maximum pumping/flow rates – to ensure the tank is not subjected to a pressure greater than that for which it has been designed;
- ❖ internal transfers of ballast;
- ❖ admissible weather conditions;
- ❖ weather routeing in areas seasonably affected by cyclones, typhoons, hurricanes, or heavy icing conditions;
- ❖ documented records of ballasting and/or de-ballasting and/or internal transfers of ballast;
- ❖ contingency procedures for situations which may affect ballast water exchange at sea, including deteriorating weather conditions, pump failure and loss of power;
- ❖ time to complete the ballast water exchange for each tank or an appropriate sequence thereof;
- ❖ continual monitoring of the ballast water operation; monitoring should include pumps, levels in tanks, line and pump pressures, stability and stresses;
- ❖ a list of circumstances in which ballast water exchange should not be undertaken
- ❖ ballast water exchange at sea should be avoided in freezing weather conditions
- ❖ personnel safety, including precautions which may be required when personnel are required to work on deck at night, in heavy weather, when ballast water overflows the deck, and in freezing conditions.

- ➢ In planning ballast water exchange operation the following shall be further considered
- ❖ the duration and time during the operation that any of the criteria will not be met;
- ❖ the effect(s) on the navigational and maneuvering capabilities of the ship; and
- ❖ the time to complete the operation.

- ➢ Ships' officers and crew engaged in ballast water exchange at sea should be trained in and be familiar with the following as appropriate:
- ❖ the ship's ballast pumping and piping arrangements, positions of associated air and sounding pipes, positions of all compartment and tank suctions and pipelines connecting them to ship's ballast pumps and, in the case of use of the flow through method of ballast water exchange, the openings used for release of water from the top of the tank together with overboard discharge arrangements;

- the method of ensuring that sounding pipes are clear, and that air pipes and their non-return devices are in good order;
- the different times required to undertake the various ballast water exchange operations including the time to complete individual tanks;
- the method(s) in use for ballast water exchange at sea if applicable with particular reference to required safety precautions; and
- the need to continually monitor ballast water exchange operations.

7) Contents of ballast water management plan

The contents of ballast water management plan may vary from company to company or ship to ship, but the minimum requirement is as follows:

I. Introduction
II. Ship particulars
III. Index
IV. Purpose
V. Plans/drawings of the ballast system
VI. Description of the ballast system
VII. Ballast water sampling points
VIII. Operation of the ballast water management system
IX. Safety procedures for the ship and the crew
X. Operational or safety restrictions
XI. Description of the method(s) used on board for ballast water management and sediment control
XII. Procedures for the disposal of sediments
XIII. Methods of communication
XIV. Duties of the ballast water management officer
XV. Recording requirements
XVI. Crew training and familiarization
XVII. Exemptions
XVIII. Approving authority

8) Sample ballast reporting form and ballast water record book sample format

Ballast Water Reporting Form

1. VESSEL INFORMATION | **2. BALLAST WATER**

Vessel Name:	Type:	IMO Number:	Specify Units: m³, MT, LT, ST
Owner:	GT:	Call Sign:	Total Ballast Water Onboard:
Flag:	Arrival Date:	Agent:	
Last Port and Country:		Arrival Port:	Total Ballast Water Capacity:
Next Port and Country:			

3. BALLAST WATER TANKS

BALLAST WATER MANAGEMENT PLAN ONBOARD? YES_____ NO_____ HAS THIS BEEN IMPLEMENTED? YES_____ NO_____

TOTAL NO. OF TANKS ONBOARD______ NO. OF TANKS IN BALLAST_____ IF NONE IN BALLAST GO TO NO. 5

NO. OF TANKS EXCHANGED_____ NO. OF TANKS NOT EXCHANGED_______

4. BALLAST WATER HISTORY:

RECORD ALL TANKS THAT WILL BE DEBALLASTED IN PORT STATE OF ARRIVAL; IF NONE GO TO NO. 5.

