Guide to Chief Mates oral examination

Special thanks to,

- **Capt. Rangith Perera**
- **Mr. Thilak Wickramasingha**
- **Capt. Aruna Kothalawala**
- **Mr. A.G.D.C Abeynayake &**
- **Students who guided me to compile this document**

Compiled by
Shane Sankaranarayana

Dear Students,

Following points shall be kept in your mind when reading this booklet:

- In writing this booklet, mostly concentrated on Chief Officer's duties, but, in some areas, some additional information is added, if considered reasonable.
- Mostly, the practical aspects are covered, and theories are not explained unless it is deemed necessary.
- Please refer the IMO, ILO, WHO, IACS, Classification Society, P & I club web sites and update yourself with the latest amendments to Conventions and Codes.
- Please refer the DGMS web site and update yourself with the latest amendments to the Sri Lankan Legislation and latest MSNs.
- Refer the latest case studies apart from the cases listed in this booklet.
- You are also required to have a good knowledge of what you have leant under all the subjects.
- You are also required to refer all the publications with regards to cargo operations and onboard safe practices such as IMDG Code, EmS Guide, MFAG, IMSBC Code, BLU Code, Timber Code, Grain Code, IS Code, ISGOTT, IBC Code, IGC Code, Thomas Stowage, Code of safe working practices for merchant seamen etc. to ensure that you are very confident in using them.
- Be very familiar with the use of stability booklets, damage control plan, damage stability book, cargo securing manual, paint manual, ballast water management plan, garbage management plan, ship security plan, ship's drawing, STS operations manual etc.
- In this guide I have used information obtained from MSN and MGN issued by MCA, UK. Keep in your mind, that such MSN & MGN are applicable on UK registered vessels only, unless similar practices are adopted by other flag states as well. But mostly I have used internationally adopted standard practices, international Conventions and Codes.

Wish you all the best!

Shane Sankaranarayana NDT (SL), BTEC (UK), MSc (UK), LLM (UK)
Head of Department,
Department of Navigation,
CINEC Campus,
Malabe,
Sri Lanka.
www.cinec.edu

ISBN 978-624-96669-0-0

23rd November 2020

Contents

DUTIES & RESPONSIBILITIES OF A CHIEF OFFICER

Authority

The chief officer is the second in command onboard and he shall take over the command of the vessel if the master is incapacitated until the company appoints a new master.

The chief officer is responsible for the following duties and in addition to that shall comply with any other duties delegated or instructed or ordered by the master in a professional order.

Responsibilities

1. Maintenance

The chief officer shall ensure the maintenance of the following areas / items are planned and executed in accordance with the PMS and the same is recorded:

a) Maintenance & cleanliness of outside of accommodation.
b) Maintenance of hull.
c) Maintain the cleanliness & upkeep of areas within the accommodation spaces excluding the engine room and CO_2 room.
d) Maintenance and cleanliness of the main deck, poop deck and forecastle deck.
e) Deck gears – cargo gears, cargo hold opening / closing devices, pilot hoists, gangways, deck lifters (on car carriers), ramps (on car & ro-ro carriers), provision crane etc.
f) Forward & aft mooring gears including the windless.
g) Pump room (on tankers).
h) Ballast tanks & freshwater tanks.
i) Cargo spaces.
j) Cargo securing devices.
k) Storerooms belongs to the deck department.
l) Weekly & monthly tests of LSA equipment.
m) Weekly & monthly maintenance, thorough examination, operational testing, overhaul and repairs of all types of lifeboats rescue boats and fast rescue boats, launching appliances and on-load and off-load release gears shall be conducted under the direct supervision of the chief officer.
n) Weekly & monthly tests of FFA equipment.
o) Maintenance of cargo lashing materials.

He may take advices and support of the engine staff when deem necessary.

He also responsible to prepare dry dock list in cooperation with the chief engineer when requested by the superintendent.

The chief officer is responsible for ordering and maintaining the stocks of stores and spare parts necessary for the deck department in accordance with the SMS.

2. Training

Chief officer is responsible for the training of the deck cadets in accordance with the company SMS and customary practices of the trade.

He also responsible for training the junior deck ratings and junior deck officers to enhance their performances.

3. Record keeping and reporting

The chief officer must ensure:

- records of maintenances and repairs are maintained.
- weekly, monthly, annual tests of the LSA & FFA recorded and reports forwarded to the company.
- the work and rest hours of the persons in the deck and catering departments are maintained and documented.
- the accidents, near misses and non-conformities are reported and actions taken to rectify them.
- the Master is informed any matter that will have an impact on the safety, pollution prevention and security.
- garbage record book, biofouling record book, ballast water record book and oil record book part II (on tankers) are maintained.
- any problems and are reported to master with regards to safety, security and pollution prevention.

4. Safety Officer (if the company has appointed chief officer as safety officer)

The chief officer is the Safety Officer onboard and he/she shall;

- implement and maintain safety culture onboard;
- ensure appropriate PPE is used in onboard operations and sufficient stocks are maintained.
- conduct safety meetings;
- conduct risk assessments and take preventive measures;
- plan & conduct safety, security and pollution prevention drills under the supervision of the master;
- carryout investigations into near misses & accidents and take corrective and preventive actions;
- inform the master in case of non-conformities observed.

5. **SSO (if the company has appointed chief officer as SSO)**

Chief officer is the Ship Security Officer (SSO).

Chief officer is responsible for maintaining ship's security equipment and reviewing the Ship Security Plan.

The chief officer shall report any breach of security to the Company Security Officer (CSO).

If the chief officer is not the SSO, he/she shall assist the Ship Security Officer (SSO) in reviewing the Ship Security Plan and shall report security related incidents to the SSO.

6. **Pollution prevention**

The chief officer shall implement the company's pollution prevention policy and shall be responsible for the;

- ballast water management;
- garbage management;
- biofouling management
- maintenance of SOPEP (in case of a tanker, SMPEP)
- If the vessel is a tanker chief officer will be responsible for the management of cargoes in accordance with the MARPOL Annex I or II as well

7. **Cargo Operations and ship's stability**

The chief officer shall;

- plan and conduct safe loading and discharging operations;
- plan and conduct safe ballasting and de-ballasting operations;
- ensure the vessel is complying with stability requirements and the hull stresses are within the limits as appropriate to the operational area of the vessel;
- segregate and stow IMDG cargoes in accordance with the IMDG Code;
- secure the cargoes in accordance with the vessel's Cargo Securing Manual;
- maintain the records of temperatures, manage spare parts and maintains records of spare parts of reefer containers;
- make damage reports in case of cargo or ship damage during cargo operations.

8. Catering department

The chief officer shall ensure;

- that the galley, cool room, provision room are clean and in hygienic condition;
- the provisions are segregated and stowed in accordance with the company's instructions;
- personal engage in food preparations are maintaining their cleanliness and hygiene;
- the company's best practices are utilized in food preparation;

9. Watchkeeping and manoeuvring

Unless changed by the master, the chief officer shall conduct 0400 hrs to 0800 hrs and 1600 hrs to 2000 hrs watches at sea and at anchorages. He shall relieve the master when the master is at the con or carrying out manoeuvring duties when requested by the master.

10. Medical Officer

The chief officer is responsible for;

- managing the ship's hospital, medicines and equipment in accordance with the flag state requirements;
- maintaining the cleanliness and hygiene of the ship's hospital;
- issuing medicines and providing medical treatments for persons when necessary;
- keeping records of medical treatments given.

11. Efficiency management

The chief officer is responsible for enhancing the ship's efficiency by complying with the relevant areas of the SEEMP and instructions (with regards to efficiency management) given by the charterers.

<u>CHIEF OFFICER'S STANDING ORDERS AND INSTRUCTIONS</u>

Standing orders

Some companies may require making chief officer's standing orders to ensure proper guidance is given to his juniors with regards to safety, security and pollution prevention. Following is an example of such standing orders.

Standing orders means permanent and written orders given to junior officers and which are applicable permanently. Junior officers are required to read and sign these orders. They shall get clarifications from chief officer if required before signing.

SMS should specify where to write standing orders. Mostly, chief officer's standing orders to be written in 'Port Logbook' or 'Cargo Logbook' or 'Chief Officer's Standing Orders/Instructions Book'.

The company may require taking approval from the master before standing orders are issued.

The chief officer shall at least address the following in his standing orders with regards to cargo operations;

- Operation of cargo gears;
- Cargo stowage;
- Cargo securing arrangements and cargo securing material management;
- Stowage and handling of IMDG cargoes and reefer containers;
- Ballast water operations;
- Bilge water management;
- Operation of cargo hold closing devises;
- Management of mooring integrity;
- Maintenance of the gangway watch;
- Handling of spare parts and provisions when received;
- Bunkering operations;
- Safety, fire and security rounds;
- Ship to shore and internal communications;
- Handling of emergencies;
- Occasions when the chief officer to be called.

Instructions

Instructions means temporary measures that the chief officer may expect from his junior officers in different occasions. As an example, temporary measures to be applied in a specific port, where as Standing orders will be applied in all the ports.

Chief officer may issue instructions when deemed necessary with regards to safety, security and pollution prevention measures. The company SMS will state where to write instructions, but again it could be in the same document where the standing orders are issued.

The junior deck officers shall read and sign these instructions before taking over the watch at port.

SHIP'S SURVEYS AND CERTIFICATES

1) Categories of certificates

- **'Certificate' or 'Permanent Certificate' or 'Full term certificate'**

  This is a certificate issued after the successful completion of an initial or a renewal survey or when all deficiencies which led to the issuance of a conditional certificate are corrected. A permanent/full term certificate is valid until the next periodical/renewal survey is due[1].

- **Interim Certificate**

  This is issued by an attending surveyor after the successful completion of an initial or renewal survey until the full-term certificate is received on board. Usually, this is valid for a period of 5 months.
  Remember, interim certificates are also issued under the following Codes and Conventions are as well;
  - ISM Code
  - ISPS Code and
  - MLC 2006

  But, these 03 interim certificates are issued for a different purpose. i.e., to continue sailing until the full-term certificates are issued AFTER COMPLYING WITH CERTAIN REQUIREMENTS, such as;
  - In the case of ISM Code – a vessel has to undergo an initial audit during the validity period of the interim SMC to issue a full-term SMC
  - In the case of MLC 2006 – a full inspection shall be carried out during the validity of the interim MLC to issue a full-term MLC.
  - In the case of ISSC – a vessel must undergo an initial verification and need to have approved SSP before a full term ISSC is issued

  The validity periods of Interim Certificates issued in accordance with the above Code & Conventions are as follows;
  - Interim DOC (ISM Code) – 12 months
  - Interim SMC (ISM Code) – 06 months
  - Interim ISSC (ISPS Code) – 06 months
  - Interim MLC (MLC 2006) – 06 months

[1] IACS, *Duties of Surveyors under Statutory Conventions and Codes*, 2016, p. 1

- **Interim Certificate of Class (or Interim Class Certificate)**

  This certificate is issued by the Classification Society immediately upon completion of the entry survey of the vessel to enable it to trade while the report of the classification survey is processed by the Class. The validity period depends upon the Classification Society[2].

- **'Conditional Certificate'**

  This is issued by an attending surveyor when deficiencies exist which cannot be corrected in the port of survey. A conditional certificate is valid only for a period long enough to permit the ship to proceed to the port where the correction will be made. Some administrations require these certificates to be called as "Short Term certificates"[3].

- **Provisional certificate**

  The term 'provisional certificate' is not defined internationally. But, most of the countries issue 'provisional certificates' when vessels to be registered in their registers. It is a temporary certificate of registry which allows the shipowners to complete the required formalities before entering into the permanent registry. The validity period depends upon the requirements of the flag as shown below:
    - Singapore – 12 months
    - Australia – 06 months
    - Sri Lanka – 06 months

  Some flag states allow to extend the provisional certificate & some flags does not. In accordance with the Sri Lankan regulations, no extensions granted.

  At the same time, with regards to statutory certification, classification societies "may issue a provisional certificate with a maximum validity of five months for the period as deemed necessary, before a full-term certificate is issued"[4]. This is similar to the interim certificates described above.

- **Exemption certificate** (excluding the Ship Sanitation Control Exemption Certificate issued under International Health Regulations)

  An Exemption is a permanent release from compliance with a Statutory Convention requirement due to the existence of specific circumstances as sanctioned by the provisions of that Convention. The 'Exemption Certificate' is linked to, and retained with its associated statutory certificate, and is issued by the Recognized Organization (OR) issuing that certificate

[2] IACS, Procedure for transfer of class, 2019, p. 3
[3] ibid
[4] https://www.classnk.or.jp/hp/pdf/Rules_Guidance/publish/370_statutorycertificates_e_2018.pdf, p. 5

under authorization from the DGMS (flag state). Authorization for issuance of an Exemption Certificate is considered on a case by case basis formed on the existence of some measure of equivalency to meet the intent of the requirement being exempted and a recommendation from the (RO)[5].

Exemptions may be granted in accordance with SOLAS and load line conventions.

In most occasions, the validity period of an exemption certificate would be similar to the validity period of the corresponding normal certificate, except in few situations as mentioned below;

Example –

- International Load Line Exemption Certificate will be issued if a coasting vessel needs to undertake a single international voyage in an exceptional circumstance. Remember, in this case, the duration of the certificate will be only to complete the single voyage only.

No exemption certificates are granted under MARPOL, MLC 2006, Ballast water management Convention, ISPS Code and ISM Code. Remember, there could be exemptions granted under MLC 2006 and the Ballast water management Convention, but, no separate 'exemption certificates' required.

- **Dispensation Letter (dispensation certificate)**

A temporary allowance granted in writing (Dispensation Letter) by the DGMS (flag state) to permit a ship to proceed without being in full compliance with a specific Convention requirement due to mitigating circumstance preventing the immediate rectification of the subject deficiency. Dispensations are issued with time specific corrective action requirements, compliance with which are reportable to the Administration by the expiration date[6].

Dispensation Letters are issued with a specific term limit of validity-either for a single voyage, or for a set period of time, and are generally limited to the minimum period of time necessary for the ship to reach a port where rectification of the deficiency can be accomplished[7].

Examples –

- Dispensations for 2nd mate when chief officer is not available as required by the minimum safe manning certificate.

[5] MSN 27/2016, DGMS, Sri Lanka
[6] Ibid
[7] Ibid

- When one ECDIS is out of order and if it cannot be repaired at the present port, a dispensation will be issued, until the next port where the ECDIS can be repaired provided the back-up ECDIS is working in order.

Examples for dispensations for seafarers;

Occasion issued	**Applicable Convention**	**Duration of validity**	**Application in Sri Lanka**
Lack of DSD certified people to carryout security related duties in accordance with SSP	STCW	30 days	Yes
No certified persons to carryout duties of SSO	STCW	30 days	No
Lack of an officer or an engineer in accordance with the minimum safe manning document	STCW	06 months	Yes
No master or chief engineer, but **only in circumstances of force majeure**	STCW	Shortest period	Yes
No certified cook	MLC 2006	30 days	Yes

- **Certificate of equivalent competency (CEC)**

  Unlike the above categories of certificates, this is issued to the seafarer, not to the vessel. Seafarers, who are not holding COCs issued by the ship's flag administration, are required to obtain a certificate of equivalent competency and validity period is not beyond the validity period of the original COC. In some administrations this is called as Certificate of Recognition (COR).

2) <u>Statutory certificates and trading certificates</u>

There are no any internationally recognized definitions for these terms. But, when considering the meaning of the terms, statutory certificates mean certificates that are required to be carried onboard in compliance with the regulations of the flag state. Trading certificates mean certificates that are not required by the statute of a flag state but, required by certain trades or organizations or charterers etc.

But, some flag states categorize all the certificates that are required to be carried on board according to their regulations as trading certificates.

Statutory certificates may include the following depending upon the flag state regulations:

a) Irrespective of the type of the cargo carried onboard, following certificates to be carried on board:

- Certificate of Registry
- Certificate of Class (if the flag state requires to class a vessel)
- Dispensation Certificate (if and when applicable)
- Crew Accommodation Certificate or Crew Accommodation Exemption Certificate
- Ship Sanitation Control Exemption Certificate/Ship Sanitation Control Certificate
- Ship's medical chest certificate
- International Tonnage Certificate (1969)
- International Load Line Certificate or International Load Line Exemption Certificate
- Minimum safe manning Certificate
- International Oil Pollution Prevention Certificate
- International Sewage Pollution Prevention Certificate
- Safety Management Certificate
- International Ship Security Certificate (ISSC) or Interim International Ship Security Certificate
- International Anti-fouling System Certificate
- International Air Pollution Prevention Certificate
- International Energy Efficiency Certificate
- International Ballast Water Management Certificate
- 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 liability for the removal of wrecks

b) In addition to above (a), cargo ships may carry:
- Cargo Ship Safety Construction Certificate
- Cargo Ship Safety Equipment Certificate
- Cargo Ship Safety Radio Certificate
- Cargo ship Safety Certificate (this will replace the above three certificates)
- Exemption certificate if applicable (an exemption certificate issued under any of above four certificates will not replace the original applicable certificate. The exemption certificate (if issued) is to be carried onboard along with the applicable original certificate)

c) In addition to above (a), passenger ships may carry:
- Passenger Ship Safety Certificate
- Special Trade Passenger Ship Safety Certificate
- Special Trade Passenger Ship Space Certificate
- Certificate of insurance or other financial security in respect of liability for the death of and personal injury to passengers

d) In addition to above (a), oil tankers may have:
    - Certificate of insurance or other financial security in respect of civil liability for oil pollution damage

e) In addition to above (a), chemical tankers may carry:
    - International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk (NLS Certificate)
    - Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk or International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk **OR**
    - International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk

f) In addition to above (a), gas tankers may have:
    - Certificate of Fitness for the Carriage of Liquefied Gases in Bulk **OR**
    - International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk

g) In addition to above (a), ships trading in Polar areas may have:
    - Polar Ship Certificate

Refer 'list of certificates and documents required to be carried on board ships, 2017' (or the latest version)

Trading certificates may include the following:

- Suez Canal certificate
- Panama Canal certificate
- Certificate of Class (when there are no flag state requirements to class a vessel)
- Certificates that are required by the port states to have onboard while entering such ports, but not required by the ship's flag state

3) <u>Types of surveys</u>

There are various types of surveys that need to be carried out in accordance with various IMO instruments to issue or maintain certificates required for a ship. These surveys may be called as statutory surveys as well. At the same time, the class of a vessel also may carryout similar types of surveys, but those are for the purpose of issuing / maintaining of certificate of class. There could be slight deviations between the statutory surveys and class surveys. Brief description of surveys required by IMO instruments are briefly describe below [as provided in IMO Resolution A. 1104(29)].

a) Initial survey

A strict survey carried out before a vessel is put into service to ensure the vessel is complying with the requirements of the relevant convention/code are complying with.

b) Annual survey

This is a survey carried out within +/- 03 months of the anniversary date of the relevant certificate. A general inspection will be carried out to ensure that the relevant equipment or applicable areas have been maintained and remain satisfactory for the service.

c) Intermediate survey

This is a survey carried out within 03 months before or after the second anniversary date or within 03 months before or after the third anniversary date. This is an inspection of specified items relevant to the applicable certificate and will be similar to an annual survey.

d) Periodical

Periodical surveys are required under cargo ship safety equipment certificate and cargo ship safety radio certificate only.
In the case of cargo ship safety equipment certificate, periodical survey is carried out within 03 months before or after the second anniversary date or within 03 months before or after the third anniversary date and this will be having a scope similar to an annual survey.
In the case of cargo ship safety radio certificate, periodical survey is to be undertaken with 03 months before or after each anniversary date. This is also has a similar scope as an annual survey.

e) Renewal survey

This is same as a periodical survey but also leads to the issue of a new certificate.

f) Inspection of the outside of the ship's bottom

This is an inspection of the underwater part of the ship and related items to ensure that they are in a satisfactory condition and fit for service.

For cargo ships, two inspections of the ship's bottom to take place out of the water within any five-year period, and at intervals of not exceeding 36 months (in accordance with the Cargo ship safety construction certificate). This is further explained under the heading of dry docking below.

On the passenger ships the inspection of the ship's bottom to be carried out annually, but, two inspections within any five-year period are to take place out of the water at intervals not exceeding 36 months.

4) Validity periods of certificates & required surveys

Certificate	Validity period	Annual	Periodical	Intermediate	Renewal
Certificate of class	05 years	+/- 3 months the anniversary date		+/- 3 months of the 2nd or 3rd anniversary date	Within 3 months before the date of expiry
Certificate of registry	UK - 05 years[8] Sri Lanka – 04 years[9]				Need to apply for a new certificate before expiry
International Tonnage Certificate	No expiry date (terminated if flag is changed)				
Passenger ship safety certificate*	01 year				Renewal survey, +/- 3 months of anniversary date
Cargo ship safety equipment certificate*	5 years	+/- 3 months the anniversary date	+/-3 months of the 2nd or 3rd anniversary date		Within 3 months before the date of expiry
Cargo ship safety radio certificate	5 years		+/- 3 months of each anniversary date		within 3 months before the date of expiry
Cargo ship safety construction certificate*	5 years	+/- 3 months of each anniversary date		+/- 3 months of the 2nd or 3rd anniversary date	within 3 months before the date of expiry
Cargo ship safety certificate***	5 years	+/- 3 months of each anniversary date	+/-3 months of the 2nd or 3rd anniversary date (periodical or Intermediate)	+/- 3 months of the 2nd or 3rd anniversary date (periodical or Intermediate)	within 3 months before the date of expiry
International Load line certificate*	05 years	+/- 3 months of anniversary date			within 03 months before the date of

8 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/799033/2019_April_A_Guide_to_Registration_V4.pdf. P. 5

9 http://www.dgshipping.gov.lk/web/images/pdf/handbook_for_shipowners.pdf. P. 4

					expiry
Interim DOC**	12 months				
DOC*	05 years	+/- 3 months before or after each anniversary date			Before the date of expiry
Interim SMC	06 months				
SMC**	05 years			between the 2nd & 3rd anniversary dates	Before the date of expiry
IOPP Certificate*	05 years	+/- 3 months of anniversary date		+/- 3 months of 2nd or 3rd anniversary date	within 03 months before the date of expiry
International pollution prevention certificate for the carriage of Noxious Liquid Substances in bulk*	05 years	+/- 3 months of anniversary date		+/- 3 months of 2nd or 3rd anniversary date	within 03 months before the date of expiry
International sewage pollution Prevention Certificate*	05 years				within 03 months before the date of expiry
Engine International Air Pollution Prevention Certificate*	No expiry date (this is required to get IAPP)				
International Air Pollution Prevention Certificate*	05 years	+/- 3 months of anniversary date		+/- 3 months of 2nd or 3rd anniversary date	within 03 months before the date of expiry
International Energy Efficiency Certificate*	No expiry date (terminated if flag is changed)				
IGC/GC*	05 years	+/- 3 months of anniversary date		+/- 3 months of 2nd or 3rd anniversary date	within 03 months before the date of expiry
IBC/BCH*	05 years	+/- 3 months of anniversary date		+/- 3 months of 2nd or 3rd anniversary date	within 03 months before the date of expiry
Minimum safe manning Certificate	Valid until change of flag or change of equipment or structural or operational conditions which affect manning level				
Interim International Ship Security Certificate	06 months				
International Ship	05 years			between 2nd & 3rd	within 06 months

Security Certificate**				anniversary dates	before the date of expiry
Interim Maritime Labour Certificate[†]	06 months				
Maritime Labour Certificate[†]	05 years			between the 2nd & 3rd anniversary dates	before the date of expiry
International Ballast Water Management Certificate*	05 years	+/- 3 months of anniversary date		+/- 3 months of 2nd or 3rd anniversary date	within 03 months before the date of expiry
Polar ship certificate*	Cargo – 5 years Passenger – 1 year	Cargo ships – Aligned with Cargo ship safety certificate or Cargo ship safety construction certificate Passenger ships – Renewal survey – annually			
Ship Sanitation Control Exemption Certificate (SSCEC) Ship Sanitation Control Certificate (SSCC)	06 months	**Notes** • SSCEC is issued when the no health risks are found onboard. • SSCC is issued when health risks are found, and actions taken to rectify the matter. • SSCEC may be extended for a period of one month until the ship arrives at a port			

Notes

***Initial Survey** is required to be carried out before the ship is put into service
**** Initial Audit** is required to be carried out
***** Cargo Ship Safety Certificate –** This certificate covers the requirements of the following certificates:

- Cargo Ship Safety Radio Certificate,
- Cargo Ship Safety Equipment Certificate
- Cargo Ship Safety Construction Certificate

[†] **Initial Inspection** is required to be carried out

5) <u>Load line certificate</u>

Condition of Assignment

There are certain conditions to be met with, prior to issuing a load line certificate at the completion of the construction of a vessel and they are known as Conditions of Assignment. In brief, Condition of Assignment ensures that:

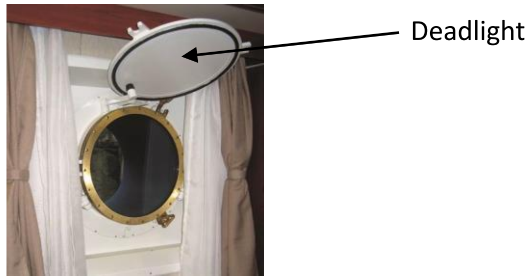
- she has sufficient reserve buoyancy
- decks are high enough for the crew to carryout operational and navigational activities
- safe access and safe working conditions available onboard
- she complies with structural strengthening requirements
- she complies with watertight and weather tight requirements

Equipment, areas and documents comes under Load Line Certificate

- Approved stability book (comes under SAFCON as well)
- Approved loading manual (loading & discharging sequences) for tankers & bulk carriers – comes under SAFCON and IOPP surveys as well.
- Document of authorization for the safe carriage of grain
- Record of conditions of assignment
- Approved stability calculation equipment (comes under SAFCON as well)
- Hatch ways and hatch coamings
- Portable beams used for closing holds & their securing arrangements
- Pontoons
- Cleats
- Cargo ports (openings in the ship side but below the freeboard deck for the purpose of loading / discharging) & their securing arrangements)
- Watertight & weather tight openings (testing of operation of watertight doors comes under SAFCON as well)
- Machinery space openings
- Ventilators
- Sounding pipes
- Scuppers
- Side scuttles (port holes below the free board deck and enclosed supper structures) and their securing arrangements including dead lights
- Freeing ports (water draining ports on raised decks)
- Gangways / accommodation ladders
- Guard rails / gunwales

Preparation for a load line Survey

- Ensure the former findings are rectified.
- Keep the stability information ready.
- Ensure the testing of stability computer is carried out in accordance with the flag state regulations and records available.
- All sounding pipes, vent pipes, must be provided with closing/opening devices, with permanently attached and in operating condition.
- Ensure all the watertight doors can be closed watertight (free of cracks, rubber beadings in good condition, rubber beadings are not painted, hinges greased, handles greased etc).
- Make sure the portholes are rust free and the rubber beadings are not painted and are in order. All the cabins on the weather deck and below the weather deck should have portholes with dead lights (a steel or aluminium lid, refer the picture below). These dead lights also must be rust free and must have rubber beadings.



(Source - https://www.wartsila.com/encyclopedia/term/porthole-port-light-sidescuttle)

- Ensure the hatches can be closed watertight. The cleats, rollers, wedges should be in good working condition. Water draining system on the hatch coaming must be in good order. The rubber gaskets in the pontoons should be in good condition.
- If required, a hose test can be tried out on the pontoons to ensure the watertight integrity is maintained.
- Check whether the booby hatch covers are working properly.
- Ensure the non-return valves on overboard discharging is in good condition.
- Check the scuppers and freeing ports for any blockages.
- De-rust and paint load line marks & draught marks.
- Guard rails and bulwarks should be in good condition and rig lifelines if required.
- Ensure the accommodation ladder/gangway is in order and the pilot ladders are in good condition.
- Keep ready the keys for storerooms, stairways etc.
- Generally, ensure the ship is watertight below and on main deck, and weather tight above main deck.

Generally, these are maintained as per the "Planned Maintenance Schedule". It is advisable to commence preparation at least 3 to 4 months before the expected survey date and use the 'survey checklist' issued by the vessel's classification society.

Method of carrying out chalk test

Chalk test is done on hatch covers as well as weather tight doors onboard. Apply chalk on the compression bar (the steel plate which will be compressed by the rubber beading) on the hatch covers or on the weather tight doors and close them properly with hatch cleats, the tightening screws or available securing methods. Immediately open them and check the rubber beading, if unbroken, regular, even and firm chalk mark is present, the closing device can be considered as weather tight.

Method of carrying out hose test

This method is usually used for testing the weather tightness of hatch covers. The hatch covers to be well secured with its securing devices such as cleats etc. A water jet with a pressure of not less than 200 Kn/m^2 is aimed at the seams of the hatch covers from a distance of about 1 m away from the seam. Usually, the water from the fire line is used for this purpose. One surveyor will monitor the application of the water pressure from the deck and another surveyor will observe any leakages from inside the holds. Hold considered as weather tight if no water leaking is found.

Method of carrying out light test

This method is also used for testing the weather tightness of hatch covers. This must be done when good sun light is available or with a strong torch light. Close down the holds as mentioned above, and the surveyor will observe for any penetration of light from inside the hold.

Method of carrying out ultrasonic test

This method is also used for testing the weather tightness of hatch covers. Close down the holds as mentioned above. An ultrasonic wave generator will be kept inside the hold and a wave receiver will be moved along the seams of the hatch covers. If any small openings are available, this can be detected by a digital indicator connected to the wave receiver.

6) Cargo Ship Safety Equipment Certificate

Form E

This form includes the safety equipment which are required to be carried onboard for the purpose of issuing the Cargo Ship Safety Equipment Certificate and the numbers of such equipment to be carried onboard.

Documents and equipment come under Cargo Ship Safety Equipment Certificate

- Nautical charts
- Nautical publications
- International code of signals
- IAMSAR Manual Volume III
- Deviation record book
- Approved fire control plan
- Approved lifesaving appliances plan

- Muster lists
- Records of LSA & FFA maintenances
- Records of fire drills, boat drills, enclosed space & recovery drills, emergency steering gear drills,
- New joiner's emergency familiarization check lists
- SOLAS training manuals (LSA & FFA)
- Certificate for pilot ladder
- Pilot ladder maintenance records

Preparation for Cargo Ship Safety Equipment survey

Ensure that:

- the former findings are rectified.
- the above-mentioned documents and records are properly maintained and available onboard.
- **hard copies** of the **International Code of signals** and **IAMSAR Manual Volume III** are onboard.
- lifeboat, it's equipment, securing arrangements and lowering / heaving up devices are in order.
- inflatable life rafts have been serviced within the last 12 months and ensure the hydro-static release unit is in order.
- survival craft portable radio equipment is in order.
- the life buoys, MOB markers, life jackets, immersion suits, pyrotechnics, SART (SART comes under Safety Radio Certificate as well) are in order.
- the bridge equipment such as BNWAS, rate of turn indicators, rudder indicators, RPM/pitch indicators, echo sounder, speed logs, GPS, VDR, LRIT, AIS, ARPA, radars, ECDIS, back up arrangements for ECDIS, azimuth circle, gyro compass, magnetic compass, navigational lights etc. are in working order.
- signals (cylinder, black balls, diamond) are in order.
- the charts and publications are corrected and up to date.
- communication system with bridge & emergency steering is in order (this comes under SAFCON Certificate as well).
- the fire control plans are posted and is legible.
- the fire dampers, sky lights are in working order.
- the fire/smoke detection system, fire pump including the emergency fire pump, fire hoses, nozzles, fixed firefighting system, fireman's outfits, BA set, portable and non-portable fire extinguishers are in order.
- no accumulation of oil in exhaust ventilation system in the galley.
- pilot transfer arrangements are properly maintained.

7) **<u>Cargo Ship Safety Construction Certificate</u> (SAFCON)**

Documents come under SAFCON certificate

- Ship's manoeuvring diagram and manoeuvring booklet
- Record of emergency steering gear drills (comes under load line as well)
- Approved ship's stability book (also comes under load line certificate)
- Approved loading manual (loading & discharging sequences manual) for tankers & bulk carriers – comes under load line and IOPP surveys as well.
- Approved damage stability book and damage control plan – comes under the IOPP survey as well
- Approved cargo securing manual.
- Emergency towing procedure
- Enhance survey reports file (for oil tankers, chemical tankers and bulk carriers)
- Material safety data sheets (MSDS)
- Ship structure access manual (for oil and bulk carriers)
- Coating technical file

Preparation for the survey

Ensure that:

- the former findings are rectified.
- above mentioned documents and records are available & maintained.
- all certificates and documents are available & valid
- enhanced survey report and evaluation reports are onboard
- stability calculations, damage stability calculation methods and damage control plans are readily available
- cargo securing manual is approved and available
- ship structure access manual is on board (for oil tankers and bulk carriers)
- the coating technical file is onboard and proper records maintained (if applicable)
- MSDS (Material Safety Data Sheets) are available
- records of manning & unmanning of engine room are entered in the logbook
- ship's manoeuvring information is available on the bridge and the manoeuvring booklet is onboard
- emergency towing arrangements are readily available (comes under ISM audit as well)
- testing of emergency steering carried out, drills are conducted and evidence available
- the auxiliary steering arrangements are in order
- compass or heading indicator in the emergency steering gear room indicates the correct heading
- communication between bridge and emergency steering gear room is in order (this comes under Safety Equipment Certificate as well)

- bridge rudder angle indicators are in order
- anchoring & mooring arrangements properly maintained, and any restrictions / warnings marked and in operational condition
- collision bulkhead is damage free
- bilge pumps operating in order
- cargo hold bilge alarms in order
- all the watertight doors can be properly operated, locally and remotely
- all fire doors are working order
- openings on the shell plating below the free board deck is in working condition
- water draining systems are in order, in vehicle spaces where fixed water spraying is used as firefighting medium
- emergency escapes are in order and properly marked
- no new materials containing asbestos are installed
- ship's identification mark is permanently marked and clearly apparent
- if over 5 years of age – prepare ballast tanks for inspection
- if over 10 years of age – prepare selected cargo spaces for inspection (tankers only)
- if over 15 years of age – prepare selected cargo spaces for inspection (dry cargo ships only)
- spark arresters on the ventilators to the bunker tanks are in order
- the remote hold ballast and dry space water level indicators are in good condition
- no any structural changes are done without class approval

Additionally, on tankers make sure (most of the following comes under the IOPP surveys as well):

- cargo tank pressure / vacuum valves are in good condition
- cargo tank venting, purging and gas freeing systems are in working order
- COW system is in order
- stripping systems are in working order
- pump room ventilation system is in good order
- emergency lighting in the pump room is in good condition
- prepare the pump room for inspection (no loose gear, no leaks, no combustible material, access ladders in good condition etc.)
- the pressure gauges on the cargo discharging lines are in good order

8) Cargo Ship Safety Radio Equipment Certificate

Form R

The "Form R" lists the;

- minimum number of persons required to operate the vessel's radio installation,

- required equipment to be carried onboard &
- methods used to ensure the availability of radio facilities such as:
  - Duplication of equipment
  - Shore based maintenance
  - At sea maintenance capability

Preparation for the safety radio survey

Ensure that:

- the former findings are rectified
- the radio licence is valid
- the latest editions of ITU publications are onboard
- the operating procedure manuals of the radio equipment are onboard
- the ship's call sign, ship station identity which requires for the radio station are posted
- proper entries are made on the GMDSS record book
- DSC equipment, radiotelephony, MF radio installation, MF/HF radio installation, direct printing telegraphy, INMARSAT ship earth station, NAVTEX, EGC receiver, EPIRB, SART (SART comes under Safety Equipment Certificate as well) etc. are working in order
- the batteries are not expired in the equipment such as EPIRB, SART etc.
- the daily, weekly, monthly etc. testing of equipment are recorded
- the GMDSS battery room is ventilated
- GMDSS back-up batteries are properly maintained and records available
- sufficient illumination is available at the radio installation
- sufficient spare parts and tools are available

9) International Oil Pollution Prevention Certificate

Form A & Form B

IOPP certificate is supplemented with **"Record of construction and equipment for ships other than oil tankers" (Form A)** and **"Record of construction and equipment for oil tankers" (Form B)**. As the name of the form suggests, it contains constructional features and equipment that she is required to carry to eliminate / control pollution by oil. Among other things, this includes;

- Whether the vessel is permitted to carry ballast water in fuel oil tanks under normal conditions or not
- List of equipment available onboard to control discharge from machinery space bilges and fuel oil tanks
- List of equipment available onboard to control discharge from cargo pump room bilges and cargo oil tanks

- Details of oil filtering equipment with alarm and automatic stopping device manufacturer, type of filters used, type of stopping device)
- Details of oil discharge monitoring and control equipment
- Approval standards (IMO resolution numbers of the required standards) of the oil filtering equipment and oil content metre
- Identification of tanks used for the storage of **oily bilge water**
- Identification of tanks used for the storage of **oil residues (sludge)**
- Whether a SOPEP is onboard or SMPEP is onboard

Preparation for an IOPP survey

Make sure that;

- an approved damage stability calculation book is available
- calibration certificates of the oil filtering equipment are available
- the oil filtering equipment is working in order
- onboard bulk carriers and tankers need to have CAS (Condition Assessment Scheme) Statement of Compliance and CAS Final report

On oil tankers ensure that:

- oil record book Part – II is correctly maintained
- proper means of communication between the deck watchkeepers and the cargo control room is available
- the stripping system is working in order
- with regards to the oil discharge monitoring equipment;
    - make sure it is working in order
    - the operating and maintenance manual is available
    - the equipment is calibrated and certificate available
    - type approval certificate is available
    - audible and visual alarms and the equipment is working in order

- the segregated ballast tanks and dedicated clean ballast tanks are oil free
- an approved STS (Ship To Ship) operation plan onboard (if applicable)
- the loading condition and intact stability book is approved and available (comes under load line and SAFCON surveys as well)
- damage stability calculation software is onboard and working in order and it's document of approval is onboard. If not, shore based damage stability calculation facility shall be available.
- slop tanks and it's piping arrangement to be in order
- UTI are working in order

- with regards to COW systems:
  - COW operational manual is approved and onboard
  - Ensure sufficient number of operational drive units are available as specified by the manual
  - system must be working in order
  - no leaks on the system
  - over pressure release unit on the pumps used for COW are operational
  - pressure test the system with working pressure

- that updated SOPEP is onboard
- remotely operated and manual valves which need to be kept closed at sea are in operational condition
- no leaks on ballast pipes passing through cargo tanks and cargo pipes passing through ballast tanks

10) <u>Preparation for ISM audit</u>

Documents and records

Ensure that;

- the former findings are rectified.
- SMS manuals are the latest versions, revisions are properly recorded, the filling system is in accordance with the SMS and all documents are controlled in accordance with the SMS.
- the SMS is updated in accordance with the latest amendments to the international conventions.
- notices & updates sent by the company are read by the applicable staff and it must be signed by them.
- all statutory certificates are in order and copies displayed as required by the flag state.
- the vessel is manned in accordance with the minimum safe manning certificate, the seafarers are complying with the certification requirements (depending upon type, size, trade of the vessel and the rank the seafarers) and all have a valid medical certificate.
- the official, deck & other required logbooks (such as ballast water logbook, garbage log book, GMDSS log book, Oil record book Part II etc) must be in order, up to date and statements/data which are required to be entered in accordance with the SMS are entered in the log books.
- operating manuals & drawings of equipment & ship are on board.
- all officers & crew are familiar with the relevant areas of the SMS manuals and signed as an evidence for understanding it.
- all officers & crew are familiar with company policies.
- all maintenance records are updated.
- the QMS reviews being conducted & sent to office.
- internal and external audit records are on board and corrective actions taken.
- a copy of the valid DOC is on board.

- the records of drills are up to date.
- reporting to the company are made in accordance with the SMS.
- latest editions of nautical publications, charts & IAMSAR Manual (Volume III) and notices to mariners available.
- the watch schedules are posted.
- the master has frequently issuing standing orders and night orders.
- LSA & FFA training manuals are onboard and updated accordingly.
- the posters which are required by the SMS (Eg – steering change over procedure, instructions with regards to lookout etc), garbage management plan etc. correctly displayed.
- muster lists are updated, and the crew is aware of their duties.
- IMO symbols of life jackets, lifeboats, rafts, escape routes, muster stations etc are displayed and clearly visible.
- the donning instructions of life jackets, immersion suits etc. are clearly visible.
- operating instructions for emergency generator, fire pump, steering, fixed firefighting systems, remote stops, lifeboat/life raft launching etc must be clearly displayed.
- the applicable check lists are used during the operation of the vessel.
- the records of permit to work systems and risk assessments are available.
- an emergency towing booklet is onboard - (comes under SAFCON survey as well)
- all records of inspections, repairs, tests of lifeboats and launching devices to be signed by the person who carried out the work and counter signed by company representative or master.
- emergency contact list is available.
- SOPEP or SMPEP is available depending upon the type of the vessel

Safety & environment protection

Ensure that;

- closing appliances, LSA & FFA maintained
- escape routes are clear from obstacles
- hull, deck and accommodation areas are maintained properly.
- all ventilation flaps are marked with open/close positions and they are identified. Ensure that they are fitted with flame screens and the dip trays are cleaned with plugs connected.
- the SOPEP equipment is in order and inventories are updated.
- a permit to work system is used when required.
- a risks assessment is carried out before commencing any work.
- work & rest hours are being complied with.
- unannounced blood alcohol tests are carried out on seafarers who do watches.
- maintenances of lifeboats and launching appliances are done in accordance with the manufacturer’s instructions and under the direct supervision of a senior officer (in most companies, under the direct supervision of the Chief Officer).
- correct PPEs are used by onboard personnel for duties as appropriate.

Navigation, bridge equipment and procedures

Ensure that;

- passages are planned from berth to berth.
- bridge equipment is tested in accordance with the SMS and manufacturer's instructions.
- bridge equipment is maintained in order.
- passage plans are used, and all officers have signed it, to ensure that they have read it.
- proper methods of position fixing are used as appropriate.
- the safety information received are regularly checked (Eg – NAVTEX, EGC, weather faxes etc)

Cargo Operations

Ensure that;

- the pollution prevention requirements are complied with.
- cargo handling is carried out in accordance with the SMS which includes;
  - ✓ use of cargo plans are for loading and unloading.
  - ✓ use ballasting / de-ballasting sequence plans.
  - ✓ use of cargo lashing plans

Calibration of measuring and testing equipment

Ensure that;

- calibration kits for portable gas measuring instruments are available and calibration records available as well.
- testing of equipment onboard is carried out in accordance with the PMS and manufacturer's instructions.

Accident/Incidents/Near misses

Ensure that;

- All accidents/incidents/near misses are documented, and company is informed.
- corrective actions are taken, based on the incident's root cause analysis.

Training

Ensure that;

- LSA & FFA training manuals are read by all staff and signed.
- Trainings are conducted according to the company's training matrix and training records are available on board.
- records of CBT provided and use of Safety videos are maintained.

- ensure onboard familiarization is given to all staff.
- type specific ECDIS training is provided to the master and to all navigation officers
- all are aware of the DPA and the role of him/her
- training on cargo handling is given as appropriate

11) <u>Preparation for ISPS audit</u>

Ensure that:

- former audit findings are rectified.
- the copy of the DOC is valid, and the latest CSR is available.
- the name and address of the company on SSP, DOC, SMC and CSR are the same.
- the SSO is qualified (having the SSO certificate).
- an approved SSP is available and any amendments approved.
- procedures are available to review and update the SSP periodically.
- records of periodical reviews of SSP are available.
- record of information for last ten ports and DoS are available.
- records of internal audits and inspections available.
- reports of security incidents are available.
- the security related duties are assigned, and the staff is aware of their duties and SSO is known by all the staff.
- security policy and security procedures are known by all the persons.
- trainings and drills conducted according to the SSP and records available onboard.
- actions to be taken in case of breach of security are known by all persons.
- the SSP is protected from unauthorized access.
- procedures available to respond to security threats or breaches of security.
- procedures for evacuation in case of security alerts are available.
- reporting procedures available.
- records of security related communications with flag state and ports are readily available.
- CSO and the contact numbers are known by all persons.
- measures are available to prohibit unauthorized access to the vessel.
- measures are available to prevent taking dangerous substances and devices onboard.
- measures are available to prohibit unwanted items coming onboard along with cargoes and ship stores.
- the required procedures at the access points to the vessel are complied with and gangway security log is maintained.
- the handling of cargoes, ship's stores are monitored.
- restricted areas identified and measures available to prohibit unauthorized access.
- procedures to follow in all levels of security are available.
- list of security equipment and their locations available.

- security equipment is tested, calibrated and in working order.
- make sure SSO is well aware of the duties of SSO which will include but not limited to
  - ✓ how to carryout security assessment.
  - ✓ how to plan and carry out inspections, audits, searches, security drills etc.
  - ✓ how to operate security equipment
  - ✓ operational limitations of security system.
  - ✓ Position and operation of security alert system

12) <u>Ballast water management survey</u>

Ensure that;

- an approved ballast water management plan is onboard and make sure that the local ballast water management requirements (local requirements of the vessel's trading areas – Eg. Intra-North Sea voyages) are attached to the appendix of the plan.
- a ballast water record book is onboard.
- in case of using D – 2 standards (treatment facilities)
  - ✓ a type approved certificate;
  - ✓ manufacturer's operating manuals;
  - ✓ installation commissioning procedures;
  - ✓ calibration procedures;
  - ✓ past calibration records are available;
  - ✓ sufficient spares for the equipment; and
  - ✓ the equipment is maintained in accordance with the manufacturer's instructions and records for the same are onboard

- an officer in charge of ship's ballast water is appointed (mostly, the chief officer) and all persons (including the said officer) who are engage in ballast water management shall be trained and be well aware of the ballast water operations.
- the ship's ballast water and sediments are managed and the local requirements in the vessel's trading areas are complied with in accordance with the ballast water management plan.
- correct entries are entered in the ballast water record book, officer in charge of the ballast water has signed each entry and the master has signed each completed page.
- the records on the ballast water record book is available at least for last two years.
- the sampling points are available and clear of obstructions to take samples.
- enclosed space entry procedures are complied with when entering into ballast water tanks.