Tanks/Holds (list multiple sources/tanks separately)	Ballast Water Source				BW EXCHANGE: circle one: Empty/Refill or Flow Through					Ballast Water Discharge			
	DATE/ TIME ddmmyy/ hhmmss	PORT or LAT./ LONG.	VOL. (units)	TEMP (units)	DATE/ TIME ddmmyy/ hhmmss	ENDPOINT LAT./ LONG.	VOL. (units)	% Exch.	SEA HGT. (m)	DATE/ TIME ddmmyy/ hhmmss	PORT or LAT./ LONG.	VOLUME (units)	SALINITY (units)
Ballast Water Tank Codes: Forepeak = FP, Aft Peak = AP, Double Bottom = DB, Wing Tank = WT, Center Tank = CT, Topside Tank = TS, Cargo Hold = CH, O = Other													

Ballast Water Record Book

Name of Ship ______________________

IMO Number ______________________

Gross Tonnage ______________________

Flag ______________________________

Total Ballast Water Capacity (in cubic meters) ________________________

Is this vessel provided with Ballast Water Management Plan yes no

Was the approved Ballast Water Management Plan implemented prior to discharge yes no

Diagram of the vessel indicating the ballast tanks:

Introduction

In accordance with regulation B-2 of the Annex to the International Convention for the Control and Management of Ships' Ballast Water and Sediments, a record is to be kept of each Ballast Water Operation. This includes discharges at sea and to reception facilities.

Ballast Water and Ballast Water Management

"Ballast Water" means water with its suspended matter taken on onboard a ship to control trim, list, draft, stability or stresses of a ship. Management of Ballast Water shall be in accordance with an approved Ballast Water Management Plan and take into account Guidelines developed by the IMO.

Date	Time	Location Port or Facility of Uptake (Port or Lat/Long)	Estimated Volume of Uptake (in cubic meters)	Location of the Exchange Operation (Port or Lat/Long)	Depth of Water at Exchange Location (in meters)	Estimated Volume of Ballast Water Discharged at Sea (in cubic meters	Estimated Volume of Ballast Remaining (in cubic meters)	Estimated Volume of Ballast Water Discharge in Port or Facility (in cubic meters).	Signature of Officer in Charge	Rank

Note: Any accidental or other exception uptake or discharge of Ballast Water shall also be recorded. The circumstances associated with the accidental or other exceptional uptake, discharge, escape or loss and the reason therefore and any general remarks associated with such and event shall also be recorded.

Apply Your Knowledge

1. Why do we need to exchange ballast water on board? List various methods of carrying out a ballast exchange.

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: C7.1.4

Topic: Safety of personnel and ship

Task Heading

- Accompany the safety officer whilst carrying out monthly safety inspection rounds

Objectives

- Understand the concept of safety culture.
- Understand the meaning of terms, “substandard acts/practices” and “substandard conditions” and their relevance with safety inspections on board the ship.
- Familiarize with the safety inspection and the things to check for during these inspections.

Index

1) Safety culture
2) Safety inspections
3) Sample checklist for safety officer’s inspection
4) Safety inspection schedule plan

Description

1) Safety culture

Safety culture can be described as the combination of attitudes, beliefs and values about safety, stemming right from the top of an organization, that go towards determining how people in the organization behave in the field of safety. In summary, it is how the company and its employees think about safety. The development of a “safety culture” and the achievement of high standards of safety depend on good organization and the whole-hearted support of management and all personnel. In order to have a safety management system in place and working, it is necessary to conduct regular safety inspections.

2) Safety inspections

- Company SMS procedures shall be followed for safety inspections. A safety inspection is a general inspection relating to occupational safety and is a slow, thorough, planned walk-through of an entire area. The purpose of this inspection is to look for substandard conditions existing in that area and any substandard practices being followed by the crew.

- **Substandard (or unsafe) act** is an act, which varies from the accepted safe practice and creates a hazard to persons, property or environment. The following could be considered as substandard (or unsafe) acts:
  - Operating without authority
  - Failure to warn
  - Failure to secure or to make safe
  - Operating at improper speed
  - Defeating safety devices
  - Rendering safety devices inoperative
  - Using of defective equipment
  - Improper use of otherwise safe equipment
  - Servicing equipment in operation
  - Not following proper work instructions or rules

  - ❖ Not using or improper use of PPE
  - ❖ Improper loading
  - ❖ Improper placement
  - ❖ Improper lifting
  - ❖ Taking up improper position for task
  - ❖ Working on moving/unsecured equipment
  - ❖ Games/horseplay
  - ❖ Attention distracted
  - ❖ Other