13) Harmonised System of Survey and Certification (HSSC)

The objective of the HSSC is to standardize the period of validity and the intervals between surveys for eleven certificates that need to be carried onboard to a maximum period of 05 years except for passenger ship safety certificate. The advantages of HSSC include:

- reduced number of surveys
- less workload on seafarers as the number of surveys are reduced
- reduction of costs
- reduced paperwork
- elimination of repetition of work as certain areas are surveyed more than in one survey as marked above in red colour under different surveys

Types of surveys under HSSC[10]

- **Initial survey** – before the vessel is put into service
- **Renewal survey** – leads to issue a new certificate, same as a periodical survey
- **Periodical survey** – inspection of the items as relevant to the certificate to ensure they are in a satisfactory condition & fit for service
- **Intermediate survey** – inspection of the specific items as relevant to the certificate to ensure they are in a satisfactory condition & fit for service
- **Annual survey** – general inspection to ensure applicable items are been maintained satisfactory for the service
- **Inspection of the ship's bottom** – to ensure the underwater part of the vessel & related items are in a satisfactory condition
- **Additional survey** – may be carried out after a repair & it could be a general or partial inspection

The harmonized system provides for[11]:

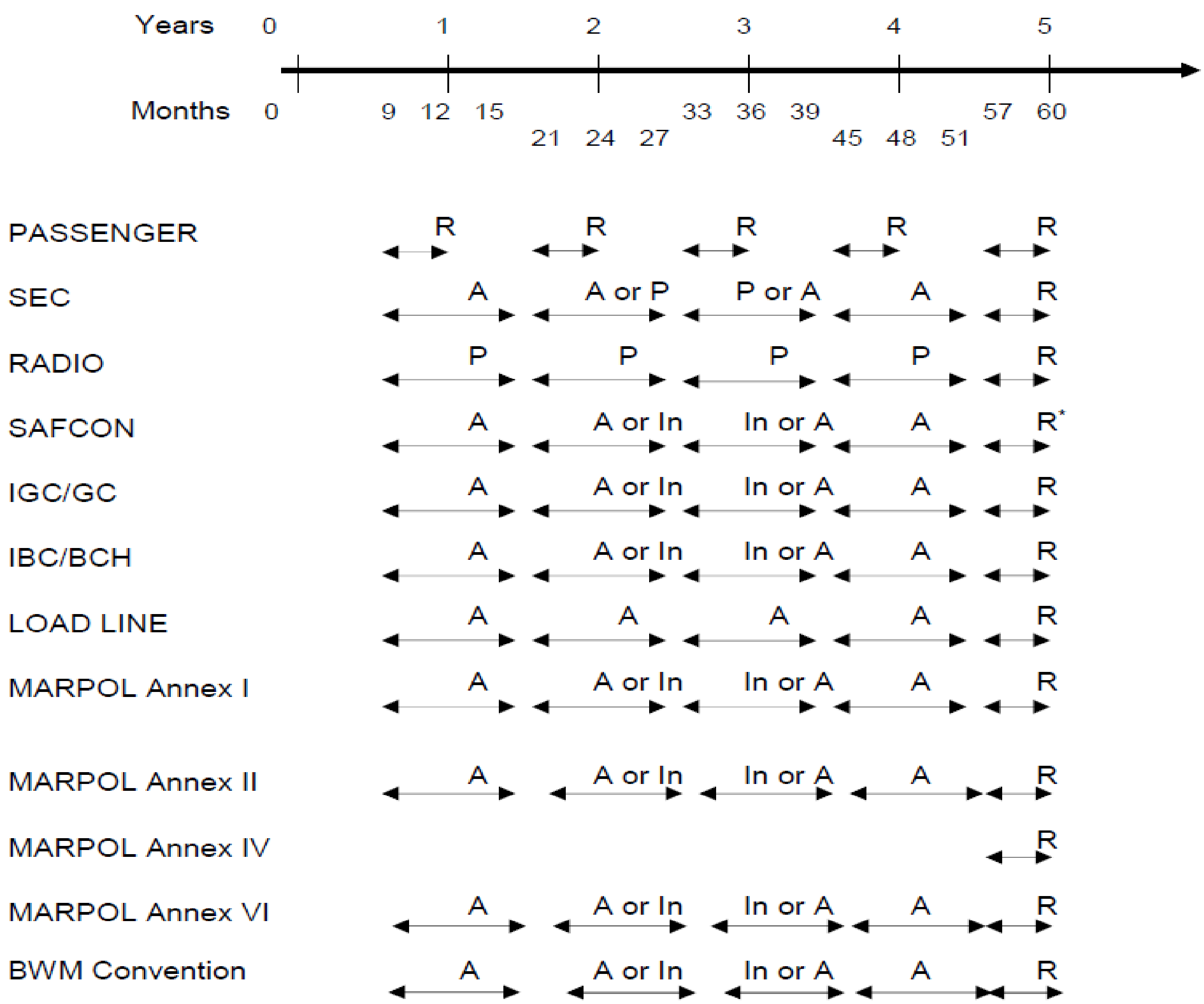
- a one-year standard interval between surveys, based on initial, annual, intermediate, periodical and renewal surveys, as appropriate, except for MARPOL Annex IV which is based on initial and renewal surveys;
- a scheme providing the necessary flexibility to execute each survey, with provision for:
  - completion of the renewal survey within three months before the expiry date of the existing certificate with no loss of its period of validity; and
  - a "time window" of six months – from three months before to three months after the anniversary date of the certificate for annual, intermediate and periodical surveys;
- a maximum period of validity of five years for all cargo ship certificates;

[10] Resolution A.1120(30), IMO
[11] ibid

- a maximum period of validity of 12 months for the Passenger Ship Safety Certificate;
- a system for the extension of certificates limited to three months, enabling a ship to complete its voyage, or one month for ships engaged on short voyages;
- when an extension has been granted, the period of validity of the new certificate starting from the expiry date of the existing certificate before its extension;
- a flexible system for inspection of the outside of the ship's bottom on the following conditions:
  - a minimum of two inspections during any five-year period of validity of the Cargo Ship Safety Construction Certificate or the Cargo Ship Safety Certificate; and
  - the interval between any two such inspections should not exceed 36 months;
- a Cargo Ship Safety Certificate under SOLAS 74/88, as an alternative to separate Cargo Ship Safety Construction, Cargo Ship Safety Equipment and Cargo Ship Safety Radio Certificates; and
- a flexible system concerning the frequency and the period of validity of certificates, subject to the minimum pattern of surveys being maintained.

Diagrammatic arrangement of the HSSC[12]

[12] Resolution A.1120(30), IMO



Code of types of survey:

R – Renewal
P – Periodical
In – Intermediate
A – Annual

---

* The cargo ship safety construction renewal survey may be commenced at the fourth annual survey and may be progressed during the succeeding year with a view to completion by the fifth anniversary date. The survey items of the fourth annual survey should not be credited to the completion of the renewal survey.

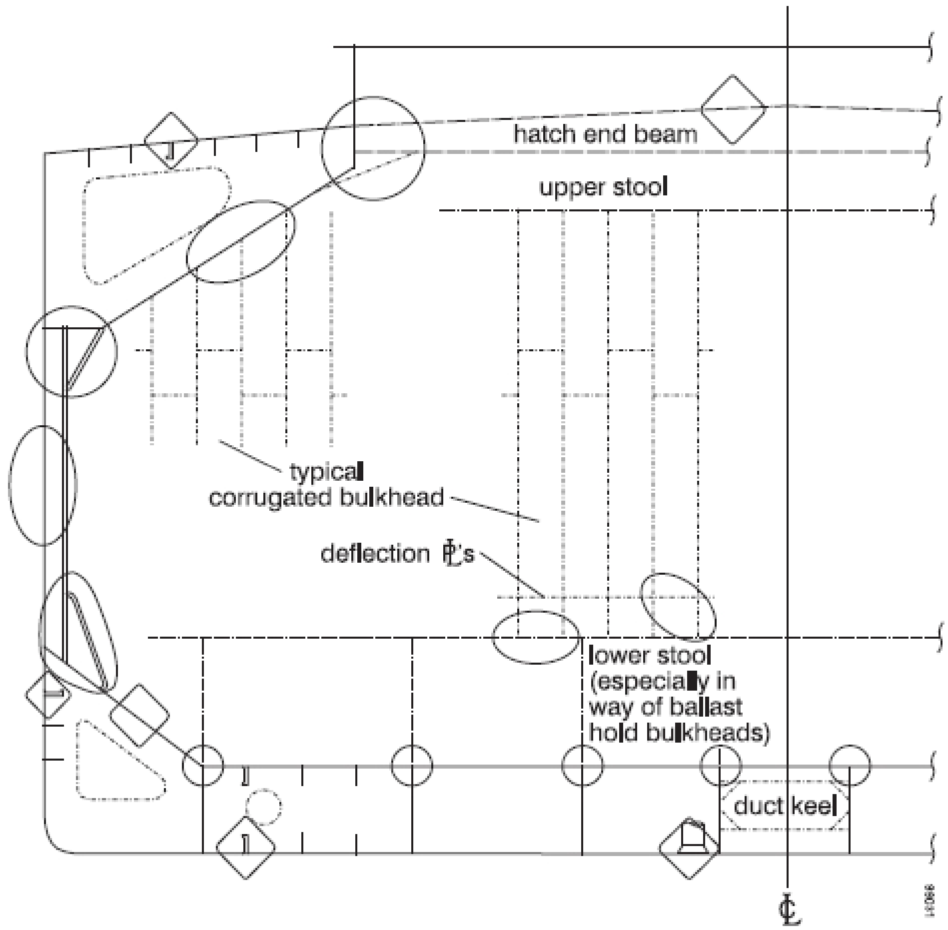
14) <u>Enhanced Survey Programme (ESP)</u>

In order to maintain a ship safety construction certificate, ships are required to undergo;

- Annual surveys,
- Intermediate survey,

- Renewal survey and
- Dry docking survey.

Even with this survey requirements, there were high number of bulk carrier and tanker losses due to various reasons, but mainly due to improper maintenance of these types of ships. As an example, considerable number the bulk carrier losses were due to structural failures. The ESP Code 2011 highlights the following locations as highly suspectable for corrosion damages and for structural failures.



Therefore, IMO came up with ESP to reduce these types of ships losses by adopting **Guidelines on the enhanced programme'1993 as amended** and the **ESP Code 2011**.

ESP is not a new type of a survey, but it lists down additional survey measures to be taken during the above mentioned surveys.

Application

Enhanced survey programme applies to the following types of vessels:

- Bulk carriers of 500 GT & above (single and double hull)
- Oil tankers of 500 GT & above (single and double hull)

ESP applies to the surveys of:

- hull structure
- piping systems in way of cargo holds (for bulk carriers),
- cofferdams,
- pipe tunnels,
- void spaces,
- fuel oil tanks,
- cargo compartments and their adjacent compartments
- all ballast tanks.
- piping systems in way of cargo tanks (for tankers),
- pump rooms (tankers)

The Code contains the minimum extent of examination, thickness measurements and tank testing. The survey should be extended when substantial corrosion and/or structural defects are found and include additional close-up survey when necessary[13].

A close-up survey means inspection of components at closer range, usually, within the reach of hand.

The ESP Code 2011, details areas (onboard) to be surveyed and how to be done during the Annual, Intermediate, Renewal and Dry-docking surveys under the Ship Safety Construction Certificate. The scope of the survey will extend depending upon the age of the vessel as well. As an example, refer the table below with regards to the close-up survey requirements of a renewal survey in cargo holds of bulk carriers.

[13] ESP Code 2011

Age ≤ 5 years Renewal Survey No. 1	5 < Age ≤ 10 years Renewal Survey No. 2	10 < Age ≤ 15 years Renewal Survey No. 3	Age > 15 years Renewal Survey No. 4 and subsequent
(A) 25% of shell frames in the forward cargo hold at representative positions (A) Selected frames in remaining cargo holds (B) One transverse web with associated plating and longitudinals in two representative water ballast tanks of each type (i.e. topside, or hopper side tank) (C) Two selected cargo hold transverse bulkheads, including internal structure of upper and lower stools, where fitted (D) All cargo hold hatch covers and coamings (plating and stiffeners)	(A) All shell frames in the forward cargo hold and 25% of shell frames in each of the remaining cargo holds including upper and lower end attachments and adjacent shell plating (A) For bulk carriers of 100,000 dwt and above, all shell frames in the forward cargo hold and 50% of shell frames in each of the remaining cargo holds, including upper and lower end attachments and adjacent shell plating. (B) One transverse web with associated plating and longitudinals in each water ballast tank (B) Forward and aft transverse bulkhead in one ballast tank, including stiffening system (C) All cargo hold transverse bulkheads, including internal structure of upper and lower stools, where fitted (D) All cargo hold hatch covers and coamings (plating and stiffeners) (E) All deck plating and under deck structure inside line of hatch openings between all cargo hold hatches	(A) All shell frames in the forward and one other selected cargo hold and 50% of frames in each of the remaining cargo holds, including upper and lower end attachments and adjacent shell plating (B) All transverse bulkheads in ballast tanks, including stiffening system (B) All transverse webs with associated plating and longitudinals in each water ballast tank Areas (C), (D), and (E) as for renewal survey No.2	(A) All shell frames in all cargo holds including upper and lower end attachments and adjacent shell plating. Areas (B)–(E) as for column 3

(A) Cargo hold transverse frame.
(B) Transverse web or watertight transverse bulkhead in water ballast tanks.
(C) Cargo hold transverse bulkhead platings, stiffeners and girders.
(D) Cargo hold hatch covers and coamings.
(E) Deck plating inside line of hatch openings between cargo hold hatches.
See sketches of appendix 3 to annex 8 for areas corresponding to (A), (B), (C), (D) and (E).
See also sketch in annex 15 for zones of side shell frames for ships subject to compliance with resolution MSC.168(79).

When it comes to;

- renewal surveys; and
- intermediate surveys for bulk carriers & tankers of 10 years of age or more;

the owner in cooperation with the Administration should work out a specific survey programme prior to the commencement of the said surveys. The survey programme should be in a written format and the survey should not commence until the survey programme has been agreed.

Number of surveyors

For bulk carriers (single skin and double skin) and tankers (both single hull and double hull) of 20,000 tons deadweight and above, two surveyors should jointly carry out the first scheduled renewal survey after the bulk carrier passes 10 years of age.

On single skin bulk carriers of 100,000 tons deadweight and above, the intermediate survey between 10 and 15 years of age should be performed by two surveyors.

15) <u>Vetting inspections</u>

The word ‘vet’ means a thorough inspection of something. Ship vetting started with the tanker industry and now used by charterers and also ship operators in the other trades as well for the purpose of ranking of ships. That means, vetting inspectors cannot pass or fail a ship but, they rate the vessel with regards to safety, environmental pollution, efficiency etc. vetting inspections may be undertaken by individual companies, terminal or recognized vetting organizations. Vetting organizations/foundations include:

- CDI (Chemical Distribution Institute) is a foundation which was created by the chemical manufacturing industry.
- SIRE (Ships Inspection Reporting Program) inspections are commissioned by the members OCIMF
- Rightship

Vetting is not a statutory requirement but is a commercial requirement. Some charter parties include a vetting clause. Preparation of a vessel for a vetting inspection, completely depend upon the objectives of the individual vetting organization. Therefore, ship staff shall adhere to the inspection check list issued by the respective vetting organization. Apart from that, following points shall be kept in mind when preparing a vessel for an inspection:

- Officers and crew to be well familiarized with their duties.
- Ship staff shall know the operation of various equipment used onboard.
- Ship staff shall know their duties during emergencies and the operation of emergency equipment.
- All shall be familiar with the relevant areas of the ship’s SMS.
- Maintain a good housekeeping onboard.
- Ensure all the records (logbooks, check lists and other documentary evidences) are correctly maintained and up to date.
- Make sure the maintenances onboard are carried out according to the ship’s PMS and the records for the same are correctly maintained.
- Fluency of the common language used onboard.
- Ship’s certification and the qualifications of the staff are appropriate and valid.

16) <u>CAP (Condition Assessment Programme)</u>

This is a non-mandatory, ship's condition assessment programme introduced by the classification societies for commercial purposes. CAP can be carried out on a vessel if it is requested by the ship owner or charterer.

Initially, CAP was used by the oil majors to differentiate old substandard vessels from old but good vessels. After the incidents of Erika and Prestige, CAP became very popular among the ship owners and the charterers.

CAP is generally applied on oil tankers, chemical tankers and bulk carriers, but, may be applied on other types of vessels after modifying the CAP.

A detailed assessment of a ship's actual condition, based on strength evaluation, and fatigue strength analysis as well as a detailed-on site systematic inspection of the hull, machinery and cargo systems can be obtained.

This programme covers:

- Assessment of the hull structure
- Assessment of the machinery and cargo systems

At the completion of the programme a vessel will be rated as below.

CAP 1 – Very good condition
CAP 2 – Good condition
CAP 3 – Acceptable condition
CAP 4 – Poor condition (below the minimum standards of the class)

The hull condition will be rated separately, and machinery/cargo systems will be rated separately.

After the completion of the CAP, the certificate of CAP indicating the ship's comprehensive rating (Overall Rating for CAP-HULL and/or CAP-MACHINERY / CARGO SYSTEM) is issued. Detailed assessment results and the relevant records are attached to the certificate of CAP. This certificate does not have an expiry date.

CLASSIFICATION SOCIETIES

The purpose of classification

The purpose of a Classification Society is to provide classification, statutory services and assistance to the maritime industry and regulatory bodies with regards to maritime safety and pollution prevention, based on the accumulation of maritime knowledge and technology[14].

Internationally, a class certificate is not required to be carried on board. A vessel may sail without a class certificate, but it is not commercially feasible. Therefore, most of the ship owners classify their ships. But the flag state may make it compulsory. As an example, to register a vessel in the Sri Lankan registry, the vessel has to be classified with an approved (approved by DGMS) recognized organization.

Classification societies are also known as Recognized Organizations or ROs as well.

Once a flag state accepts a classification society to act on behalf of them, it becomes a recognized organization for that flag state.

The advantages of classification

- Easier to obtain insurance with beneficial premiums.
- Re-sale value of a classified ship is higher than an un-classify ship.
- Some cargo policies require cargo to be shipped in classed vessels.
- Classed vessels guarantee that she meets statutory requirements, therefore it is an attraction to shippers.
- A large body of expert opinion is available during design and building of a vessel and also during vessel's service.
- Owner has an independent opinion on the standard of construction and maintenance of his vessel.
- Availability of local surveyors worldwide, therefore inspection of damages, repairs etc can be done easily.

International Association of Classification Societies (IACS)

There are about 50 classification societies around the world. Among them only twelve classification societies have the membership of IACS. The design, construction, maintenance standards of IACS

[14] Classification societies – what, why and how?, IACS, http://www.iacs.org.uk/media/3785/iacs-class-what-why-how.pdf

members are in a high quality than non IACS members. Therefore, the IACS members have a better reputation around the world.

Members of IACS

- ABS (American Bureau of Shipping)
- BV (Bureau Veritas)
- CCS (China Classification Society)
- CRS (Croatian Register of Shipping)
- DNV-GL
- KR (Korean Register of shipping)
- LR (Lloyd's Register)
- NK (Nippon Kaiji Kyokai)
- RINA (Registro Italiano Navale)
- RS (Russian Maritime Register of Shipping)
- IRS (Indian Register of Shipping) – the latest member
- PRS (Polski Rejestr Statkow)

Procedure of carrying out surveys in foreign ports where class surveyors are not available (this is a very common problem when a vessel is classed with non-IACS members)

The non IACS classification society can appoint an IACS member to carry out the required surveys, but this will be done according to the non IACS classification society standards. The results of the survey will be informed to the non IACS classification society, so that they can issue a certificate. Otherwise the IACS member will endorse the existing certificate but they will not issue a new certificate.

Dual classification

A dual class vessel is one which is classed by two Societies between which there is a written agreement regarding sharing of work, reciprocal recognition of surveys carried out by each of the Societies on behalf of the other Society and full exchange of information on the class status and survey reports.

ROs who do not have surveyors around the world may enter into dual classification with other ROs who have surveyors around the world. There are requirements implemented by IACS in relation to Dual classification.

Double classification

A double classed vessel is one which is classed by two Societies and where each Society works as if it is the only Society classing the ship and does all surveys in accordance with its own requirements and schedule.

There are requirements implemented by IACS in relation to Double classification.

The class will be suspended:

- When a ship is not operated in compliance with the class requirements
- When a vessel proceeds to sea with a less freeboard than assigned.
- When the owner fails to request a survey after having detected defects or damages affecting the class.
- When repairs, alterations or conversions affecting the class are carried out without requesting the attendance of a surveyor.
- When the class renewal, annual, intermediate and special surveys have not been completed by the end of the time period. (it will be suspended automatically)

The class will be withdrawn:

- If requested by the owners.
- If the class was suspended for more than 6 months.
- If the ship is reported loss.
- If the ship will not trade further as declared by her owners.
- If a vessel is reported as constructive total loss and the owner does not give his intentions to repair the ship for re-instatement of class.

After suspension or withdrawal of class, they will:

- Inform the owners, flag state and underwriters.
- Delete the vessel from their register.
- Convey the information to appropriate data bases (EQUASIS, SIReNaC etc)

<u>CONTENTS OF SHIP'S PLANS AND MANUALS</u>

1) **Dry docking plan** consists of:
   - distribution of blocks and shores. This is provided with the aid of longitudinal side elevations, transverse cross sections and plan views.
   - positions of the transducers of the echo sounders
   - positions of sea chests
   - positions bilge keels
   - positions of rudder & propeller

2) **Plug plan** (sometimes this is combined with the docking plan) consists of:
   - the locations of tank drain plugs located on the exterior of the hull

3) **General arrangement plan** consists of:
   - principle dimensions to check the required berthing space
   - information on ship's general particulars
   - locations of all the compartments including accommodation spaces. These are provided with the aid of longitudinal side elevations and plan views
   - passages to above compartments
   - drawing of each deck from the bridge deck to the bottom most deck containing spaces and the equipment on the decks. The mooring arrangements are provided on the forecastle deck and on the poop deck
   - some general arrangement plans also provides summarized information from other plans as well, such as positioning of bottom plugs, visibility diagrams etc.

4) **Rigging plan** consists of:
   - arrangement of all lifting appliances relevant to cargo operations.
   - with reference to derricks, cranes and union purchase:
     - Positions of guys
     - Resultant forces on blocks, guys, wire ropes and booms
     - Positions of blocks
     - Identification mark of individual items
     - Maximum and minimum distances the cranes and derricks can be used from it's base
     - Range of horizontal angles of the derricks and the cranes that can be used
     - Arrangements and working range of union purchase
   - Position & size of deck eye-plate
   - Size & SWL of blocks, booms, runners, topping lifts, shackles etc.

5) **Mooring arrangement plan** consists of:

- positions of winches, windlasses, fair leads, bollards and other equipment used for mooring purposes.
- arrangement of mooring ropes for mooring purposes
- plate thicknesses, arrangement and types of steel used in staging (seats of bollards and roller leads) used for roller leads, bollards
- angles of roller lead (if they are angled)
- SWL of the bollards, roller leads, fair leads etc.

6) **Midship section plan** consists of:

- scantlings of plates
- rise of floor
- longitudinal profiles

7) **Capacity plan** consists of:

- positions of all spaces used for cargo storing, fuel oil, ballast water, fresh water, sludge, waste oil, engine room bilge water, overflow oil, drain oil etc.
- volume of the above spaces
- maximum weights that can be occupied
- maximum free surface moments of spaces used to store liquids

8) **Tank arrangement plan** consists of:

- positions (by means of frame numbers and distances from aft) of fresh water, ballast, fuel oil and other tanks. These positions are provided with the aid of diagrams containing longitudinal side elevations and also plan views
- distances to above tanks from aft (LCG)
- capacities of the tanks
- vertical centres of gravities
- maximum free surface moments

9) **Shell expansion plan** consists of:

- position of keel the plate
- position the bilge keel (if available)
- position of the sheer strake
- bottom plates
- hull plates

- a numbering system of the bottom and hull plates. These plates are lettered (alphabetical letters) from the keel towards the sheer strake and numbered (numerical numbers) from aft to fwd for identification purposes. This is very important when identifying / reporting of the positions of plates which are damaged and need to be replaced.

10) Cargo securing manual consists of[15]:

- Include number, locations, type & MSL of the fixed cargo securing devices. A plan or list of such devices may be provided and shall have appropriate documents for each type of lashing device which includes name of manufacturer, simple sketch, material(s), identification marks MSL etc.
- Number, function and design characteristics of the portable cargo securing devices, including drawings or sketches. Appropriate documentation shall be available for each type of portable cargo securing device which shall include name of manufacturer, simple sketch, material(s), identification marks MSL etc.
- Inspection and maintenance schemes for the cargo securing materials.
- Stowage and securing methods of non-standardized and semi-standardized cargoes with illustrations.
- Stowage and securing of containers and other standardized cargoes with illustrations.
- Other allowable stowage patterns than mentioned above (thumb calculations)

11) Cargo Safe Access Plan (CSAP)

Ships which are specifically designed to carry containers should have a Cargo Safe Access Plan (CSAP). This plan should detail arrangements necessary for the conducting of cargo stowage and securing in a safe manner. It should include:

- handrails;
- platforms;
- walkways;
- ladders;
- access covers;
- location of equipment storage facilities;
- lighting fixtures;
- container alignment on hatch covers/pedestals;
- fittings for specialized containers, such as reefer plugs/receptacles;
- first aid stations and emergency access/egress;
- gangways; and
- any other arrangements necessary for the provision of safe access.

[15] MSC.1/Circ.1353/Rev.1, IMO

12) Ship Security Plan consists of:

- Measures to prevent use of weapon or other dangerous substances onboard against others.
- Identification of restricted areas
- Measures to prevent unauthorized access to ship as well as to unauthorized areas.
- Procedures for responding to security related incidents (threats, breaches etc.)
- Procedures to be followed during three security levels.
- Procedures for evacuation.
- Duties and responsibilities of on-board personnel.
- Procedures for auditing the security related activities.
- Procedures for security related training and drills.
- Procedures for updating the ship security plan.
- Procedures for interfacing with port facilities.
- Procedures for reporting security incidents.
- Identification of ship security officer and company security officer, including CSO's 24 hr contact details.
- Procedures & frequencies for testing, calibration and maintenance of security equipment.
- The location of the activating points of the ship security alert system.
- Procedures of using the ship security alert system.

12) Coating technical file (CTF)

This is applicable for **protective coatings in dedicated seawater ballast tanks** of;

- all type of ships of not less than 500 GT;
  - for which the building contract is placed on or after 1 July 2008, or
  - in the absence of a building contract, the keels of which are laid, or which are at a similar stage of construction on or after 1 January 2009, or
  - the delivery of which is on or after 1 July 2012

- double-side skin spaces arranged in bulk carriers of 150 m in length and upward

The inspection of surface preparation and coating process shall be agreed between the ship owner, shipyard and the paint manufacturer. Evidences of these inspections will be included in the CTF and it shall contain:

- copy of Statement of Compliance or Type Approval Certificate;
- copy of Technical Data Sheet (paint manual), including:
  - product name and identification mark and/or number;
  - materials, components and composition of the coating system, colours;
  - minimum and maximum dry film thickness;
  - application methods, tools and/or machines;

- condition of surface to be coated (de-rusting grade, cleanness, profile, etc.); and
- environmental limitations (temperature and humidity)

- shipyard work records of coating application, including:
  - applied actual space and area (in square metres) of each compartment;
  - applied coating system;
  - time of coating, thickness, number of layers, etc.;
  - ambient condition during coating; and
  - method of surface preparation

- procedures for inspection and repair of coating system during ship construction;
- coating log issued by the coating inspector, stating that the coating was applied in accordance with the specifications to the satisfaction of the coating supplier representative and specifying deviations from the specifications (example of daily log and non-conformity report)
- shipyard's verified inspection report, including:
  - completion date of inspection;
  - result of inspection;
  - remarks (if given); and
  - inspector signature

- procedures for in-service maintenance and repair of coating system.

The CTF shall be kept onboard throughout the life time of the vessel and will be issued by the ship yard. Following shall be recorded in the CTF:

- In-service maintenance,
- Repair
- Partial re-coating activities
- Full re-coating

13) Ship structure access manual

This applicable for;

- oil tankers of 500 GT & above and
- bulk carriers of 20,000 GT and more, which are constructed on or after 1 January 2005.

A ship's means of access to carry out overall and close-up inspections and thickness measurements shall be described in a Ship structure access manual **approved by the Administration**. The Ship structure access manual shall include the following for each space in the **cargo area**:

- plans showing the means of access to the cargo species

- plans showing the means of access within each cargo space to enable overall inspections and close-up surveys
- instructions for Inspection and Maintenance of Means of Access
- instructions for rigging and use of portable means of access
- inventory of portable means of accesses
- instructions for safety rafting (large tankers use rafts inside cargo tanks in partly ballasted conditions for close-up surveys)
- records of inspections and maintenances of the ship's means of access.

14) VOC (Volatile Organic Compounds) management plan

In accordance with the MARPOL Annex VI, **all the tankers carrying crude oil** shall have onboard an **approved VOC management plan**. This plan shall be available onboard before obtaining IAPP Certificate. Such a plan shall contain at least[16]:

- Identification of designated person responsible for VOC management.
- Duties and responsibilities of other people who are engage in VOC operations
- Training procedures of onboard persons
- Operation manuals of;
  - Volatile Emission Control System (VECS)
  - Vapour recovery system or any other VOC control system manuals;
  - Inert gas system;
  - Crude oil washing
  - Operations of P/V valves

- General arrangement plan.
- Capacity plan
- Cargo tank venting system piping diagram
- Inert gas system piping diagram
- VECS piping system
- Vapour recovery system or other VOC control system drawing

15) STS (Ship To Ship) Operations Plan

In accordance with the MARPOL Annex I any oil tanker involved in STS operations shall carry on board an **approved Plan** prescribing how to conduct STS operations (STS manual). Such a plan will contain;

- Names and ranks of responsible persons for STS operations.

---

[16] Volatile organic compound emissions from cargo systems on oil tankers, OCIMF, https://www.ocimf.org/media/115782/Volatile-Organic-Compound-Emissions-from-Cargo-Systems-on-Oil-Tankers.pdf

- Responsibilities of persons onboard who will be engaged in STS operations
- A STS transfer operations to be conducted under a designated Person in Overall Advisory Control (POAC) as required by MARPOL. This manual will list down suitable persons who can be designated as POAC including his/her qualifications and duties. POAC will be appointed with the agreement of Administration, cargo owners or oil tanker's operators. This manual will list down sample suitable persons who can be appointed as POAC, such as:
    - One of the masters of the vessels engage in STS operations; or
    - STS superintendent or
    - Lightering coordinator or
    - Mooring master employed by STS resource provider
- Information to be reported to coastal state before the commencement of a STS operation
- Criteria to be considered when selecting an area for STS operation.
- List of information that should be send to the vessels from the STS Service provider (STS organiser), so that the masters of the vessels can prepare their own vessels for the operation.
- Navigational warning to be broadcasted before and during the transfer operation to all ships.
- Actions to be taken in case of communication failures while manoeuvring for STS operations or during the STS transfer operations.
- Fender arrangements.
- Information regarding horses, pipe reducers, mooring equipment, lighting, ancillary equipment etc.
- Emergency signals and actions to be taken in case of an emergency.
- Guidelines for risk assessment.
- Information to be exchanged between ships.
- Guidelines for ship manoeuvrings for STS operations.
- Vessel's maximum and minimum free board heights.
- Guidelines for preparing for mooring operations.
- Pre-transfer procedures.
- Guidelines on planning the cargo transfer.
- Guidelines to be followed during the cargo transfer.
- When to suspend a cargo transfer.
- The Elimination of Electrical Current and Electrostatic Charge in Cargo Hoses
- Guidelines on the use of communication equipment, their transmitting aerials and other navigational equipment for the purpose of avoiding fire hazards.
- Guidelines for completion of the cargo transfer.
- Guidelines for unmooring operations.
- STS transfer check lists.
- Mooring arrangement plan.
- Tank capacity plan.
- Record of STS operations taken place.

16) Plans and procedures for recovery of persons from the water

The purpose of this document is to provide guidance for the master and other crew members on board the ship regarding procedures for recovering persons from water or from crafts in distress.

This document is to be kept onboard and maintained in accordance with SOLAS regulation III/17-1 and in order to achieve its purpose, crews on board should be familiar with this document. This contains;

- Responsibility of the master with regards to recovery operations
- Recovery process
  - ➢ Planning the whole recovery process which includes risk assessment.
  - ➢ Points to consider when bringing the vessel to the distress area
  - ➢ Methods to bring the distress people alongside the vessel
  - ➢ Identified rescue zones of the own vessel (areas where the distress people can be taken alongside of the own vessel for the purpose of recovering)
  - ➢ Methods of recovery when distress people are alongside. This may include;
    - ✓ Use of ladders including the accommodation ladder
    - ✓ Use of rescue boats
    - ✓ Use of cargo gears (if available)
    - ✓ Use of provision crane
    - ✓ Use of recovery net (if available)

  - ➢ Check list to be used in recovering distress people

- Actions to be taken when people can be recovered without putting own vessel in danger
- Taking care of the recovered persons.
- List of ship’s recovery equipment.

17) Others

Plans and documents which comes under pollution prevention measures (Example – SEEMP, Ballast water management plan, bio fouling management plane etc.) are discussed under the heading of ‘Pollution Prevention’ below.

RISK MANAGEMENT & ASSESSMENT ONBOARD

The ISM Code states, "Safety management objectives of the company should .... establish safeguards against all identified risks". Therefore, risk assessment is compulsory, and this is achieved through flag state regulations. Some flag states have provided general formats and procedures in risk assessment methods.

Ship management companies have their own methods (which of course comply with flag state requirements) of risk assessments. Therefore, the chief officers are required to have a good idea about the ship or company specific risk assessment process.

IMO defines risk as the combination of the frequency and the severity of the consequence. In simple terms, what it means is:

Risk = **severity of the consequences** x **likely hood of occurrences**

The following is an abstract obtained from the "A Guide to Risk Assessment in Ship Operations' published by IACS with regards to risk assessment onboard ships.

Risk management is defined as the process whereby decisions are made to accept a known or assessed risk and/or the implementation of actions to reduce the consequences or probability of occurrence[17].

A hazard is a substance, situation or practice that has the potential to cause harm. For the purpose of avoiding a hazard;

- it must be identified
- the risks associated with the identified hazard to be assessed
- the controls to reduce the risks that are deemed intolerable to be applied; and
- the effectiveness of the applied controls to be monitored

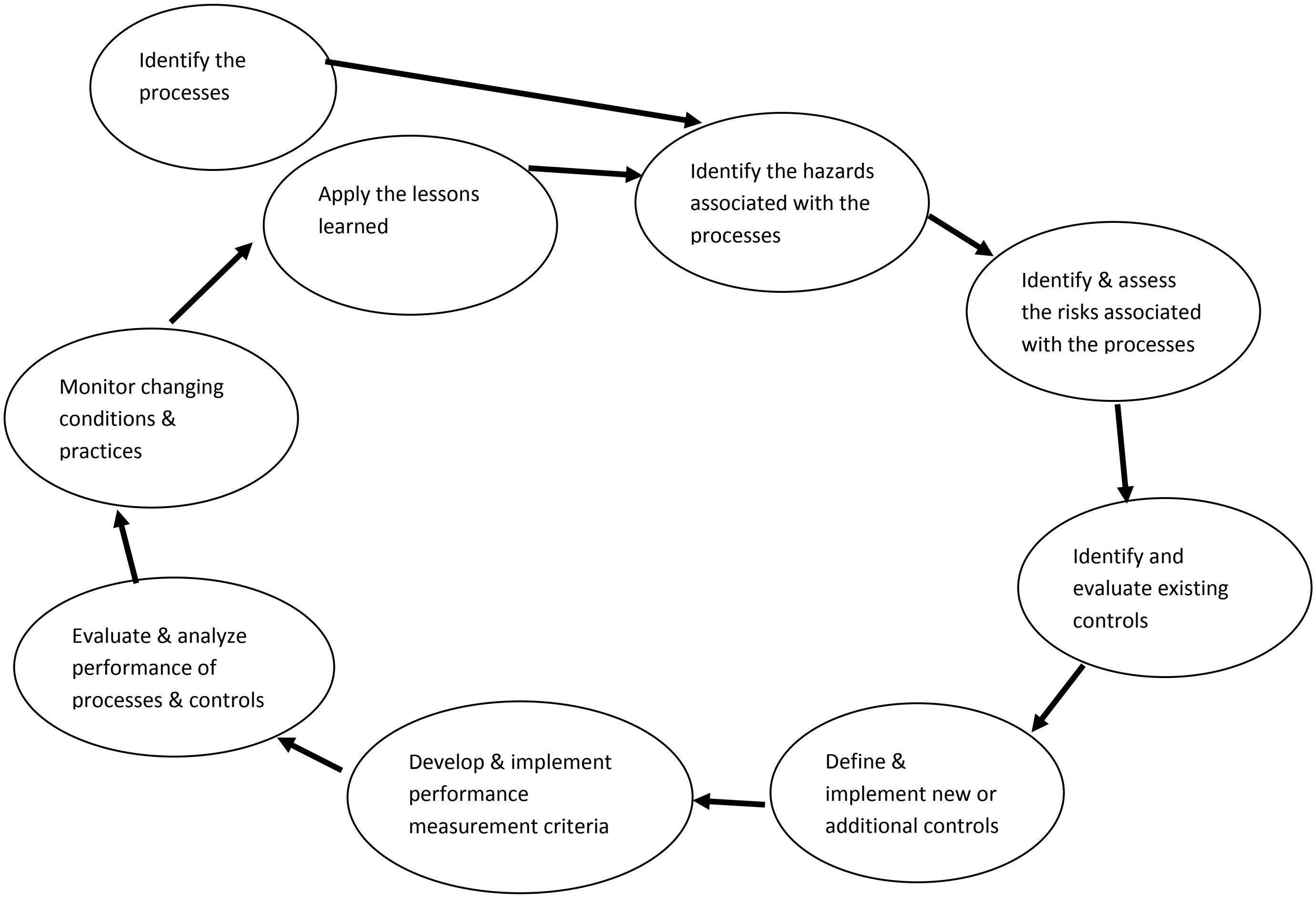
The controls may be applied either to reduce the likelihood of occurrence of an adverse event, or to reduce the severity of the consequences. The risks that we are concerned with, are those that are reasonably foreseeable, and relate to:

- the health and safety of all those who are directly or indirectly involved in the activity, or who may be otherwise affected
- the property of the company and others
- the environment

The risk management process may be summarized by the flowchart below[18].

[17] ISO 8402:1995/BS 4778

[18] Guide to risk assessment in ship operations, IACS, http://www.iacs.org.uk/download/1927



Therefore, risk management means the whole process of mitigating and / or eliminating the risks and in practical terms, this includes;

- Identification of the former accidents and injury records onboard, near miss records, requirements of the ship's SMS, company circulars and accident injury reports within the fleet. These records and reports will help you to take **proactive measures** in managing risks. Basically, this means application of lessons learned.
- Identify the risks involved with various duties onboard. This may also depend upon the age of the ships, equipment onboard, trade, type of the vessel, number of people onboard etc.
- Critically analyse the hazards involve with the present process onboard the vessel against the lessons learned and international standards.
- Evaluate the existing controls against the international standards
- Discuss with the senior management onboard to decide the amendments to be entered into the existing process.
- Apply or implement additional controls and monitor the successfulness of the same while re-assessing it when changing circumstances.
- Evaluate the outcome and see any further amendments are required.
- Finally, remember the analysing and the evaluation of the existing process has to be an ongoing process.

Risk assessment is basically one element of risk management. That is something we do only before we start some job, but risk management is a continuous process to eliminate risks from the whole system onboard.

The identification of hazards is the first and most important step since all that follows depends on it. It must be complete and accurate, and should be based, as far as possible, on observation of the activity. But hazard identification is not as easy as it may first appear. Completeness and accuracy can be achieved only if the process is systematic. Those charged with the task must have sufficient training and guidance to ensure that it is conducted in a thorough and consistent manner. The terms used should be clearly defined and the process must be fully described; for example, hazards must not be confused with incidents, and incidents must not be confused with consequences.

The risks associated with each hazard are evaluated in terms of the likelihood of the harm and the potential consequences. This, in turn, enables the organization to establish priorities and to decide where its scarce resources may be used to greatest effect.

The combination of likelihood and consequence is normally illustrated as follows:

RISK ESTIMATOR

		Consequence		
		Slightly Harmful	Harmful	Extremely Harmful
Likelihood	Highly Unlikely	Trivial Risk	Tolerable Risk	Moderate Risk
	Unlikely	Tolerable Risk	Moderate Risk	Substantial Risk
	Likely	Moderate Risk	Substantial Risk	Intolerable Risk

The table below indicates the recommended response in each case.

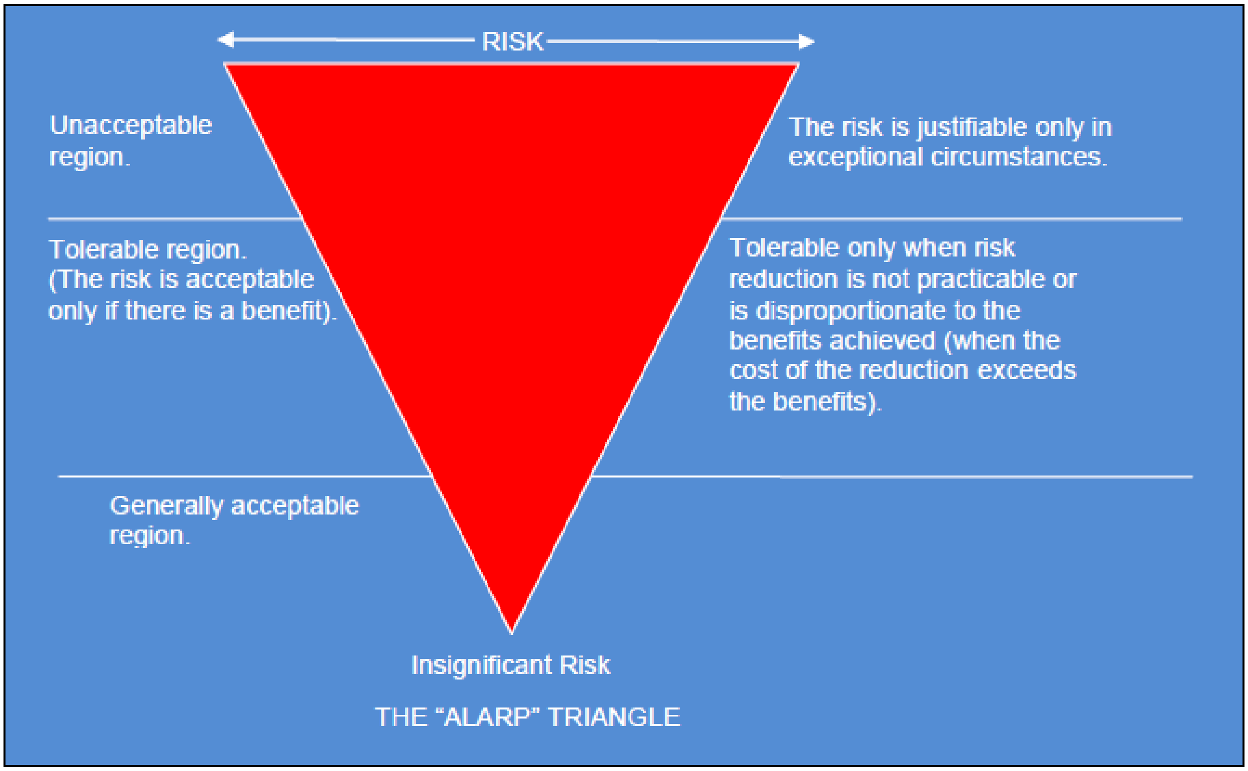
Trivial	No action is required.
Tolerable	No additional controls are required. Monitoring is required to ensure control is maintained.
Moderate	Efforts are required to reduce risk. Controls are to be implemented within a specified time.
Substantial	New work not to start until risk reduced. If work in progress, urgent action to be taken. Considerable resources may be required.
Intolerable	Work shall not be started or continued until the risk has been reduced. If reduction is not possible, the activity shall be prohibited.

The tables above are shown in the form in which they most commonly appear, but they are not mandatory. The risk matrix may be expanded to include more rows and columns, depending on how finely the company wishes to distinguish the categories. The terms used for likelihood and consequence may be changed to assist understanding. For example, likelihood may be expressed in terms of "once per trip", "once per ship year" or "once per fleet year", and consequence may be made more specific by the use of "first aid injury", "serious injury" or "death", not forgetting the consequences for property and the environment.

When deciding on priorities for the application of controls, the frequency of the activity should also be taken into account; for example, it may be more urgent to address a "moderate" level of risk in a process that occurs every day than to impose controls over an activity that involves "substantial" risk, but will not be carried out in the near future.

Furthermore, the terms applied to the levels of risk in the table above should not be interpreted too rigidly. Risk should be reduced to a level that is *As Low As is Reasonably Practicable* (ALARP). If a "tolerable" level of risk can be reduced still further for a reasonable cost and with little effort, then it should be. Standards of tolerability tend to be far stricter after an accident than before.

The ALARP concept is often illustrated thus:



The people chosen to undertake risk assessments should be those most familiar with the area, and who have most experience of the task to be assessed and the process must be systematic.

As stated before, the companies can have their own methods of risk assessment. At the same time, companies have already assessed the risk involved with known duties and jobs on board. These known duties and jobs include, but not limited to:

- dry docking
- anchoring
- mooring operations
- coastal navigation
- navigation with pilot onboard
- electrical work
- enclosed space entry
- cargo work

The chief officer may use these risk assessments as it is, or they may be modified. A chief officer must be care full enough to not to use the risk assessment made by the company blindly. If the risks of the required job or the duty are not pre-assessed, the chief officer has to carry out a risk assessment and keep the records.