- **Substandard (or unsafe) conditions** are defined as condition, which vary from normal Safe condition and, if not corrected could lead to an accident. The following could be considered as substandard (or unsafe) conditions/ situations/ practices:
  - ❖ Improper guards or barriers
  - ❖ No or inadequate or PPE
  - ❖ Defective tools, equipment or materials
  - ❖ Proper tools not available
  - ❖ Congestion / restricted action
  - ❖ Lack of adequate housekeeping
  - ❖ Inadequate warning systems
  - ❖ Fire or explosion hazards
  - ❖ Excessive noise
  - ❖ Inadequate ventilation
  - ❖ Substandard lighting
  - ❖ Inadequate design of workplace
  - ❖ Exposure to chemicals
  - ❖ Exposure to radiation
  - ❖ Hazardous atmospheric conditions: fumes, dusts, vapours
  - ❖ Other

- To identify these acts / practices and conditions (if any) is what the safety officer is looking for during his / her inspections. In short it is to search out all hazards that can harm people, damage environment, cargo or vessel.

- It is not necessary to complete an inspection of the whole ship at one time, as long as each accessible part of the ship is inspected as governed by flag regulation or company's specified guidelines. It may be easier to get quick and effective action on recommendations arising out of an inspection, if one section is dealt with at a time.

- Before beginning any inspection, previous reports of inspections of the particular section should be read, together with the recommendations made and the subsequent action taken. The control measures identified in any relevant risk assessment should also be read, and compliance with them checked during the inspection. Any recurring problems should be noted and, in particular, recommendations for action which have not been put into place.

- It is not possible to give a definitive checklist of everything to look for but safe access, the environment and working conditions are major items. Suggestions for consideration on these particular issues are given below in a form of checklist, which could be used for these safety inspections.

- The findings of the safety officer's inspection should be included in the safety committee meeting minutes. A record should be kept of all inspections.

3) Sample checklist for safety officer's inspection

The following are examples of questions the safety officer should consider. This is not intended to be an exhaustive list, and should be varied according to the particular design or conditions on a particular ship.

- **Means of Access/Safe Movement**
  - Are means of access, if any, to the area under inspection (particularly ladders and stairs), in a safe condition, well lit and unobstructed?
  - If any means of access is in a dangerous condition, for instance when a ladder has been removed, is the danger suitably blocked off and warning notices posted?
  - Is access thorough the area of inspection both for transit and working purposes clearly marked, well lit, unobstructed and safe?
  - Are fixtures and fittings over which seamen might trip or which project, particularly overhead, thereby causing potential hazards, suitably painted or marked?
  - Is any gear, which has to be stowed within the area, suitably secured?
  - Are all guard-rails in place, secure and in good condition?
  - Are all openings through which a person could fall, suitably fenced?
  - If portable ladders are in use, are they properly secured and at a safe angle?

- **Working Environment**
  - Is the area safe to enter?
  - Are lighting levels adequate?
  - Is the area clear of rubbish, combustible material, spilled oil etc?
  - Is ventilation adequate?
  - Are members of the crew adequately protected from exposure to noise where necessary?
  - Are dangerous goods and substances left unnecessarily in the area or stored in a dangerous manner?
  - Are loose tools, stores and similar items left lying around unnecessarily?

- **Working Conditions**
  - Is machinery adequately guarded where necessary?
  - Are any necessary safe operating instructions clearly displayed?
  - Are any necessary safety signs clearly displayed?
  - Are permits-to-work used when necessary?
  - Is crew working in the area wearing any necessary protective clothing and equipment?
  - Is that protective clothing and equipment in good condition and being correctly used?
  - Is there any evidence of defective plant or equipment and if so what is being done about it?
  - Is the level of supervision adequate, particularly for inexperienced crew?
  - What practicable safety improvements could be made?

- **General**
  - Are all statutory regulations and company safety procedures being complied with?
  - Is the safety advice in publications such as code of safe working practices for merchant seaman, merchant shipping notices etc. being followed where possible?
  - Have the crew members in the area any safety suggestions to make?
  - Have any faults identified in previous inspections been rectified?

4) Safety inspection schedule plan

For proper planning and to ensure no spaces /areas are missed out during these inspections; a safety inspection schedule plan can be drawn for the use of the safety officer. This will assist the safety officer to keep a track of the spaces already inspected and the ones remaining. A simple diagram can be drawn to ensure it covers the deck and spaces on your vessel. Inspection records can be maintained as shown below.