Example of risk assessments

Refer the below risk matrix along with the two examples provided;

Risk matrix

Risk matrix									
					Increasing frequency				
					Remote	**Not likely**	**Possible**	**Possibility of isolated incidents**	**Probable**
					Industry Not happened within last 5 yrs	**Company** Could happen **Industry** Has happened within last 5yrs	**Company** Has already happened **Industry** Happens more than 1 per year	**Company** Could happen 1 per year **Vessel** Once in lifetime of vessel	**Company** Could happen more than 1 per month **Vessel** Once per year
Increasing consequences	**Health & safety**	**Environmental impact**	**Public impact**		**1**	**2**	**3**	**4**	**5**
	Maximum First aid	Minimal or no impact	N/A	**A**	**A1**	**A2**	**A3**	**A4**	**A5**
	Medical treatment	Minor impact for short duration	Impact on part of the community in the area	**B**	**B1**	**B2**	**B3**	**B4**	**B5**
	Life threatening or long term effect 1 person	Serious impact	Impact on small community	**C**	**C1**	**C2**	**C3**	**C4**	**C5**
	More than 1 person	Very serious impact	Impact on large on large community	**D**	**D1**	**D2**	**D3**	**D4**	**D5**

Example – 1 (Risk assessment in anchoring. In both the below examples, the column number 7 is to be completed by the risk assessor at the time of carrying out the risk assessment)

Risk assessment							
Job	Anchoring						
Assessor in company	DPA						
Assessor onboard	Master						
Date							
What are the sources of harm	**What can go wrong**	**What happens if it goes wrong**	**Risk rank**	**Preventive measures**	**Risk after preventive measures**	**Vessel specific measures (if applicable)**	**What has to be done if it goes wrong**
Anchor, chain, windless, stopper	Defective equipment or bad practices	Grounding, collision, pollution, loss of anchor, injury	**D3**	Training in anchor handling, proper maintenances, use of checklists, correct orders	**C3**		Use of contingency plans
Bad weather	Chain damage, anchor dragging	Grounding, collision, pollution, loss of anchor, injury	**D3**	Training in anchor handling, use of checklists, correct orders	**C3**		Use of contingency plans, use of quick release mechanism
Lack of knowledge on sea bottom	Foul anchor	Loss of anchor/chain & damage to under water obstructions, pollution	**D3**	Good voyage planning, refer all available information	**C2**		Slipping the cable on deck
Noise	Persons handling anchor are exposed to noise	Deafness	**B4**	Use of ear protection	**B2**		
Rust & other particles	Emission of rust & particles when chain is moving	Eye/skin injury, dust inhalation	**C4**	Proper maintenance of anchoring equipment, use of correct PPE	**B2**		
Guillotine & devil's claws	In correct seamanship techniques	Back pain, injuries to fingers	**C4**	Proper training & situational awareness	**B2**		
Additional comments							
							Signature

Example – 2 (Risk assessment in ballasting)

Risk assessment							
Job	Ballasting						
Assessor in company	DPA						
Assessor onboard	Chief officer						
Date							
What are the sources of harm	**What can go wrong**	**What happens if it goes wrong**	**Risk rank**	**Preventive measures**	**Risk after preventive measures**	**Vessel specific measures (if applicable)**	**What has to be done if it goes wrong**
Defective pump, valves, lines	Ballast system may not work, overflow, air suction, filling or emptying wrong tank	Impact on stability, structural damage	**B4**	Maintenance of ballast system, compliance with BWMP, familiarization & training	**B2**		Report of notification
Bad practices	Overflow, discharge in prohibited area	Pollution, detention	**B4**	Familiarization, training, compliance with BWMP & local regulations	**B2**		
Defective treatment system	Introduction of invasive species	Pollution	**B4**	Maintenance of the system, proper monitoring	**B3**		
Additional comments							
							Signature

CARGO OPERATIONS

1) General cargo operations

Information required from the shipper

- Weight, volume and the stowage factor of the cargoes.
- Type of cargo (glass in crates, steel billets, steel coils, cement in bags etc.)
- In case of IMDG goods, the Class & UN number of the cargo (handling of IMDG is explained separately below).
- Port of discharge
- Ventilation requirements
- Whether any special stowage, segregation of lashing arrangements are required and
- Any other information which are inherent to the proposed cargoes

Precautions to take

- Clean the holds according to the requirements of the shipper and make sure the bilge wells are clean and dry.
- Make sure the access to the cargo working area are clean and in good order with proper illumination.
- Ensure the cargo working areas have sufficient lighting.
- If the ship's cargo gears to be used, make sure they are in good working condition.
- If cargo ventilation is required, make sure they are in working order.
- Consider the following points when preparing the stowage plan;
    - ➢ Load density of the stowage area, weight, volume and stowage factor of the cargo.
    - ➢ Available lashing points onboard
    - ➢ Viability of loading one type of cargo above another type (example – steel billets can not be loaded over fragile cargoes)
    - ➢ Possibility of closing cargo holds after loading
    - ➢ If the cargo to be loaded on deck, consider the visibility range from the bridge, possibility of securing cargo gears after the completion of loading.
    - ➢ Port rotation.
    - ➢ Cargo segregation requirements to avoid damage to cargo (Example – tainting damage to food products when carried with rubber products)
    - ➢ It is always better to load heavy weights and awkward shape cargoes on the tank top of the cargo hold

- Refer the shipper's instructions as well as the industry publications such as Thomas Stowage for any special precautions to be taken.

- Ensure to order sufficient lashing materials and dunnage.
- Brocken stowage shall be reduced as much as possible to increase the cargo carrying capacity.
- Duty officers must ensure the SWL of the cargo gears are not exceeded.
- Be very careful and vigilant while unlashing the cargoes at the discharging port, as the cargo may fall on cargo workers.
- Do not allow the cargo workers to use small hand hooks on the bags when handling bagged cargoes whish are in paper bags. If hooks are used to handle them, the cargo damage will be higher due to damages to the paper bags. Refer the picture below[19];

- Cargo workers has a practice of swinging the cargo while hanging on the crane/derrick to reach corners of the hold. This shall not be allowed as it may over stress the whole cargo gear.
- Give proper instructions to duty officers and deck watch keepers with regards to cargo stowage and cargo lashing.

Cargo stowage plan on a general cargo vessel

Cargo stowage plans are essential to identify the positions of cargo onboard and these shall be given to the duty officer so that he knows exactly where to load the cargo, amounts of cargo, types of cargo and the ports that will be discharged.

A chief officer needs to consider about the following factors when making a cargo stowage plan:

- Discharging port rotation;
- IMDG requirements if loading any such cargoes;
- Possibility of tainting damage;
- Possibility of ventilating if a particular cargo is to be ventilated;
- Viability of opening tween deck pontoons for the purpose of discharging under deck cargoes;
- Accessibility of cargo for lashing and discharging;
- In the case of loading containers, stack weight;
- Load density, broken stowage and the stowage factor; and
- Viability of stowing heavier cargoes at the edges of a cargo hold. The runner wire of a crane/derrick does not reach the corners of a cargo hold because the hold opening is smaller

[19] https://en.wikipedia.org/wiki/Hook_(hand_tool)

than the tank top area. In that case, need to stow such cargoes directly below the hatch opening. Refer the picture[20] below:

The below sample stowage plan is prepared to explain how to make such a plan but, without considering the load densities, stowage factor and broken stowage.

Apart from the diagrammatic illustration of the positions of the cargo, it also should contain the port of loading, date of loading, voyage number, colour code, departure draughts etc.

Port rotation and the colour code are as below:

i) Bombay

ii) Colombo

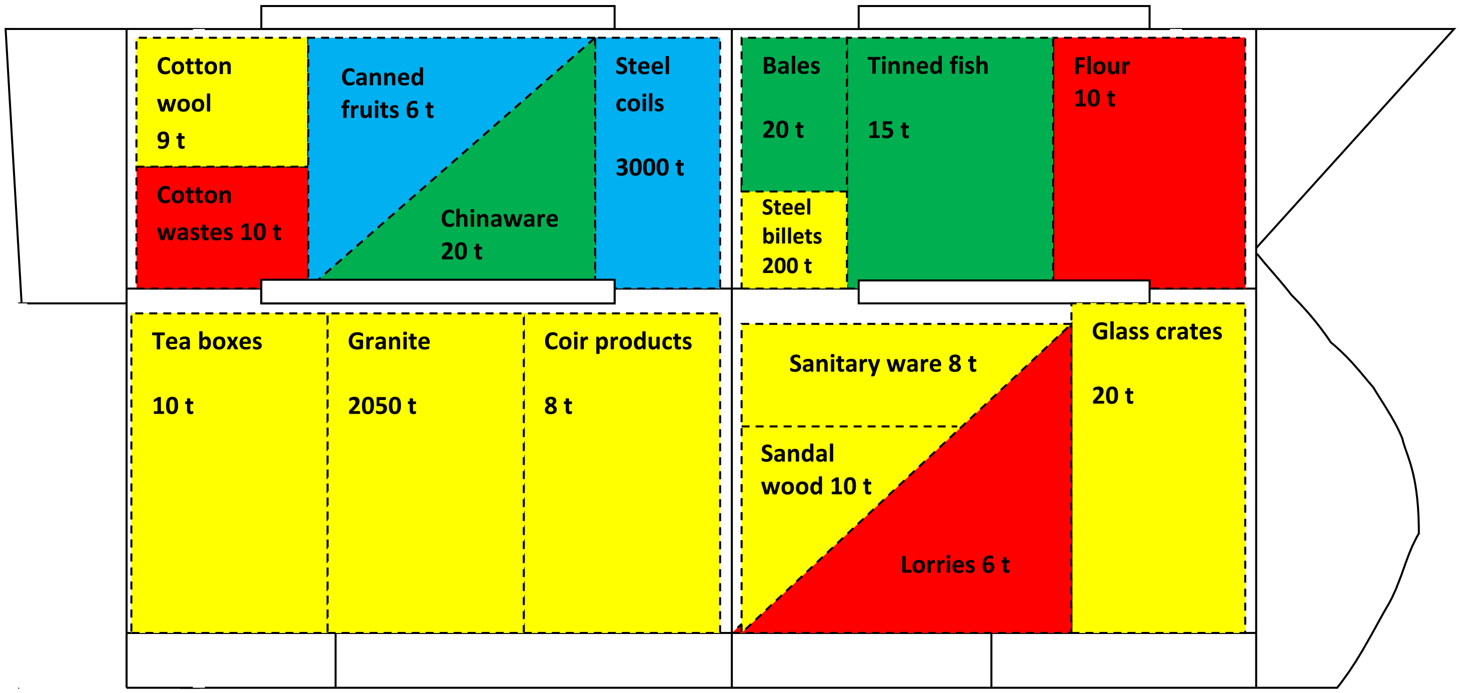
iii) Port Kelang

iv) Singapore

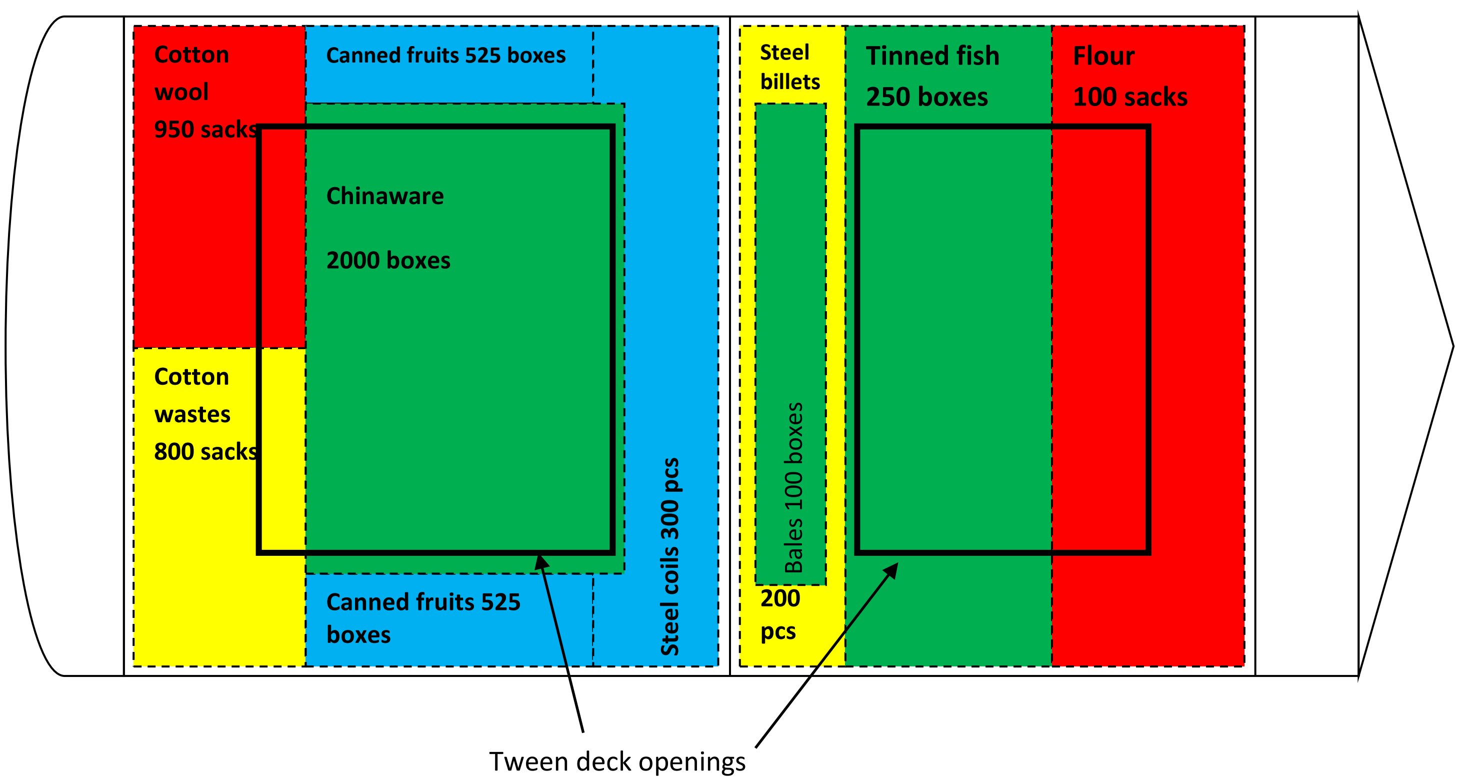
With the aid of the below stowage plans, self-study (refer the upper & lower hold stowage plans along with the longitudinal stowage plan) following points;

- the information provided on a stowage plan
- how the cargoes on the starboard side and port side are marked
- how the cargoes at the centre are marked
- how to mark when different types of cargoes are loaded on top of each other

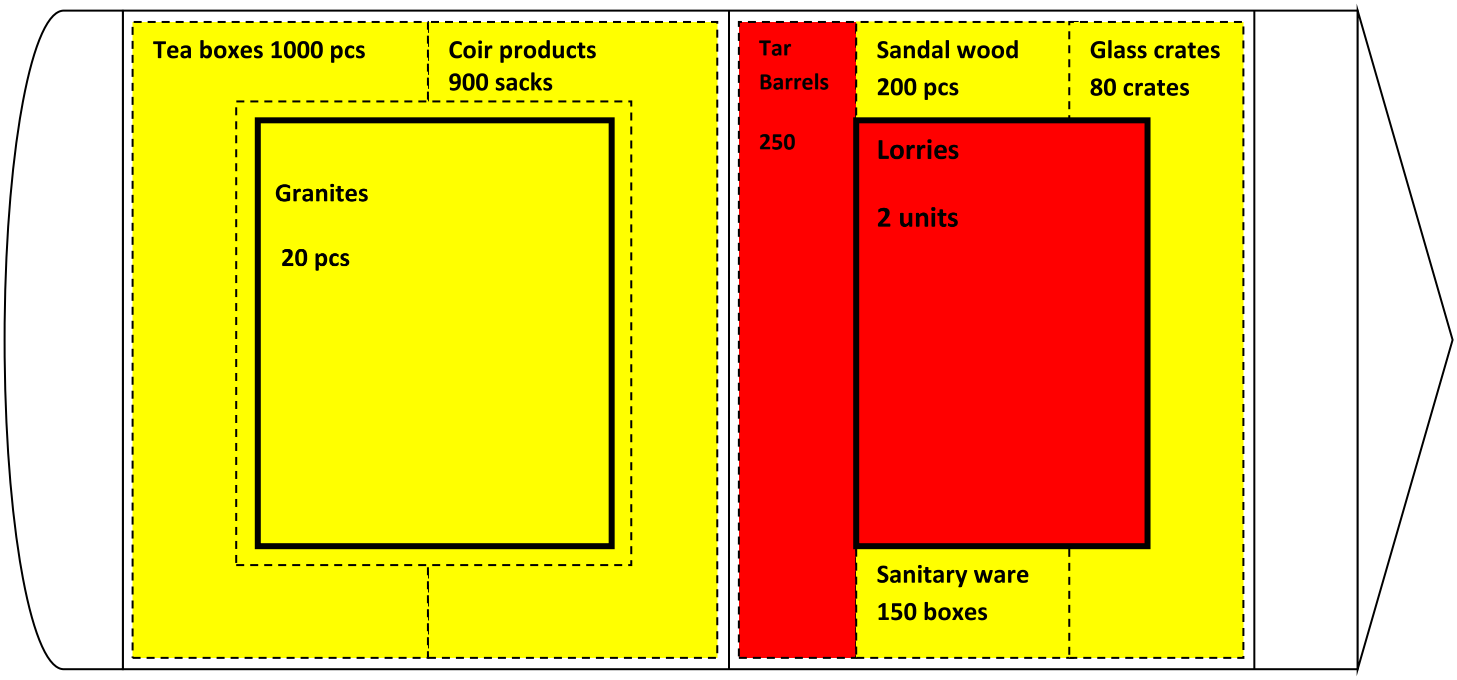
[20] http://www.allship.net/ships/multipurpose-tweendeckers/mpp-tweendecker-general-cargo-vessel


Cotton wool 9 t
Cotton wastes 10 t
Canned fruits 6 t
Chinaware 20 t
Steel coils 3000 t
Bales 20 t
Steel billets 200 t
Tinned fish 15 t
Flour 10 t
Tea boxes 10 t
Granite 2050 t
Coir products 8 t
Sanitary ware 8 t
Sandal wood 10 t
Lorries 6 t
Glass crates 20 t

Upper hold


Cotton wool 950 sacks
Canned fruits 525 boxes
Chinaware 2000 boxes
Cotton wastes 800 sacks
Canned fruits 525 boxes
Steel coils 300 pcs
Steel billets
Bales 100 boxes
200 pcs
Tinned fish 250 boxes
Flour 100 sacks
Tween deck openings

Lower hold



2) **Loading of heavy lifts**

Precautions to be taken:

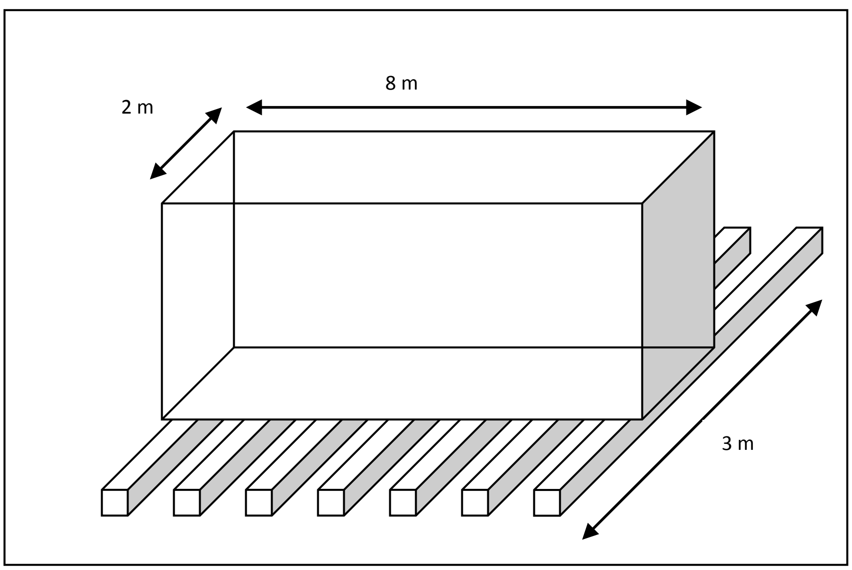
- Check the weight of the cargo and make sure the load density will not be exceeded.
- If a spreader or heavy pallets are used in heaving up the cargo, take the weight of the spreader or the pallets also into account.
- If the load density is insufficient, place dunnage.
- Select an appropriate place with sufficient lashing points. Ensure the securing points are strong enough for lashing this cargo.
- Calculate GM;
  - just after the weight is taken by the derrick;
  - when the derrick head is at the highest position during the operation; and
  - after loading and make sure it is positive always
- Check the maximum list during the operation and take actions to reduce it, if excessive, .
- Minimize free surface effect by emptying or filling the tanks completely.
- Ensure the vessel is upright prior to the commencement of the operation.
- Stop all other cargo operations.
- Inform heads of departments.
- Un-authorized persons are not to be allowed onboard.
- Ensure the gangway is up and the moorings are tight.

- Cast off barges if moored alongside.
- Beware of the "lateral drag".
- Lash all loose items.
- Lay the dunnage in the fore & aft direction or diagonally. So that the weight will be spread over the transverse beams and frames.
- Attach steadying lines (guide ropes) to the weight to control the swing of the cargo.
- Just after the weight is taken by the derrick, check the cargo slings and wires.

Following precautions may be obtained if the load density is going to be exceeded:

In a transversely framed ship, the dunnages should be laid down in the fore and aft direction or diagonally.

In calculating the length of dunnages, we will use an example of 120 t of weight having a base area of 8 x 2 m² to be loaded in a hatch of having a load density of 5 t per m².

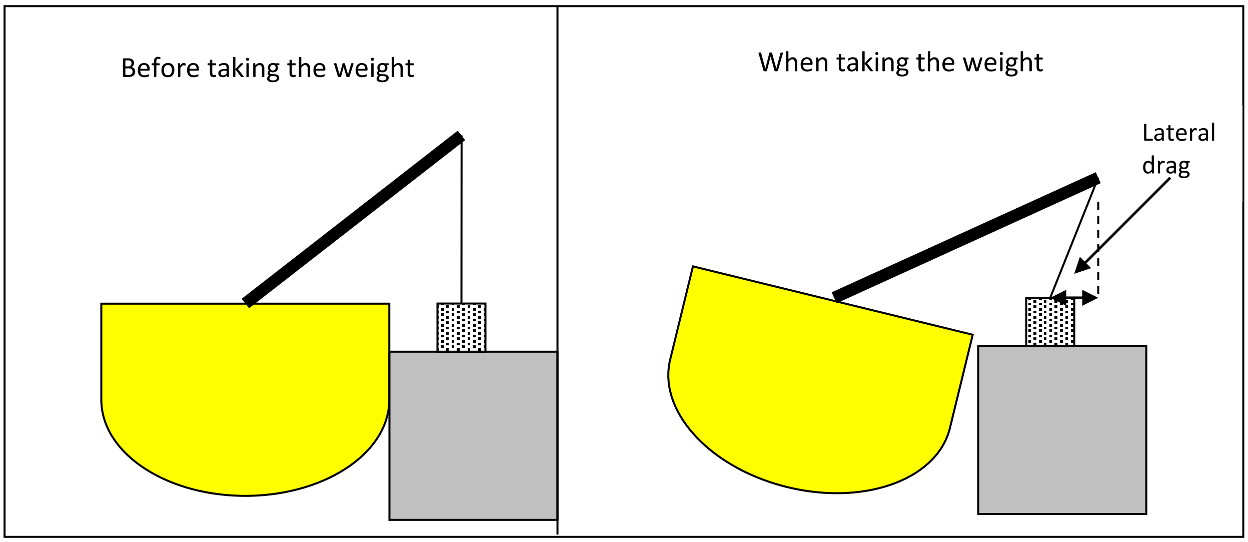


The weight per m² of the present load = 120 / (8 x 2) = 7.5 t per m²
Therefore, the load density exceeds.
Dunnages to be laid throughout the length of the cargo. Therefore, the final length of the cargo area is 8 m. We will assume the breadth of the final cargo area as 'Y',
Therefore,
120 / (8 x Y) = 5
Y = 3 m.

Therefore at least 3 m long dunnages must be used. Always make sure that the **(Weight) / (Final area)** is less than or equal to the load density.

If the cargo to be loaded on a pontoon, ensure the dunnages are long enough to reach the hatch coamings, so that the weights will be taken by the ends of the pontoons.

The lateral drag



As the above figure shows, the horizontal movement of the cargo due to listing of the vessel is known as the lateral drag. This could happen while loading as well as discharging. When loading, the drag is away from the ship and when discharging it is towards the vessel. The dangers involving lateral drag includes:

- The heavy cargo may start swinging violently.
- The momentum of swing may impede the SWL of derrick and it's components.
- If the cargo is on a lorry or supposed to load on to a lorry, it could turn over or damage.
- The cargo and the ship's hull may be damaged.
- Possibility of injuring the people around.

Lateral drag can be reduced by maintaining the position of the derrick head above the weight throughout the operation.