ACCOMMODATION BLOCK		
AREA	INSPECTION	
	LAST	DUE

ENGINE ROOM BLOCK		
AREA	INSPECTION	
	LAST	DUE

DECK BLOCK		
AREA	INSPECTION	
	LAST	DUE

BELOW DECK BLOCK		
AREA	INSPECTION	
	LAST	DUE

Apply Your Knowledge

1. Check the records of safety inspections rounds and discuss any ten significant findings which needed a follow up.

IMU

Function: Ship security

Competence: Contribute to the enhancement of maritime security through heightened awareness

Task number: D1.1

Sub task Reference number: D1.1.4, D1.1.5, D1.1.6, D1.1.7

Topic: Ship security

Task Heading

- Demonstrate proper procedures whilst maintaining a security watch at sea and in port.
- Demonstrate understanding of the duties and procedures to be followed at all the three security levels for access control, cargo, stores, etc as per the Ship's Security Plan.
- Locate all the restricted areas on board your vessel.
- Participate in carrying out a thorough search for stowaway, narcotics, explosives or other contraband items. Use company's vessel search checklist.

Objectives

- Understand the duties and procedures to be followed at all the three security levels for access control, cargo, stores, etc. as per the ship's security plan.
- Understand the importance of maintaining restricted areas, and the procedures to be to be followed at all the three security levels as per the ship's security plan.
- Familiarize in carrying out a thorough search for stowaway, narcotics, explosives or other contraband items using company's vessel search checklist.

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1) Ship security plan
2) Procedures for maintaining security watch
3) Ship security duties and procedures to be followed at the three security levels
   a) Access control
   b) Monitoring ship security
   c) Cargo handling
   d) Stores handling
   e) Restricted areas
4) Carrying out search for stowaway, narcotics, explosives or other contraband items
5) Sample of ship specific search checklist

Description

1) Ship security plan

Each ship carries a ship security plan (SSP) which is approved by the administration of country where the ship is registered. The plan specifies the procedures for three security levels and addresses issues such as access control to the ship, restricted areas on board, procedures concerning security with respect to handling of cargo ship's stores and unaccompanied baggage, and procedures for monitoring the security of the ship.

2) Procedures for maintaining security watch

- The ship security plan provides details regarding the security watch (patrols) required at sea and when in port at different levels of security. Each crew member is assigned certain security patrolling duties. The new joiners are briefed by the ship security officer (SSO) regarding the requirements pertaining security on that ship and his / her duties with respect to security.

- Gangway watch-keeper/ security patrol reports to the SSO/ OOW for all matters regarding safety and security in the area of the gangway. He should notify them if in doubt on any matter or in the event of an emergency situation. An alert watch shall be maintained at all times at the gangway and other access points. This requires careful scrutiny of the quayside and off shore side area and, in particular, any movements of personnel near open decks, mooring lines fore and aft, suspicious boats etc.

- A watch is further maintained against theft of the ship's equipment and stores or any suspicious packages being left on board.
- Check and suitable record is maintained regarding all visitors boarding and leaving the ship. Check is maintained on any instance of persons boarding or leaving the ship other than by the gangway, i.e., leaping into main decks, down conveyors etc.
- While navigating in piracy prone areas and otherwise too, a close lookout is kept on suspicious crafts in the vicinity. Additional visual lookouts accompanied with radar being used at short range serves the purpose. Vessel may be carrying additional security guards; however they do not relieve the OOW of his responsibilities to keep a safe watch.

3) Ship security duties and procedures to be followed at the three security levels

The ship security plan provides details regarding duties and procedures are to be followed at all the three security levels for access control, cargo, stores, etc. which are as follows:

a) Access control

❖ The SSP establishes the security measures covering all means of access to the ship identified in the ship security assessment (SSA). These includes access ladders, access gangways, access ramps, access doors, side scuttles, windows and ports, mooring lines and anchor chains, cranes and hoisting gear. The duties and procedures as a security measures covering all means of access to the ship at various security levels are:

Security level 1

- ✓ Continuous manning of authorized access point (gangway etc.,)
- ✓ Security search notice board at gangway and carrying out random search of persons and their belongings
- ✓ Checking identification of all persons boarding vessel and maintaining a visitor's log and gangway log
- ✓ Having hawse pipes covered/ rat guards in place /fire wires are greased and safely secured preventing use as means for unauthorised access
- ✓ Cranes/ hoisting gears manned when in use, else raised or secured
- ✓ Liaise with PFSO for Identification and control of stevedores
- ✓ Keeping all external entrances to accommodation, E/R, escape routes are secured
- ✓ Ensuring all other access points including weather deck openings, stores etc. are secured
- ✓ Maintaining a key control log

Security level 2

In addition to procedures of security level 1

- ✓ Limiting the number of access points to the vessel
- ✓ All visitors boarding vessel escorted
- ✓ Frequency of searches Increased
- ✓ Cross checking purpose of visit by supporting documents
- ✓ Checking boarding personnel photo ID cards
- ✓ Restricting area on the shore side, for embarkation checks when required

Security level 3

In addition to procedures of security level 2

- ✓ In close co-operation with those responding to the security incident or threat and the port facility, the measures undertaken including the following
  - Restricting to only one single access point entry
  - Thorough search of all personnel boarding vessel & belongings (100%)
  - Escorting all personnel needing to board

- Additional personnel to guard/patrol designated areas for search of persons
- Suspend embarkation/disembarkation, cargo operations, stores when directed

b) Monitoring ship security

Security level 1

- ✓ Patrolling ship's deck and access points
- ✓ Using ships lighting in port /anchorage at night & reduced visibility
- ✓ Monitoring quayside and water side areas visually.
- ✓ At sea using lighting consistent with safe navigation.
- ✓ Ensuring adequate illumination at authorized access point

Security level 2

In addition to procedures of security level 1

- ✓ Increasing frequency of patrol & additional persons for security lookouts.
- ✓ Increasing coverage and intensity of lighting
- ✓ Liaising with shore side and waterside patrols if provided by port facility
- ✓ Carrying out full or partial search of the vessel

Security level 3

In addition to procedures of security level 2

- ✓ In close co-operation with those responding to the security incident or threat and the port facility, the undertake measures including the following :
- Increasing number of assigned personnel for security and frequency of patrols to ensure continuous monitoring.
- Using spot lights and floodlights to enhance the visibility of the deck and surrounding areas
- Using lighting to enhance the visibility of surrounding waters
- Carrying out full or partial search of the vessel if required

c) Cargo handling

Security level 1

- ✓ Security measures applied in liaison with the port facility
- ✓ Checking cargo, cargo transport units and cargo spaces prior to and during cargo operations
- ✓ In close co ordination with the port facility verifying the integrity of the cargo to ensure that there has been no tampering.
- ✓ 5-20% of items / packages to check randomly for signs of tampering
- ✓ Vehicles subjected to search (5-20%) prior loading
- ✓ Securing all cargo holds on completion of cargo.

Security level 2

In addition to procedures of security level 1

- ✓ Increasing verification and checking of cargo, cargo transport units through
- ✓ Increasing in frequency and detail of visual and physical examination;
- ✓ Increasing checks of cargo spaces.
- ✓ Increasing frequency and detail in checking of seals or other methods used to prevent tampering (25-50%)
- ✓ In liaison with the port facility increasing search of vehicles (25-50%)

Security level 3

In addition to procedures of security level 2

- ✓ In close co-operation with those responding to the security incident or threat and the port facility, the measures undertaken may include the following :
- ✓ Continuously conduct visual and physical examination of the cargo.
- ✓ Check seals of all containers for tampering.

d) Stores handling

Security level 1

- ✓ Confirming that the stores have been ordered by, or on behalf of the ship.

✓ Carrying out documentary check of the stores / unaccompanied baggage's /bunkers presented for delivery to ensure stores/bunkers match the order prior to being loaded on board;
✓ Ensuring immediate secure stowage of ship's stores / unaccompanied baggage's to prevent tampering.

Security level 2

In addition to procedures of security level 1

✓ Physical, visual and documentary check prior to receiving stores / unaccompanied baggage on board.
✓ When bunkering, bunker manifold to be kept manned at all times.