- While discharging, the runner and the topping lift should be lowered quickly as soon as possible after the weight touches the ground.
- While loading, the topping lift shall be lowered as the vessel heals to keep the derrick head above the cargo and the load must be taken slowly and also, it is advisable to use steadying lines.

3) Oil tanker cargo operations

a) Information required (for crude oils) from the shipper

- API or the density of the cargo
- Correct loading temperature
- Approximate discharging port temperature
- Manifold connection size
- Number of connections
- Loading quantity
- Grade of cargo
- If different grades to be loaded, the segregation requirements (double valve segregation or single valve segregation)
- Whether heating is required
- H_2S content of the cargo

b) Documents required

- Material Safety Data Sheet (MSDS)
- Dedicated Clean Ballast Tank Operation Manual
- Crude Oil Washing Operation and Equipment Manual (COW Manual)
- Oil record book – Part II
- Evidence for passing vetting inspections
- Ship / shore safety checklist and other check lists
- Approved STS operations plan and record book (only for STS operations)
- VOC Management plan and the record book, if applicable
- Empty tank certificate (issued by a surveyor confirming that all the cargo is discharged)
- OBQ certificate (verification of cargo tank content including slop tanks before the commencement of loading)
- List of last three cargoes
- Pumping log – (signed by C/O and terminal which indicate the manifold pressure during discharging)
- ROB / Dry tank certificate (issued by a terminal representative from the terminal specifying the volume of cargo left onboard as unpumpable, if any, after discharging).
- Loading/discharging/ballasting/de-ballasting sequence plans
- ISGOTT

c) Safety precautions to be observed before, during & after cargo handling

- Ensure the applicable checklists (pre-entry, COW wash, ship / shore safety checklists etc.) are completed correctly.
- Pre-arrival tests such as trying out inert systems, cargo pumps, testing of high-level alarms, emergency stops etc. before going for the port.
- Make a de-ballasting/ ballasting sequence plan and a loading/discharging sequence plan
- Purge tanks with inert gas until the O_2 content of the tanks are less than 08% and have a positive pressure.
- Make sure the pump room blowers are working in order, bilges are cleaned, and bilge alarms are working in order
- Pre-arrival meeting to be held
- Upon arrival;
  - ✓ Ship/shore meeting to be held
  - ✓ necessary information like, loading / discharging plan, rate of loading/discharging, starting rate, topping-off rate, emergency communications etc. to be agreed with the terminal;
  - ✓ complete the ship/shore safety check list with the terminal representative and signed by both parties;
  - ✓ plug scuppers and dip trays;
  - ✓ following notices to be posted;
    - No smoking
    - No naked lights
    - No unauthorized persons
  - ✓ Connect manifolds and
  - ✓ Two fire horses to be rigged, one on the fwd of the manifold and the other on the aft of the manifold. If monitors are used, they should be pointed towards the manifold and ready for immediate use. Other FFA appliances also shall be readily available.
- OBQ (On Board Quantity) and contents of the slop tanks will be checked at the port of loading.
- Put the auto tensioning winches on manual mode.
- Rig emergency towing wires fwd & aft (fire wires).
- Bravo flag to be hoisted or the red lighted to be switched on.
- Torches, walky-talkies and mobile phones used on deck must be intrinsically safe
- Hot work must not be carried out on board and on the terminal
- During medium and high frequency radio transmission (300 kHz — 30 MHz), significant energy is radiated which can, at distances extending to 500 metres from the transmitting antennae, induce an electrical potential in unearthed ‘receivers’ (derricks, rigging, mast

stays etc.) capable of producing an incentive discharge. Low energy transmissions, such as satellite and VHF communications, do not produce the same sources of ignition[21].

- Ensure the junior officers, pump man and others who are involved in cargo operations are well aware of their individual duties of the loading/discharging/ballasting/de-ballasting plan that the chief officer has made
- Pump room ventilating systems shall be switched on at least 10 mins before the commencement of the cargo operations and the emergency escape systems must be readily available.
- Double check whether the correct valves are open.
- Stat loading or discharging at the agreed slow rate.
- Ensure no leaks (at the manifold, on the lines), and cargo is going to or discharging from the correct tank.
- When everything is in order, may increase the loading or the discharging rate to the agreed maximum.
- Maintain a positive pressure with a O_2 concentration of 8% (5% or less in the IG system) or less inside the tanks during cargo operations or COW operations.
- Accommodation openings to be kept closed during cargo operations.
- Continuous deck and pump room rounds to be carried out.
- Cargo manifold to be maned during the cargo operations, monitor the pressure at the manifold and it shall be entered on the **pumping log**.
- If applicable, comply with the Volatile Organic Compound (VOC) emission requirements
- No soot blowing to be carried out.
- Ullages to be checked at frequent intervals. Frequency to be increased when topping-up and when about to finish the cargo
- When closing valves, should be closed slowly to avoid pressure surges during cargo operations (known as water hammer or liquid hammer)
- In case of product tankers may have to take samples, therefore, need to have sampling procedures.
- After the completion of loading, calculate the amount of cargo onboard (ship's figure) by means of temperature, density and ullage
- While discharging, if the master is expecting to carryout COW, an advanced notice to be given to the terminal and authorization should be received.
- When closer to end of discharge, adjust the trim to enable stripping of the cargo.
- After the completion of discharging obtain a "Empty tank certificate" from a cargo surveyor.
- During the loaded passage;
  - ✓ ensure the required positive pressure is maintained;
  - ✓ O_2 content of the tanks are less than or equal to 8%;
  - ✓ Temperature of the cargo is maintained as required by the charterer;
  - ✓ No hot work to be carried out on deck

[21] International Safety Guide for oil tankers and Terminals, 2015

4) Chemical tanker cargo operations

a) Information required from the shipper

Cargo to be refused if sufficient information required as mentioned below, are not available:

- Amount and the grade of the cargo
- A full description of the physical and chemical properties of the cargo
- Venting requirements
- Safety precautions applicable for the expected cargo.
- Density and the temperature of the cargo.
- Loading/discharging rates and maximum allowable pressure during the loading/discharging operations.
- Whether purging with Nitrogen is required or not.
- Whether the cargo requires addition of inhibitors.
- Compatibility with other materials

b) Documents required

- Cargo record book
- Procedures and Arrangements Manual (P & A Manual)
- Shipboard Marine Pollution Emergency Plan for Noxious Liquid Substances (SMPEP)
- Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk or International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk
- Shipping document as required by the Annex to the IBC Code (optional)
- IBC Code or national regulations
- If the cargo is a mixture, an analysis indicating the dangerous components contributing significantly to the total hazard of the product shall be provided. Such analysis shall be certified by the manufacturer or by an independent expert acceptable to the Administration
- Tank dry & fitness certificate (issued at the port of loading, before start loading)
- Onboard quantity document (after the completion of discharge)
- If applicable, manufacturer's inhibition certificate. Certain cargoes required to be inhibited for the easy and safe handling. In that case, the manufacturer of the inhibiter is required to issue a certificate stating following information related to the added inhibitor:
  - Name & amount added
  - Date added and the effective duration
  - Applicable temperature limitations
  - Actions to be taken if voyage duration exceeds the effective duration of the inhibitor

- Cargo shall be refused, if this inhabitation certificate is not available (if inhibitor is added). A copy of this certificate shall be retained onboard. If no inhibitors added and if there is a possibility of losing the effectiveness of the cargo before the cargo is discharged, issue a letter of protest.

c) Safety precautions to be observed before, during & after cargo handling

- The MSDS (Material Safety Data Sheet) shall be supplied to the master.
- Ensure the cargo is compatible with the coating, lines in the tanks and pumps.
- Make sure the nominated cargo is compatible with the adjacent cargoes.
- If heating or cooling is required, make sure such facilities are working in order.
- Need to clean the tanks as per the requirements of the charterers.
- Check what are the special safety precautions to be taken in handling the nominated cargo (Eg – use of protective clothing, breathing apparatus etc.).
- Make sure the venting systems, PV valves, vapour return valves etc. are in good working order.
- Ensure the portable vapour detection instruments are available for the type of cargo
- Ensure the safety alarms fitted in pump room are working in order
- Ensure the gauges and alarms in the cargo system are working in order
- Rig two towing – off wires (fire wires) fore and aft
- No soot blowing during cargo operations
- No hot work onboard and also on the terminal
- Following warning signs to be displayed on deck:
  - ➢ No naked lights
  - ➢ No smoking
  - ➢ No unauthorized persons
- Ensure the red flag or the red light is on
- Start the pump room blowers at least 15 minutes before the cargo operations and continues throughout the operations
- Check whether the product name of the cargo is on the “certificate of fitness for the carriage of noxious liquid substances in bulk” and ensure that the quantity and characteristics of each product to be loaded are within the limits indicated in the same certificate. The certificate of fitness also contains tanks suitable for the carriage of each cargo allowed and also a tank arrangement plan.
- Cargo shall not be accepted without a certificate of inhibitor (if added)
- Adhere to the safety procedures and practices provided in the IBC Code, SMS, procedures and arrangements manual (P & A manual) and industry safe practices:
  - Check whether the product name is listed in chapter 17 or 18 of the IBC Code or the latest edition of MEPC.2/Circular on “PROVISIONAL CATEGORIZATION OF

LIQUID SUBSTANCES IN ACCORDANCE WITH MARPOL ANNEX II AND THE IBC CODE"

- The requirements of the IBC Code do not apply, if the product name is listed on Chapter 18
- Refer the Appendix – 1 of the IBC Code which provides few flow charts for loading and handling of cargoes

- FFA & SMPEP equipment shall be ready for immediate use
- No cargo operations to be conducted if lightning at the near vicinity
- The portable electrical equipment shall be intrinsically safe
- Scuppers and dip trays are plugged
- All the personnel protective equipment shall be ready for immediate use
- Ensure the manifold is correctly connected and manned during the operation.
- Pre-cargo operations meeting to be held with the terminal representatives and ensure measures and procedures for the following are agreed with the terminal:
  - loading/discharging sequences, maximum, initial, topping off rates
  - points of contacts (to be used in case of an emergency)
  - receiving nitrogen for inerting, purging or line cleaning (if applicable)
  - emergency signals and communication procedures
  - emergency stopping procedures and complete the ship/shore safety checklist
  - emergency spill procedures
  - whether cargo lines require pigging. Pigging means use of another liquid in draining the lines during loading
  - agree with the cargo sampling procedures

- Cargo vapour may be vented or collected depending upon the local regulations
- Ensure the tank cleaning is carried out in accordance with the approved (P & A Manual)
- Close cargo related valves slowly to avoid pressure surges during cargo operations (known as water hammer or liquid hammer)
- Crew and the officers must be aware of the hazards involve with the particular cargo
- Ensure all the checklists are complied with as appropriate
- If nitrogen is used from ashore (for inerting or purging), need to agree the receiving pressure/rate with the terminal and other safety practices are followed
- Before the commencement of loading tanks will be inspected and 'tank dry certificate' will be used.
- In the case of heated cargoes, if the temperature of the cargo is less or more than specified, stop loading and inform charterers. Loading to be continued only with the charterer's approval.
- If the cargo is not at the specified loading temperatures and if there are reasons to believe that the cargo may cause damage to ship structure or the paint condition of the cargo tank, need to issue a letter of protest.

- Ensure to take samples of each grade of cargo with a terminal representative
- Maintain the required pressure in the tanks
- Start loading/discharging at the agreed lower rate. Make sure cargo is loaded/discharged to or from the correct tank. Make sure no leakages. Then increase the rate to the agreed level slowly.
- Check the ullages and tank pressure throughout the operation and record them.
- Check the vapour concentrations on deck during the cargo operations and log them. If the concentrations rise beyond the permitted values, may have to stop cargo operations and the deck personal may have to use breathing apparatuses until the concentration is lesser.
- After the completion of loading/discharging blow through the lines before disconnecting the manifold. Have a good communication with the terminal during blow through process. For some cargoes Nitrogen gas must be used instead of deck air for blowing though.
- During the voyage:
    - If nitrogen from the terminal is used, ensure sufficient nitrogen is available onboard to comply with the inerting requirements
    - Check the levels, pressures and temperatures of cargo tanks daily

- Before the commencement of unloading, check the temperatures and ullages, calculate the amount of cargo onboard and compare with the load port figures.
- When discharging different grades of cargoes, label the manifold pipes to indicate which pipe will be used to discharge which grade.
- When there are different grades of cargoes to be discharged refer the charterers instructions when making the discharging sequence plan.
- After the completion of discharging, all the cargo tanks to be checked with a terminal representative to ensure all the cargoes are well drained and on board quantity certificate has to be signed by the chief officer and the surveyor.
- Follow the SMS in stripping the tanks.
- During discharging, if it is required to enter into the tank for ‘squeegeeing’ (some cargoes are required to be pushed towards the suction pipe when the tank in about to empty), follow safety practices.
- Remember, whatever mentioned above are only general actions/precautions/instructions. Therefore, need to refer P & A manual, SMS, charterers instructions, IBC Code etc for further details of individual cargoes.

5) Gas tanker cargo operations

a) Information required from the shipper

- Correct technical name of the cargo
- A full description of the physical and chemical properties necessary for the safe containment of the cargo
- Action to be taken in the event of spills or leaks
- Counter-measures against accidental personal contact
- Fire-fighting procedures and fire-extinguishing agents
- Procedures for cargo transfer, gas freeing, ballasting, tank cleaning and changing cargoes
- Special equipment needed for the safe handling of the particular cargo
- Minimum inner hull steel temperatures
- Emergency procedures
- Compatibility
- Details of the maximum filling limits allowed for each cargo that may be carried at each loading temperature, the maximum reference temperature and the set pressure for each relief valve

b) Documents required

- Certificate of Fitness for the Carriage of Liquefied Gases in Bulk or International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk
- IGC Code or national legislation
- MFAG
- Procedures and Arrangements Manual (this provides ship specific instructions for cargo related operations)
- Certificate of Quality (provides the product specification and quality in terms of physical characteristics and component constituents and it is issued by the loading terminal)
- Certificate of Origin (this is a document issued by the manufacturer or shipper, countersigned by the customs authorities and attesting to the country in which the cargo was produced)
- Time Sheet (this records all timing details of the ship’s movements and operations from the ships entry to its final departure from the port. This is usually prepared by the vessel’s agents and is countersigned by the Master. Its purpose is to provide an agreed statement of facts relating to timing of events and any delays)
- Certificate of Tank Fitness (this is issued by independent surveyor with regards to particular tank conditions prior to loading)
- Certificate of inhibitor added (certain gases require an inhibitor added for transportation and the certificate shall include the following:
  - Name and the quantity added

- The date added and duration of effectiveness
- Any temperature limitation
- Action to be taken if the voyage duration exceeds the effective time period of the inhibitor

c) Safety precautions to be observed before, during & after cargo handling

- Rig two towing – off wires to be rigged fore and aft
- No soot blowing during cargo operations
- No hot work onboard and also on the terminal
- Warning signs to be displayed
- Ensure the red flag or the red light is on
- Start the pump room and compressor room blowers at least 10 minutes before the cargo operations and continues throughout the operations
- Ensure the safety alarms fitted in pump room and the compressor room are working in order
- Crew and the officers must be aware of the hazards involve with the particular cargo
- Check whether the technical name of the cargo is on the "certificate of fitness for the carriage of liquefied gases in bulk" and ensure that the quantity and characteristics of each product to be loaded are within the limits indicated in the same certificate. The certificate of fitness also contains tanks suitable for the carriage of each cargo allowed and also a tank arrangement plan.
- Cargo shall not be accepted without a certificate of inhibitor (if added)
- Adhere to the safety procedures and practices provided in the IGC Code (the Chapter 19 provides a list of gasses that can be carried in liquefied form, technical detains and special requirements) procedures and arrangements manual and industry safe practices
- FFA equipment shall be ready for immediate use
- The portable electrical equipment shall be intrinsically safe
- Cargo tanks, pipelines and pumps to be cleaned and dried
- Piping systems should be thoroughly blown through with adequate quantities of compressed air followed by nitrogen
- The emergency shut down systems, operation of actuator valves, compressor and pump room cut outs are in working order
- Ensure the pipelines are aligned
- Personal protective equipment shall be ready for immediate use
- The gas detection equipment for the cargo is calibrated and is in working order
- Ensure the following are agreed with the terminal:
  - Signals to be used for standby, start, slow down and to stop operations
  - Pumping rates
  - Pumping or loading sequence
  - Actions to be taken in case of emergencies

- Emergency shutdown procedures

- Ensure to close cargo related valves during cargo operations slowly to avoid pressure urges (shock pressures or liquid hammers)
- Ensure the hold and inter-barrier spaces are properly inerted or filled with dry air as applicable
- The oxygen content in inert gas shall not be more than 5% and also it shall not react with the cargo. Further lower levels of oxygen may be required for cargoes which may react with oxygen
- Shall not use ship generated inert gas with certain types of cargoes as it may contaminate the cargo (due to high CO_2 concentration in inert gas)
- Cool down of tanks and pipelines to be undertaken to control thermal stresses and loading rates should be restricted during cool down.
- Complete the safety check lists
- No cargo operations to be conducted if lightning in the immediate vicinity
- Monitor the tank pressures and temperatures during cargo operations as well as during the passage
- Ensure the re-liquefaction and boil-off control systems are in order to reduce cargo loss during the passage
- As the LNG (mainly methane) cargo cannot be re-liquefied (as it requires complex refrigeration cycle requiring considerable power), it may be vented or burned, to maintain tank pressures at required levels. Local regulations may prohibit venting of cargo. It may also be used as fuel and this is the only cargo that may be used as fuel.
- During discharging (in addition to above):
  - Cargo pumps are normally started with the discharge valve shut or fractionally open to reduce both the starting load and pressure surge. It may also be necessary to re-circulate to adjust pressures and cool deck lines.
  - The tank pressure will tend to fall as cargo is removed. If the discharge rate is high there may be insufficient boil-off to maintain positive pressure in the tank, and vapour should be added to prevent a vacuum. The vapour may come from the shore, or can be generated aboard by diverting some cargo liquid to a vaporiser. Tank pressures should be monitored throughout the discharge.
  - Discharge can cause pressure changes in the hold or interbarrier spaces, the rate of change depending upon the cargo system design. Pressures in such spaces should be watched during discharge and any necessary action taken.
  - On completion of discharge, liquid lines and cargo hoses or loading arms should be drained, purged and depressurised using the facilities provided. The isolating valves should then be closed and the ship-shore connections can then be broken. Bonding wires, if fitted, should not be disconnected until after the hoses have been disconnected.

REFER THE IGC CODE

6) Handling of container cargoes

a) Information required from the shipper

- Number of high cubes and normal cubes
- Number of 20, 40 footer etc. containers to be loaded
- Number of reefer containers
- Number of fan containers
- Information on IMDG goods (handling of IMDG goods are discussed separately)
- Number of oversized goods (over height, over width, over length cargoes stowed in open top containers and / or flat tracks)
- Port rotation and the destination of each container
- Verified gross mass

b) Documents required for cargo operations

- Documents related to IMDG goods (handling of IMDG goods are discussed separately)
- Stowage plan (usually, this is sent to the ship before arrival at the port of loading) and also a soft copy of the final loading plan will be provided by the planner after berthing. The chief officer shall ensure that it is complying with the ship's requirements.
- Bay plans
- Cargo manifest
- Verified gross mass of containers to be provided preferably by means of Electronic Data Interchange (EDI) or Electronic Data Processing (EDP) by the shipper
- Cargo securing manual
- Reefer manifest (if reefers are to be loaded)
- Cargo Safe Access Plan (CSAP) – for specially designed container ships only

c) Safety precautions to be observed before, during & after cargo handling

- Make sure the navigational visibility is not affected by the heights of the container tiers. This can be identified by the ship's stability computer and also container stacking plans.
- Ensure the tier heights do not affect the securing of the holds and the cargo gears. This can be identified by the ship's stability computer and also container stacking plans.
- Make sure the stack weight [maximum weight that can be loaded. This is similar to the load density but, the load density is provided per m^2. The stack weight is provided per container unit area (example - for 20 footers, 40 footers etc.). It is given in stability book and remember that the stack weight on deck and holds may not be the same] is not exceeded.

- NOTE – the "ALLOWABLE STACKING WEIGHT FOR 1.8 G" given on CSC plate (refer the CSC plate below[22]) on containers refers to a different stacking weight than mentioned above. It refers to the total load that can be loaded on top of that container. Therefore, make sure not to exceed the allowable stacking weight as well. "1.8 G" means when accelerated vertically 1.8 times the force of gravity. When a vessel is not moving, the weights of the containers which are loaded on top of each container will be acting on the bottom containers, but, when a vessel is pushed upwards by waves, a higher weight will be acting on the containers than the total masses of the containers loaded on top. That is why the "Allowable Stacking Weight" is calculated for a vertical acceleration of 1.8 times the force of gravity.

- Try to avoid isolated stacks of containers in holds or on deck. Where possible, load containers so that they are evenly distributed.
- Try to avoid loading heavy containers above light containers and at the top of a stack, unless the stowage arrangement is found satisfactory when checked using the approved loading computer. This will affect the vessel's GM and the lashings both.
- Make a lashing plan referring to the cargo securing manual.
- Make sure the IMDG cargoes are positioned in correct places (explained in detail below)
- Make sure the reefer containers and fan containers are loaded in correct positions as they need ship's power supply.
- Most of the container ships uses lashing bins (refer the picture below[23]) for collecting twist locks. When a vessel is berthed, lashing bins will be taken onto the pier by means of gantry cranes ashore or ship's cargo gears. These lashing bins can be secured on top of a 20-footer container. Need to make a space for the lashing bin.

[22] www.google.com/search?q=csc+plate+on+containers&tbm=isch&source=iu&ictx=1&fir=qUp_Xz43DjvnGM%253A%252CqpBUmxOy0Es88M%252C_&vet=1&usg=AI4_-kSazfVvIUDS0nRhdcxqWkR9KbOw_g&sa=X&ved=2ahUKEwiTmZaO96_hAhXBjOYKHXFWBM4Q9QEwBHoECAkQBg#imgrc=bvu7RSePsllBaM:&vet=1
[23] http://shipsbusiness.com/gearbox.html

- Container spreaders are used in handling containers by means of cranes and derricks. There are 20-footer spreaders for 20-footer containers and 40-footer spreaders for 40-footer containers. Spreaders are used only on ships used as feeder vessels and vessels visiting port which does not have gantries. Spreaders can be secured on top an equivalent size container. Therefore, need to allocate positions for securing spreaders. Refer the picture below[24].

Spreader

- During cargo operations:
  - Make sure the final loading plan (soft copy) provided by the planner complies with the ship's requirements.
  - Unlike of other ship's cargo operations, on container ships the cargo operations are very fast, having few gantries at one time depending upon the length of the vessel. Therefore, ensure the vessel is having sufficient stability throughout the cargo operations by calculating the stability for few worst-case scenarios.
  - Keep the anti-heeling pump on. Container ships experiences lists due to asymmetrical loading/discharging very often. On container ships there are two side tanks (one on port side and the other on the stbd side) which are known as anti-heeling tanks and 50% of the tanks are full of ballast water. The anti-heeling pump automatically detects the list and transfer ballast water between these two tanks in order to keep the vessel upright. This pump shall be switched off before the vessel proceeds to sea.
  - Do not let the cargo workers to drop lashing materials on deck as it may damage ship's deck as well as the lashing material itself.
  - Prepare damage reports for the damaged containers loaded (of course, they shall not be allowed to load if they are severely damaged)

[24] https://timarsportequipment.se/produkt.php?ID=448

- Make sure to make damage reports if the vessel's structure is damaged by the cargo workers.
- Ensure all the containers loaded are sealed.
- Plug/un-plug after loading and before discharging reefer containers. If possible, the motors of the reefer containers to be loaded facing aft to avoid damages by sea spray and severe winds.
- Ensure the duty officers are complying with the stowage and lashing plans provided to them.
- Duty officers shall ensure that only the containers that are to be discharged are discharged to prevent over carriage or under carriage of cargoes.
- Note down the date and time on the reefer temperature records at the time of loading and before discharging.
- Be careful when using double stacking cones (picture below[25] between containers which needs to be discharged at different ports.

- Reject if any leaking container is received.

• Make sure to take the lashing bins and spreaders on board before the completion of cargo operations.
• During the voyage:
  - Need to carry out a lashing inspections daily.
  - No hot works to be carried out close to IMDG goods.
  - With regards to reefer containers ensure:
    ➢ Temperatures are within the set temperatures. The set temperatures can be obtained by the reefer manifest or it will be written on the partlow chart (explained below) or indicated digitally on the reefer container;
    ➢ No alarms are activated. If any alarms are on, inform the electrical engineer and try to rectify it;
  - If found any IMDG cargo leaking, refer the IMDG code and give instructions to crew to take safety precautions. Inform the shipper, charterer, ship owner and P & I club and take required safety precautions.

[25] https://www.ec21.com/offer-detail/Sell-stacking-cone-double--5215005.html

d) Further information with regards to reefer containers

Reefer manifest

Refer the below sample reefer manifest;

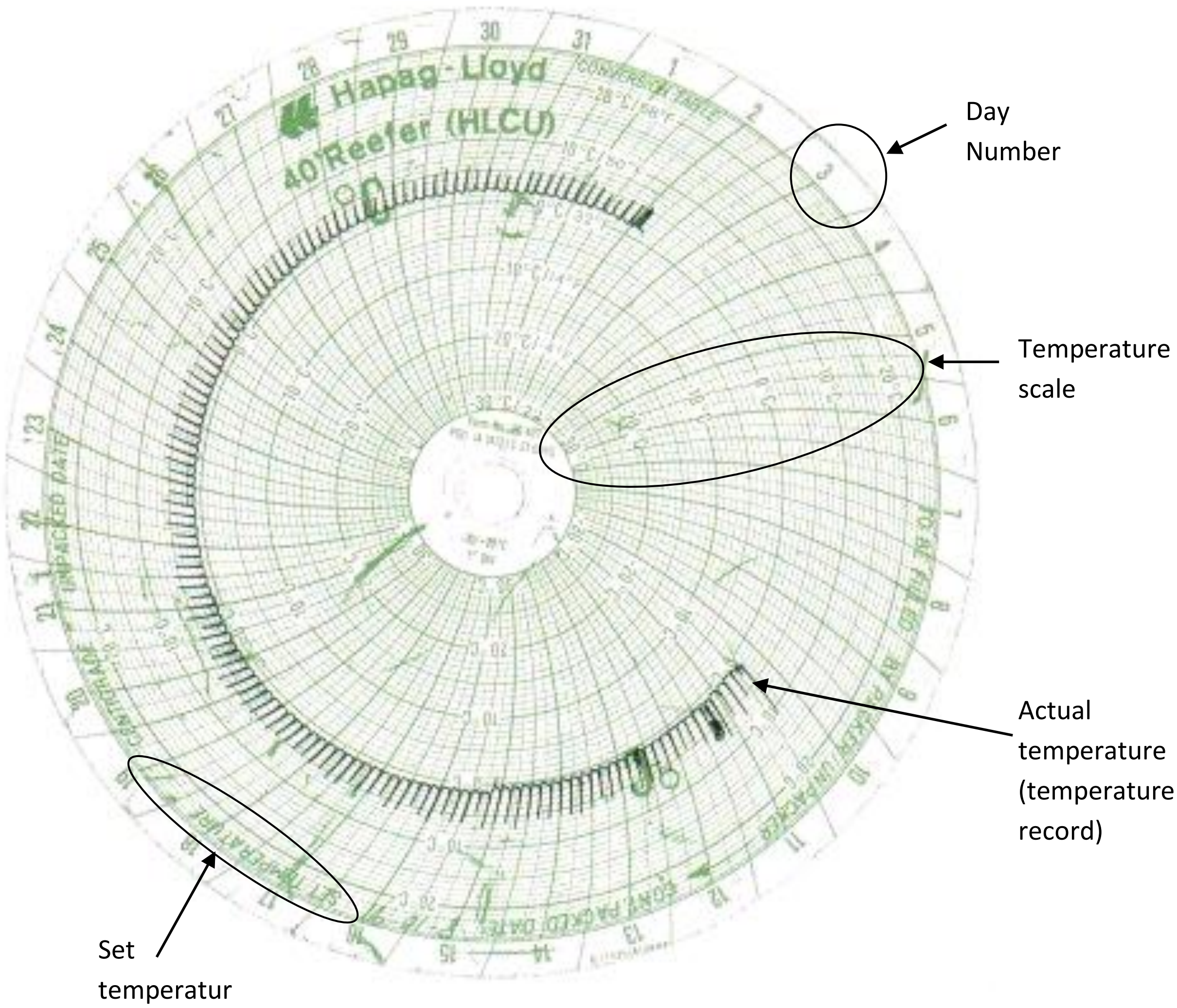
Name of the vessel:......... Voyage No.:............. Date:.............. Port of loading:..............

Container number	Container type			Commodity	Shipper	Consignee	Position onboard	Set temperature	Ventilation	Gross weight	Place of delivery	Remark (B/L No.)
	20'	40'	Other									

Partlow chart (temperature recording card)

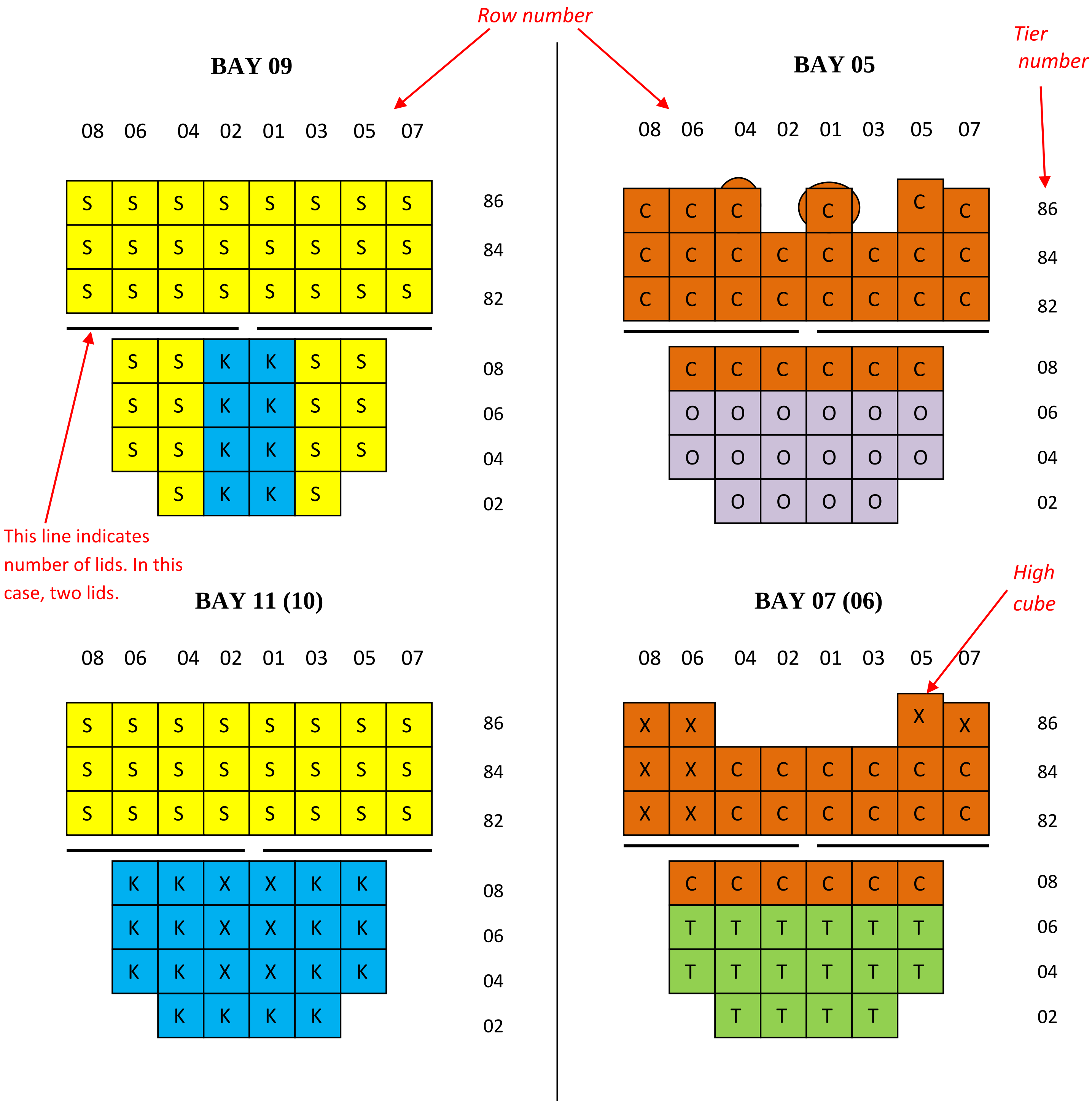
Usually, these charts are capable of recording temperature for a period of 31 days. Refer the below partlow chart for further details[26].

[26] www.google.com/search?tbm=isch&sa=1&ei=AI-iXOjsMdDXz7sP86GoSA&q=Partlow+chart+on+reefer+containers&oq=Partlow+chart+on+reefer+containers&gs_l=img.3...1863401.1871836..1874179...0.0..0.2761.9694.8-1j3......0....2j1..gws-wiz-img.2XmbFPlSN50#imgrc=oOTf5NOk-rZXEM:



e) Container stowage plan

On container ships there are two plans used related to container stowage, i.e. stowage plan and the bay plans. The stowage plan illustrates athwart ship cross sections of each bay, refer the figure below:

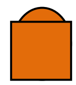
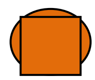


Apart from the diagrammatic illustration as shown in above, a container stowage plan will include:

- Port of loading
- Date of loading
- Voyage number

- IMDG Class
- Colour code
- Port rotation
- Departure draughts

Different colours are used to indicate different discharging ports. English alphabetical letters in capitol are used to indicate the name of the port. There are no internationally accepted codes or colour codes for this purpose. It can be decided by the user of the loading software. In the above container stowage plan;

S	- Singapore		
K	- Kobe		- Over height container
C	- Colombo		
O	- Osaka		- Over height & over width container
T	- Tokyo	X	- 40-footer container

Apart from the above abbreviations and symbols there are various symbols and abbreviations used to identify reefers containers, empty containers, containers with over length cargoes, containers carrying IMDG etc.

The above plan is prepared for a vessel having the below mentioned port rotation:

Colombo
Singapore
Kobe
Osaka
Tokyo

Carefully study the above plan by keeping the port rotation in your mind. The cargo to be discharged in the last port is loaded at the bottom most areas. This has to be considered (port rotation) when planning 40 footers on top of 20 footers as well.

Bay numbering

A bay means a container length (20-footer or 40-footer) area when looking through a bird's eye. Each odd number bay represents 20-footer slots. Each even number represents 40-footer slots. In accordance with the above stowage plan, bay number 06 means 40-footer slots consisting bay number 05 and 07. The 'X' mark indicates the 40 footers. In bay 06 there are 06 forty-footer containers on port side (on deck) and 2 forty footer containers on stbd (on deck) and no forty footers under deck in bay 06.

Row numbering

Odd numbers are used on the starboard side and even numbers are used on the port side in numbering rows. Numbering starts from the athwart ship centre line of the vessel. In the case of the above stowage plan, the number of starboard side slots equal to the number of port side slots (i.e. no centre most tier). If there is a centre most container tier, it will be numbered as ‘00’ and the rest will be numbered as usual.

Tier numbering

Different tier numbering systems are used for under deck and on deck container slots, but, in both cases, even numbers are used. In the case of under deck, numbering starts from ‘02’ and in the case of on deck slots its starts from ‘82’.

Container positions onboard

Any container can be identified by bay, row and the tier number. Refer the below example:

A container in position “06 05 86” means the bay number is 06, row number is 05 and the tier number is 86. That means the high cube in the above diagram.

Number ‘05 04 86’ refers to the over height container in the above diagram

Bay plan

This is the second type of cargo plan used on container ships and a bay plan will include detailed information about each container in a particular bay. This information includes:

- Loading port
- Discharging port
- Serial number of each container
- Row and the tier number
- Information with regard to nature of the cargo (such as reefer or IMDG)

Refer the below bay plan made for the underdeck containers of the bay number 11(10) of the above container stowage plan:

Loaded/discharge port

Row and tier numbers

Tier number

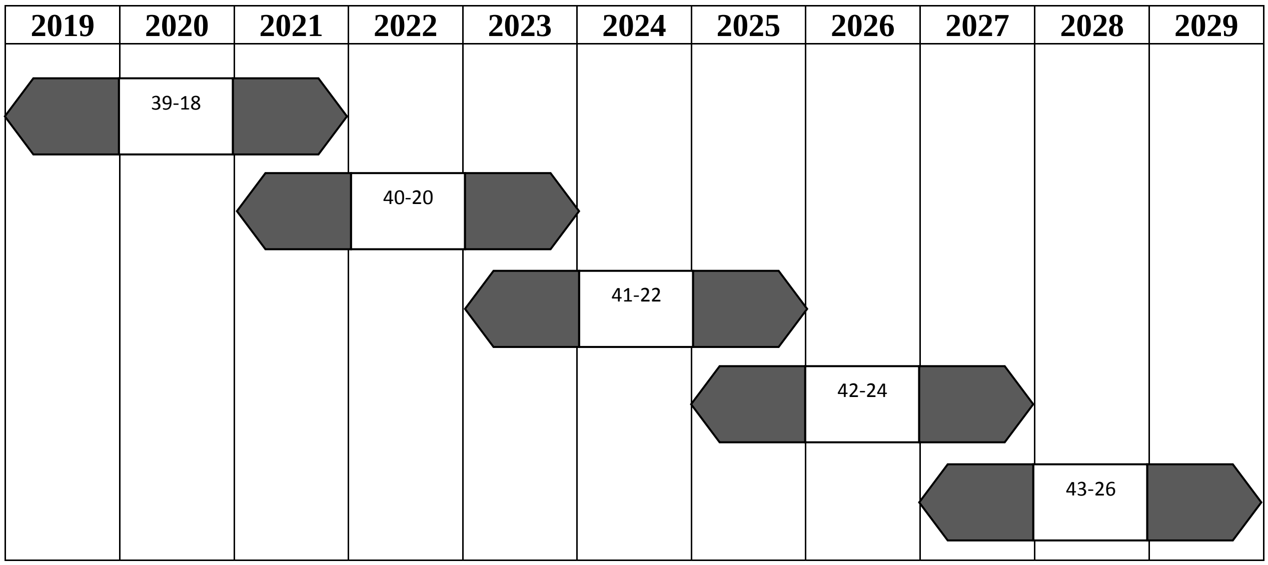
Total weight of the tier

MUM/Kobe Container No. 15 t 06 08	MUM/Kobe Container No. 15 t 04 08	MUM/Kobe Container No. 30 t 02 08	MUM/Kobe Container No. 30 t 01 08	MUM/Kobe Container No. 15 t 03 08	MUM/Kobe Container No. 15 t 05 08	08	120
MUM/Kobe Container No. 15 t 06 06	MUM/Kobe Container No. 15 t 04 06	MUM/Kobe Container No. 30 t 02 06	MUM/Kobe Container No. 30 t 01 06	MUM/Kobe Container No. 15 t 03 06	MUM/Kobe Container No. 15 t 05 06	06	120
MUM/Kobe Container No. 15 t 06 04	MUM/Kobe Container No. 15 t 04 04	MUM/Kobe Container No. 30 t 02 04	MUM/Kobe Container No. 30 t 01 04	MUM/Kobe Container No. 15 t 03 04	MUM/Kobe Container No. 15 t 05 04	04	120
	MUM/Kobe Container No. 15 t 04 02	MUM/Kobe Container No. 30 t 02 02	MUM/Kobe Container No. 30 t 01 02	MUM/Kobe Container No. 15 t 03 02		02	90

105	150	150	150	150	105	Permissible weight (t)
45	45	120	120	45	45	Max weight (t)
06	04	02	01	03	05	Row number

7) IMDG cargoes

a) Amendment cycle of the IMDG Code



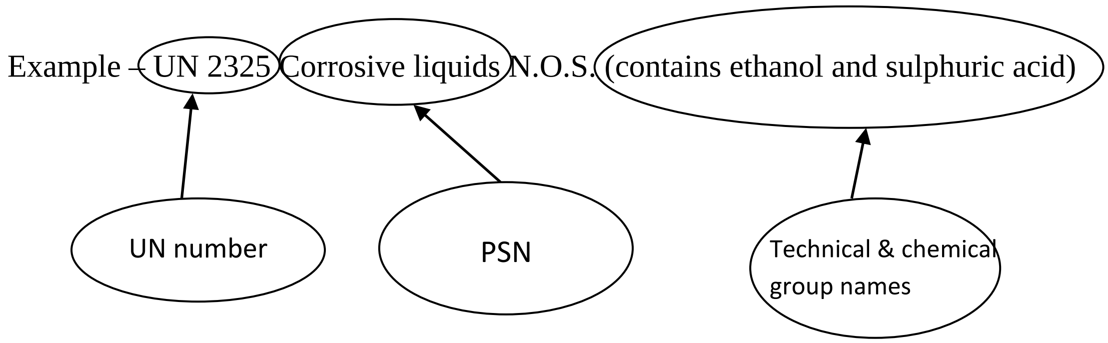
- Each amendment is valid for a period of 03 years
- Take the edition 39-18 as an example. From 1st of January 2019, it can be used voluntarily. From 1st of January 2020, it is mandatory. From 1st of January 2021, either the edition 39-18 or 40-20 edition could be used.

b) How to refer the IMDG Code

The code is to be referred against the UN number provided by the shipper in the dangerous cargo declaration and the UN numbers are listed in the DGL in the numerical order. But, if the UN number is not provided by the shipper, but if the proper shipping name is provided, UN number can be obtained from index page of volume 2 (the back of the Volume 2), since the proper shipping names are provided in the alphabetical order along with the UN number.

c) Generic or "Not Otherwise Specified" (N.O.S.)

Sometimes goods that may be considered as dangerous goods (but, not listed in the IMDG Code) or mixtures of dangerous goods may be received for shipment. Before packing into a container, these types of substances are tested to determine the nature of danger involved. Once the nature of danger is identified, a proper shipping name (PSN) and UN number (the UN number will be allocated in accordance with the nature of danger) will be allocated. Remember, these substances do not have a specific "proper shipping name" even though they are listed in the same column. That means, the name in the dangerous goods list (DGL) which most equivalently describes the substance or article is used as the PSN.



The main generic entries & all the N.O.S. entries given in the DGL are listed in Appendix A of Volume – 2.

d) Subsidiary risk (Sub-risks)

This means that a particular cargo has a "sub-risk" in addition to the main risk. On a shipper's declaration, it is indicated **within brackets** after the class if applicable. [example **- (5.1)**]
The subsidiary risks cannot be identified by referring to the IMDG label on a container, but, only by referring the column 4 of the DGL or by the shipper's declaration.

e) Packing group

IMDG cargoes (not all of them) are group into three groups known as "packing group", depending upon the degree of the danger. The PG I has the greatest danger and the PG III has the least danger. On a shipper's declaration this is given in **BOLD CAPITOL** letters. (Example - "**PG II**").

f) Limited quantities

Certain classes of dangerous goods can be transported if they are packed in small containers protected by an outer packing. Refer the Column 7a of the DGL & chapter 3.4 of volume 2 when carrying such cargoes in limited quantities.

Column 7a of the DGL provides the maximum quantity per inner packaging for transporting dangerous goods in limited quantities. If "0" is given in this column for a particular dangerous good, that cargo cannot be transported in by using provisions under limited quantities.

On a shipper's declaration this is indicated as "**LIMITED QUANTITIES**" or "**LTD QTY**" or "**GOODS SHIPPED IN LIMITED QUANTITIES**".

Stowage of goods when carrying in limited quantities

When carrying dangerous goods in limited quantities the *Stowage Category A* to be used and other towage provisions given in the column 16a of the DGL are not applicable.

Segregation of goods when carrying in limited quantities

The segregation provisions of chapters 7.2 to 7.7 of the volume – 1 and the column 16b of the DGL are not applicable, and, dangerous goods of division 1.4 compatibility group S shall not be stowed in the same compartment or hold with dangerous goods of class – I of compatibility groups A & L.

g) Excepted quantities

"Excepted quantities" are very similar to "Limited quantities" but the maximum inner and outer packages are smaller. That means, the amount of dangerous goods carried is smaller than under the provisions of limited quantity. Because the dangerous goods are packed in small containers and the outer package weight is limited, there are some exemptions from the rules.

On a shipper's declaration this is indicated as "**Dangerous goods in excepted quantities**".

Column 7b of the DGL contains an alpha-numeric code which indicates the maximum quantity for inner & outer packaging. Refer the table in chapter 3.5 of the IMDG Code to identify the meaning of alpha-numeric codes.

Stowage of dangerous goods of excepted quantities

Requirements of Stowage Category A to be complied with when carrying dangerous goods in excepted quantities. The provisions in column 16a of the DGL are not required to be complied with.

Segregation of dangerous goods of excepted quantities

Provisions given in chapters 7.2 to 7.7 and the column 16b of the DGL are not required to comply.

h) Segregation

The column 16b of the DGL provides segregation codes prefixed with "SG". Need to refer the volume 1 of the IMDG Code for the detailed segregation requirements for each dangerous cargo and these specific requirements are provided under the heading of "Segregation codes".

At the same time, a summary of segregation methods between classes are provided under the heading of "segregation table" in chapter 7.2.4 of the volume 1. This table provides only the **general provisions** for segregation between the various classes of dangerous goods. Therefore, in the case of conflicting provisions between "segregation table" and the DGL, the DGL takes precedence over the "segregation table".

i) Loading of IMDG

Information required

- Proper shipping name
- Class
- UN Number
- Packing group (if applicable)
- Sub-risk (if applicable)
- Flashpoint (if applicable)
- Marine pollutant (if applicable)
- EMS schedule
- Whether it is in limited or excepted quantity

Documents required

- IMDG Code and the supplement
- Document of Compliance (DOC contains which types of classes may be stored on different cargo areas of the ship and also it contains a list of equipment that need to have on board to carry IMDG) – issued by flag state
- Shippers declaration (declaring that proper shipping name, class UN number are correct, and the cargo is properly packed, marked, labelled and ready for shipment) – issued by the shipper
- Packing certificate (declaring that the container is packed in accordance with the applicable regulations) – issued by the packer [this is not required for tank containers]
- Dangerous goods manifest
- Copy of the competent authority approval for each consignment when carrying vehicles having metal hydride storage systems (refer UN number 3166)

Document of Compliance[27]

Chief Officers are required to have a good knowledge about the Document of Compliance (DOC) with regards to the loading of IMDG cargoes. Refer the below DOC and study it thoroughly to get a good idea.

The second page of a DOC (see the below DOC) refers to the loading of IMDG goods under deck and on deck. Read the end notes provided on the same page.

The last page of the appendix provides a list of equipment the vessel is supposed to have in order to carry IMDG cargoes.