Security level 3

In addition to procedures of security level 2

✓ In close co-operation with those responding to the security incident or threat and the port facility, the undertaking measures including the following :
- Subject ship's stores / unaccompanied baggage's to thorough checking by conducting continuous visual and physical examination of the ship stores.
- Restrict or suspend or refuse handling of ship's stores / unaccompanied baggage's /bunkers if required;

e) Restricted areas

All the restricted areas on board the ship are identified in accordance with the ship's SSP. Normally the restricted areas include:

✓ navigation bridge
✓ machinery spaces of category A
✓ other control stations as defined in chapter II-2 of ISPS code
✓ crew accommodation
✓ spaces with access to potable water tanks, pumps, or manifolds
✓ spaces containing security and surveillance equipment and systems and their controls and lighting system controls
✓ ventilation and air-conditioning systems spaces and other similar spaces
✓ cargo spaces and spaces containing ship's stores
✓ spaces containing cargo pumps and their controls
✓ spaces containing dangerous goods or hazardous substances
✓ any other areas as determined by the CSO, through the SSA to which access must be restricted to maintain the security of the ship

The duties and procedures for monitoring restricted areas at various security levels are as follows:

Security level 1

✓ Marking all restricted areas
✓ Securing / patrolling restricted areas
✓ Sealing FW filling pipes.
✓ Ensuring securing arrangement in place for spaces containing hazardous substances. (Paint locker, Oxy-acetylene room, chemical lockers etc.)
✓ Spaces containing emergency equipment should be accessible
✓ Securing cargo hatches when not in use, patrolled when open
✓ Reporting unauthorized entry / breach to SSO

Security level 2

In addition to procedures of security level 1

✓ Additional personnel patrolling restricted areas periodically
✓ Increasing frequency of patrolling restricted areas
✓ Establishing restricted areas adjacent to authorized access point.
✓ Securing areas that are not already secured at security level 1

- ✓ Sealing lifeboats

Security level 3

In addition to procedures of security level 2

- ✓ In close co-operation with those responding to the security incident or threat and the port facility, the measures undertaken include the following
  - Additional persons continuously patrolling restricted areas & adjacent areas
  - Setting up additional restricted areas adjacent to access points
  - Setting up additional restricted areas in proximity to the security incident or believed location of the security threat
  - Searching of the vessel to include restricted areas
  - Continuous manning of engine room and bridge

4) Carrying out search for stowaway, narcotics, explosives or other contraband items

- ➢ A thorough search of the ship must be carried out for stowaway, narcotics, explosives or other contraband items prior to departure each port, particularly from the final port of each country visited and rounds repeated immediately after departure, especially from countries with a high incidence of stowaways.
- ➢ A log entry must be made stating the time of the search, the personnel involved in the search, and its outcome.
- ➢ Regarding contrabands and drugs, it is recommended to carry out a search of the ship prior to arrival in each port. The department heads usually coordinate for a simultaneous search, the result of which are recorded in the drugs and contraband log maintained on board. The contraband search shall be carried out in all probable areas including cabins, companionways, toilet and showers, deck housing, lifeboat storage compartments, deck storage rooms, engine room, cofferdams, galleys and stewards' stores etc.
- ➢ For carrying out a thorough search of the ship for narcotics, stowaways, explosives or any other contraband items suspected to be on the vessel, a ship specific checklist is provided in the SSP. This shall be referred to when conducting such a search. Additional precaution as in the case of search for an explosive may be required as advised in the SSP. The checklist is drawn in the format mentioning the area of the ship to be searched and the designated persons for conducting search there. Once the search is completed, the checklist is completed and signed by persons responsible.
- ➢ The checklist is completed by the SSO and duly signed by all. This is to be given to master prior departure every port. Log entry of search is to be made in the deck log book.

5) Sample of ship specific search checklist

ACCOMMODATION BLOCK

A - NAV. BRIDGE DECK OR 6TH DECK

1. Wheelhouse/Chartroom ( )
2. Transformer Room ( )
3. Toilet ( )
4. Lift Emergency Exit - Ext. ( )
5. Safety Store - Ext. ( )
6. Nav. Bridge Deck Front & Aft-Ext. ( )
7. Stairs & Compass Deck - Ext. ( )

B - CAPTAIN'S DECK OR 5TH DECK

1. Captain's Cabin + Bedroom + Toilet ( )
2. C/O's Cabin + Bedroom + Toilet ( )
3. 2/ E Cabin + Bedroom + Toilet ( )
4. Ch Eng's Cabin + Bedroom + Toilet ( )
5. Fire Fighting Station (216) ( )
6. Alleyway, Stairs & Exit (P&S) ( )
7. Store (221) – Ext. ( )

C - OFFICER DECK OR 4TH DECK

1. Stationery Locker ( )
2. Pilot Cabin + Toilet ( )
3. 2/0 Cabin + Toilet ( )
4. 3/E Cabin + Toilet ( )
5. Telephone Station ( )
6. Electric Distribution ( )
7. Fire Fighting Station ( )
8. E/O Cabin + Toilet ( )

D - 3RD DECK

1. Locker ( )
2. Bosun Cabin + Toilet ( )
3. Owner Cabin + Toilet ( )
4. C/Cook Cabin + Toilet ( )
5. Bonded Store ( )
6. Treatment Room ( )
7. Fire Fighting Station ( )
8. Hospital Room + Toilet ( )
9. Fitter Cabin + Toilet ( )
10. Super Cargo Cabin + Toilet ( )
11. Locker ( )
12. Electric Distribution ( )
13. Alleyway, Stairs & Exit (P&S) ( )
14. Store (425) – Ext.

E - CREW DECK OR 2ND DECK

1. Messman Cabin + Toilet ( )
2. Engine Lab ( )
3. M/M II Cabin + Toilet ( )
4. AB I Cabin + Toilet ( )
5. Locker ( )
6. AB III Cabin + Toilet ( )
7. Locker ( )
8. Cadet Cabin + Toilet ( )
9. Locker ( )
10. Electric Distribution ( )
11. Fire Fighting Station ( )
12. AB IV Cabin + Toilet ( )
13. Locker ( )
14. AB II Cabin + Toilet ( )

SEARCH TEAMS

OVERALL INCHARGE OF DECK AND ACCOMODATION : CHIEF OFFICER
OVERALL INCHARGE OF ENGINE ROOM : CHIEF ENGINEER.

TEAM	AREA OF SEARCH	SEARCH -PATTERN .
TEAM 1: Incharge : Duty Officer AB-1 &AB-2.	Main Deck , Fore peak Area, Cofferdams & Stores Oustide Accomodation & Life boats(2).	Forward to Aft. Simultaneously on port And stbd
TEAM 2: Incharge : Bosun AB-3 & AB-4.	Tunnels and Holds	Forward to Aft Simultaneously on port And stbd
TEAM 3 : Incharge :Chief Cook GS	Bridge , Accomodation & Stores inside Accomodation	Top to Bottom
(Note :--- Team 1 will comply additionally with Team 3 Duties Form 1900 hrs To 0700 hrs)		
TEAM 4: Incharge : 2 / Engineer E/Off , Fitter , MM-1	Engine Room and Steering Gear Room.	Bottom to Top
TEAM 5 : Incharge : Duty Engineer MM-2 & MM-3	Engine Casing , E/Rm Stores & Funnel	Top to Bottom

REMARKS: ______________________________
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SEARCH CARRIED OUT BY :

NAME : ______________________	RANK : CHIEF OFFICER
NAME : ______________________	RANK : DUTY OFFICER
NAME : ______________________	RANK : BOSUN
NAME : ______________________	RANK : CHIEF COOK
NAME : ______________________	RANK : CHIEF ENGINEER
NAME : ______________________	RANK : SECOND ENGINEER
NAME : ______________________	RANK : DUTY ENGINEER
On Passage from ______________________	To ______________________

PORT : ______________________
DATE : ______________________
TIME : ______________________

Master / Ship Security Officer

PORT: DATE :

Declaration
All officers and crew signing this declaration acknowledge having carried out a search of the areas designated to them, including their individual cabins, and that no narcotics, stowaways, explosives or any other contraband items were found during the search.

NAME	RANK	SIGNATURE
....	**Master**	....
....	**Chief Officer**	....
....	**2nd Officer**	....
....	**3rd Officer**	....
....	**Ch. Engr**	....
....	**2nd Engr**	....
....	**3rd Engr**	....
....	**4th Engr**	....
....	**El.Offr**	....
....	**6th Eng**	....

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. Refer to your ship's security plan and list the actions to be taken to comply with level 2 security.
2. The vessel is going to transit a piracy area after 48 hours. What is the role of the ship security officer and what precautions will be taken under his supervision to prepare the vessel for the transit?