[27] www.wanhai.com, CIBRDGCERT

(Compiler's note – This is a 6 page document. Pages 1, 3 & 6 are shown below)

DNV·GL

DOCUMENT OF COMPLIANCE FOR THE CARRIAGE OF DANGEROUS GOODS

G130073
Date of issue:
2017-11-08

Issued in pursuance of the requirement of regulation II-2/54.3 of the International Convention for Safety of Life at Sea, 1974, as amended
under the authority of the Government of

THE REPUBLIC OF LIBERIA

by **DNV GL**

Particulars of Ship

Name of Ship:	**CIMBRIA**
Distinctive Number or Letters:	**90902**
Port of Registry:	**MONROVIA**
Type of Ship:	**Container ship**
Date on v[illegible]d	**2002-04-22**
IMO Number:	**9241190**

This is to certify:

1. That the construction and equipment of the above mentioned ship was found to comply with the provisions of regulation II-2/19.3 as applicable according to II-2/1.2.4 of the International Convention for the Safety of Life at Sea, 1974, as amended.

2. That the ship is suitable for the carriage of those classes of dangerous goods specified in the appendix hereto, subject to any provisions in the IMDG Code for individual substances, materials or articles also being complied with.

This document is valid until **2022-10-16.**

Issued at **Shanghai, China** on **2017-11-08**

for **DNV GL**

This document is signed electronically in accordance with IMO FAL.5/Circ.39/Rev.2. Validation and authentication can be obtained from trust.dnvgl.com by using the Unique Tracking Number (UTN): n1066714-fud and ID: G130073

Xin Jian Amon Mo
Surveyor

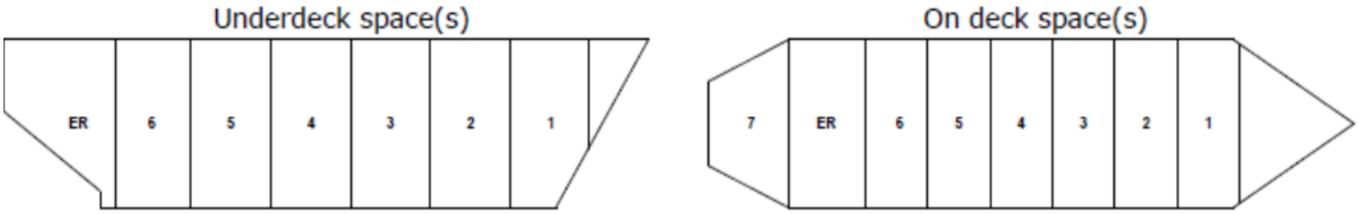
There are no special requirements in the above-mentioned regulation II-2/19 for the carriage or dangerous goods of classes 6.2 and 7, and for the carriage of dangerous goods in limited quantities, as required in chapter 3.4 of the IMDG Code, and excepted quantities, as required in chapter 3.5 of the IMDG Code.

APPENDIX

DNV GL Id No: **G130073**
Date of issue: **2017-11-08**

Sketch of the vessel

Cargo spaces indicated in the sketch are corresponding with the table(s) hereafter



Packaged goods

	Underdeck space(s)						On deck space(s)			
Class	**1, 2**	**3 to 6**					**ER 1)**	**1 to 6**	**7**	
1.1 to 1.6	**P 1)**	**X**					**X**	**P**	**X**	
1.4S	**P**	**P**					**P**	**P**	**P**	
2.1 hydrogen and hydrogen mixtures exclusively	**X**	**X**					**X**	**P**	**P**	
2.1 other than hydrogen and hydrogen mixtures	**P 1)**	**C 1)**					**X**	**P**	**P**	
2.2	**P**	**P**					**X**	**P**	**P**	
2.3 flammable	**X**	**X**					**X**	**P**	**P**	
2.3 non-flammable	**X**	**X**					**X**	**P**	**P**	
3 FP < 23°C	**P 1)**	**C 1)**					**X**	**P**	**P**	
3 23°C ≤ FP ≤ 60°C	**P**	**P**					**X**	**P**	**P**	
4.1	**P**	**P 2)**					**X**	**P**	**P**	
4.2	**P**	**P 2)**					**X**	**P**	**P**	
4.3 liquids	**P 3)**	**C 3)**					**X**	**P**	**P**	
4.3 solids	**P**	**C**					**X**	**P**	**P**	
5.1	**P**	**P 2)**					**P 2)**	**P**	**P**	
5.2	**X**	**X**					**X**	**P**	**P**	
6.1 liquids FP < 23°C	**P 1)**	**C 1)**					**X**	**P**	**P**	
6.1 liquids 23°C ≤ FP ≤ 60°C	**P**	**C**					**X**	**P**	**P**	
6.1 liquids FP > 60°C	**P**	**P**					**P**	**P**	**P**	
6.1 solids	**P**	**P 2)**					**P**	**P**	**P**	
8 liquids FP < 23°C	**P 1)**	**C 1)**					**X**	**P**	**P**	
8 liquids 23°C ≤ FP ≤ 60°C	**P**	**C**					**X**	**P**	**P**	
8 liquids FP > 60°C	**P**	**P**					**P**	**P**	**P**	
8 solids	**P**	**P**					**P**	**P**	**P**	
9 goods evolving flammable vapour exclusively	**P 1)**	**C 1)**					**P**	**P**	**P**	
9 other than goods evolving flammable vapour	**P**	**P 2)**					**P**	**P**	**P**	

P Indicates PACKAGED GOODS PERMITTED
C Indicates IN CLOSED FREIGHT CONTAINERS OR PORTABLE TANKS PERMITTED
X Indicates NOT PERMITTED

APPENDIX

DNV GL Id No: **G130073**
Date of issue: **2017-11-08**

List of equipment

According to the provisions of regulation 19.3 as applicable according to II-2/1.2.4

Para	Requirement	Equipment provided		
1.1	Compliance with reg. 10.7.2	**Hold 1 to 6: Fixed CO2 system**		
3.1.1	Immediate supply of water	**Remote start of the main fire pumps from the navigation bridge**		
3.1.2	Quantity of water and arrangement of hydrants	**Provided**		
3.1.3	Water cooling	**Hold 1, 2: Fixed water-spraying system of 5 l/min per m²**		
3.1.4	Cargo hold flooding	**Not provided**		
3.2	Sources of ignition	**Explosion protection of electrical equipment in**		
		Hold 1, 2: **Hold 3 to 6:**	**at least** **at least**	**IIB T5, IP65** **IIB T4, IP55**
		Electrical equipment is capable of being isolated in		
		Hold 1 to 6: **Hold 1 to 6:** **Hold 1 to 6:**	**lighting** **reefer container sockets** **reefer monitoring** **system**	**non-ex.-proof** **non-ex.-proof** **non-ex.-proof**
3.3	Detection system	**Hold 1 to 6: Sample extraction smoke detection and alarm system**		
3.4.1	Mechanical ventilation	**Hold 1, 2: Six air changes/h (Exhaust from upper and lower part)** **Hold 3 to 6: Two air changes/h (Exhaust from upper and lower part)**		
3.4.2.1	Safety of fans	**Hold 1 to 6: Provided**		
3.4.2.2	Wire mesh guards	**Hold 1 to 6: Provided**		
3.4.3	Natural ventilation	**Not applicable**		
3.5	Bilge pumping	**Hold 1 to 6: Additional bilge system, isolating valve with locking device and warning signs**		
3.6.1	Full protective clothing	**Four sets**		
3.6.2	Additional self-contained breathing apparatuses	**Two sets in addition to fire-fighter's outfits**		
3.7	Portable fire extinguishers	**Additional total of 12 kg dry powder**		
3.8	Insulation of machinery space boundaries	**Underdeck holds: Not applicable** **On deck space between frame no. 11 and 28: Located above engine room (deck(s) not insulated)**		
3.9	Water spraying system	**Not applicable**		
3.10	Separation of ro-ro spaces	**Not applicable**		

Sample of a Shipper's declaration

MULTIMODAL DANGEROUS GOODS FORM

1 Shipper/Consignor/Sender
Oil Field Services
K16B Platform
Continental Shelf
The Netherlands

2 Transport document number
QRG-12

3 Page 1 of 1 pages

4 Shipper's reference

5 Freight forwarder's reference

6 Consignee
Peterson SBS Den Helder BV
Paleiskade 43
1781 AN Den Helder

7 Carrier (to be completed by the carrier)
SNS Pool

8 This shipment is within the limitations prescribed for:
(Delete non-applicable)

~~PASSENGER AND CARGO AIRCRAFT~~ ~~CARGO AIRCRAFT ONLY~~

SHIPPER'S DECLARATION
I hereby declare that the contens of this consignment are fully and accurately described below by the Proper Shipping Name, and are classified, packaged, marked and labelled/placarded and are in all respects in proper condition for transport according to the applicable international and national governmental regulations.

10 Vessel/flight No and date
POOL VESSEL

11 Port/place of loading
K16B

9 Additional handling information
24 hour emergency response telephone number: (USA 011)++31-223-763456231

12 Port/place of discharge
DEN HELDER

13 Destination
Den Helder

UN	Proper shipping name	Class	PG	Flashp	EMS	# of pkg - type of packing	NET	GROSS	NEQ	Remarks
UN 1066	NITROGEN, COMPRESSED	2.2			F-C, S-V	4 Cylinders in gasrack CP-231	40 kg	200 kg		
UN 1072	OXYGEN, COMPRESSED	2.2 (5.1)			F-C, S-W	2 Cylinders in gasrack CP-231	22 kg	150 kg		
UN 1992	WASTE, FLAMMABLE LIQUID, TOXIC, N.O.S. (CONTAINS METHANOL, GAS CONDENSATE AND SLUDGE)	3 (6.1)	II	20 °C	F-E, S-D	1 Tank container THSA 796	2200 L	4600 kg		MARINE POLLUTANT
UN 2990	LIFE-SAVING APPLIANCES, SELF-INFLATING	9			F-A, S-V	4 life rafts, unpacked, loaded in basket GSA 342	380 kg	1246 kg		
UN 1268	PETROLEUM PRODUCTS, N.O.S.	3	II	2 °C	F-E, S-E	1 plywood box loaded in container HT-297	4 L	12 kg		LTD QTY

15 Container identification No./ vehicle registration No.
see above

16 Seal number(s)
n/a

17 Container/vehicle size &type

18 Tare mass (kg)

19 Total gross mass (including tare) (kg)
-

CONTAINER/VEHICLE PACKING CERTIFICATE
I hereby declare that the goods described above have been packed/loaded into the container/vehicle identified above in accordance with the applicable provisions.

MUST BE COMPLETED AND SIGNED FOR ALL CONTAINER/VEHICLE LOADS BY PERSON RESPONSIBLE FOR PACKING/LOADING

21 RECIEVING ORGANISATION RECEIPT
Recieved the above number of packages/containers/trailers in apparrent good order and condition, unless stated hereon: RECIEVING ORGANISATION REMARKS:

20 Name of company
Nederlandse Aardolie Maatschappij

Name/status of declarant
John Loosakker, MATCO

Place and date
K16B, 02 jul 2012

Signature of declarant

Haulier's name

Vehicle reg. no.

Signature and date

DRIVER'S SIGNATURE

22 Name of company (OF SHIPPER PREPARING THIS NOTE)
Oil Field Services

Name/status of declarant
John Loosakker, MATCO

Place and date
K16B, 02 jul 2012

Signature of declarant

Dangerous goods manifest

This is a document that is required to be submitted to the port before arrival and also before departure when carrying packaged dangerous goods (IMDG). This is also come under the IMO list of FAL forms. Refer the below form for further guidance

IMO DANGEROUS GOODS MANIFEST

(IMO FAL Form 7)

(As required by SOLAS 74, chapter VII, regulations 4.5 and 7-2.2, MARPOL 73/78, Annex III, regulation 4.3 and chapter 5.4, paragraph 5.4.3.1 of the IMDG Code)

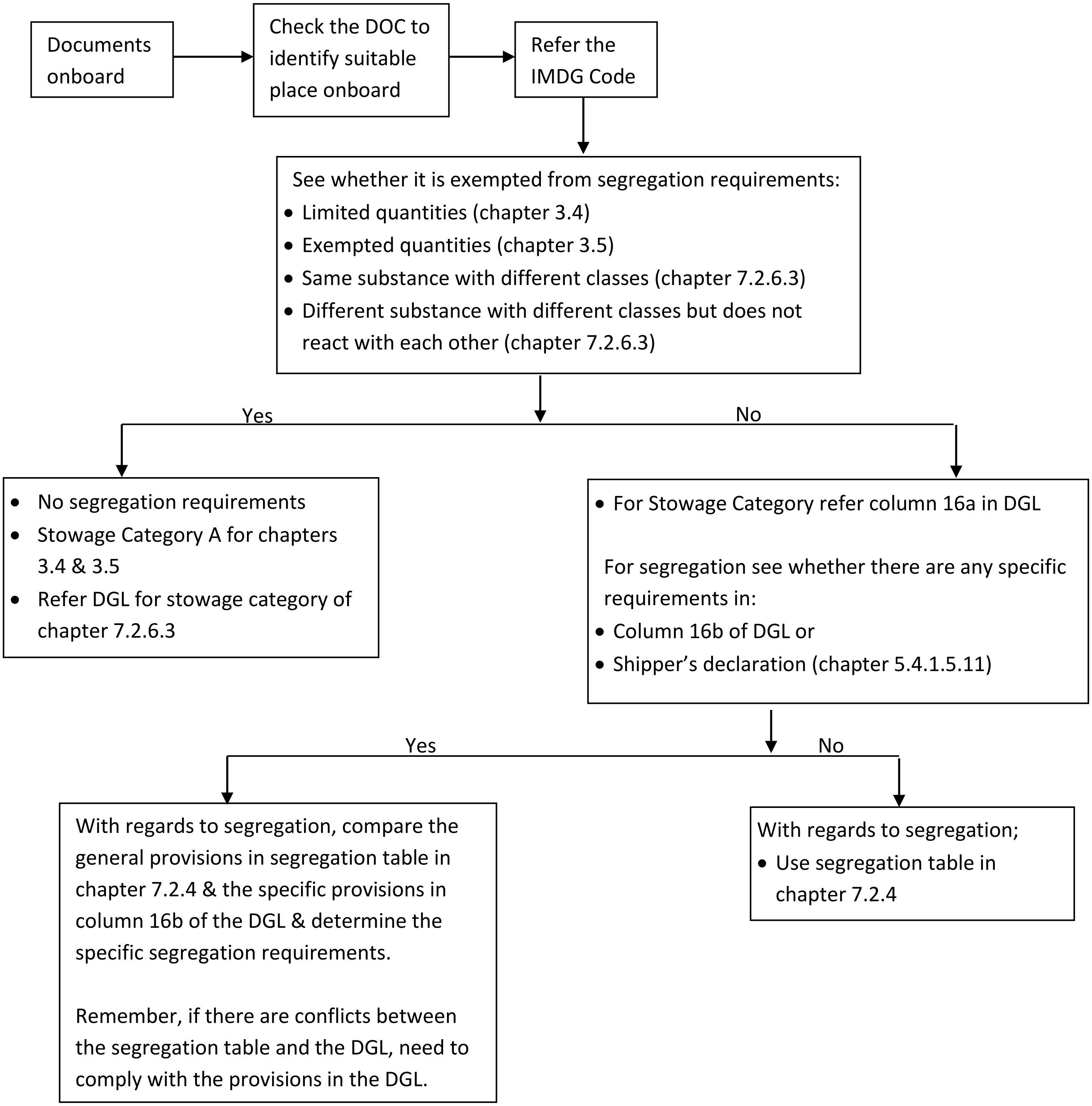
		Page Number
1.1 Name of ship	1.2 IMO number	1.3 Call sign

1.4 Voyage number	2. Flag State of ship	3. Port of loading	4. Port of discharge

5. Booking/ Reference Number	6. Marks & Numbers Container Id. No(s). Vehicle Reg. No(s).	7. Number and kind of packages	8. Proper Shipping Name	9. Class	10. UN No.	11. Packing Group	12. Subsidiary Risk(s)	13. Flashpoint (in ºC.c.c.)	14. Marine Pollutant	15. Mass (kg) Gross/Net	16. EmS	17. Stowage position on board

Additional information	
18.1 Name of master	19.1 Shipping Agent
18.2 Place and date	19.2 Place and date
Signature of master	Signature of Agent

Loading procedure of IMDG cargoes[28]



- Ensure the containers are not leaking and they are labelled correctly at the time of loading (do not forget the other usual precautions).

[28] Modified version of the Segregation table in chapter 7.2.8 of volume - 1

- Identify the emergency procedures from IMDG Supplement, make a summary of IMDG cargoes onboard against their relevant emergency procedures and make it available on the bridge.
- The loading information provided on a Document of Compliance is also in the ship's stability computer, therefore, while planning by means of the stability computer, if a DG container is placed in a wrong place, it will be highlighted in the stability computer with a warning sign.
- Information (relevant to segregation) provided in the IMDG Code also available in the stability computer. At the same time, the segregation information in the stability computer may not be updated in accordance with the latest amendments to the IMDG Code. Therefore, do not forget to refer the IMDG Code, when segregating between IMDGs.

Transport of vehicles by sea

- This applies when carrying vehicles (cars, lorries, boats, motor bikes etc.) powered by gas or liquid or batteries.

- The IMDG code classifies them as Class 9 and UN no. 3166.

- Vehicle or any containers having vehicles do not require any type of labelling, but the shipper need to provide dangerous goods declaration/s.

- If any fuel tanks of such equipment found leaking do not accept such cargoes onboard.

- IMDG code will not be applied if the fuel tank of the equipment is completely empty and batteries are protected against short circuits.

- Carriage of vehicles by sea are not subjected to the requirements of the IMDG Code, if vehicles are stowed on the special category and ro-ro spaces or on the weather deck of a ro-ro ship or a cargo space designated by the Administration in accordance with the SOLAS 74, chapter II-2, regulation 20 as specially designed and approved for the carriage of vehicles, and there are no signs of leakage from the battery, engine, fuel cell, compressed gas cylinder or accumulator, or fuel tank when applicable.

NOTE : TAKE COUPLE OF EXAMPLES OF IMDG CARGOES AND REFER THE CODE & THE SUPPLEMENT, TO BECOME MORE FAMILIAR WITH THE CODE

8) Bulk cargoes (in general)

a) How to refer the IMSBC Code

Each cargo in the code is assigned a Bulk Cargo Shipping Name (BCSN). The BCSN will be supplemented by the UN number (IMDG Code) when the cargo is a dangerous good. Individual schedules of solid bulk cargoes in the IMSBC Code are given in the alphabetical order of the BCSN.

b) Angle of repose

This is the maximum angle between the horizontal plane and the cone slop of a free-flowing granular material. This can be measured by:

- Laboratory testing (tilting box method)
- Onboard test method

Method of testing the angle of repose onboard:

- Fill a 3 litre conical flask with the cargo
- Pour about 2/3 of that on to a rough paper so as to produce a starting cone
- Then pour the rest of the cargo from a height of a few millimetres on top of the cone carefully
- Rotate the flask around the cone while pouring to make the cone symmetrical
- Using a protractor measure the angle without hitting the cone
- The angle should be measured at four places, about 90º apart
- Repeat the same thing for another two samples as well

c) Flow moisture point (FMP)

This is the percentage moisture content (wet mass basis) at which a flow state will develop.

d) Transportable moisture limit (TML)

This is the maximum moisture content of a cargo deemed safe for carriage by sea in ships other than specially designed ships. Cargoes having the moisture content higher than the TML shall only be transported on specially designed ships.

e) Measuring of moisture content onboard

Laboratory tests are required to be carried out to measure the moisture content accurately. The below mentioned method can be used to see whether the cargo contains substantial amount of moisture. If you suspect the moisture content given in the cargo declaration is wrong, you can request a new laboratory test certificate.

Half fill a cylindrical can (0.5 to 1 litre) with the cargo. Take the can in one hand and bring it down sharply to strike a hard surface (table) from a height of about 20 cm. Repeat this for about 25 times at one or two seconds intervals. Check the surface of the can for moisture or fluid conditions. If free moisture or a fluid condition appears, prepare arrangements to have additional laboratory tests, before loading.

f) Cargo groups as defined in the IMSBC

- **Group A**

  Cargoes which may liquefy if shipped at moisture content in excess of their TML.

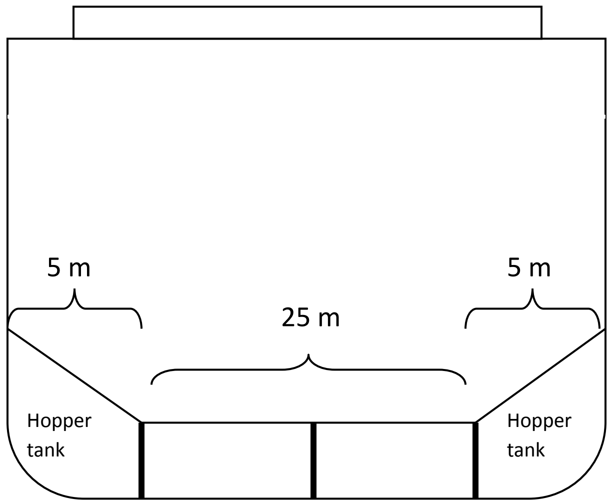
- **Group B**

  Cargoes which possess a chemical hazard which could give rise to a dangerous situation on a ship. Group B cargoes include;
  - Dangerous goods in solid form in bulk having the same UN numbers as given in the IMDG Code and
  - Materials hazardous only in bulk (MHB)

- **Group C**

  Cargoes which are neither liable to liquefy (Group A) nor possess chemical hazards (Group B).

g) Calculation of amount of cargo to be loaded



With reference to the figure above, assume that the;

Length of the hold	= 40 m
Breadth of the tank top	= 25 m
Horizontal width of one hopper tank	= 5 m
Load density of the hold	= 15 tm^{-2}
Volume of the cargo space	= 25000 m^3
Stowage factor of the cargo to be loaded	= 1.5 m^3t^{-1}

Calculation

Cargo area on the tank top = 40 x 25 = 1000 m^2
Weight of the cargo to be loaded on tank top = 1000 x 15 = 15000 t

Therefore, volume of the cargo on tank top = 15000 x 1.5 = 22500 m^3
Height of the cargo on tank top = 22500 / (40 x 25) = 22.5 m

Now, need to consider about the cargo that can be loaded on the hopper tanks as well. But, remember DO NOT INCREASE HEIGHT OF THE CARGO VOLUME MORE THAN 22.5 m.

The weight that can be loaded on one hopper tank can be calculated by the following formula:

Weight= 0.5 x length x horizontal width x load density

Therefore:

Weight on one hopper tank = 0.5 x 40 x 5 x 15 = 1500 t
Weight on both hopper tanks = 2 x 1500 = 3000 t
Volume on both hopper tanks = 3000 x 1.5 = 4500 m^3

Therefore:
Total cargo to be loaded = 3000 + 15000 = 18000 t
Total volume of the cargo = 22500 + 4500 = 27000 m^3

Therefore:
Volume of the cargo that can be loaded = 25000 m^3 (maximum cargo space)
In this case the KG of the cargo will be the VCG provided in the stability book for this cargo space.

If the hold space is more than 27000 m^3, then of course the KG of the cargo would be = 22.5 / 2 = 11.25 m

h) Loading of bulk cargoes

Information required

- BCSN (Bulk Cargo Shipping Name)
- Cargo group
- Stowage factor
- Angle of repose
- Trimming procedures
- Chemical properties (IMO class, UN number, whether the cargo is 'MHB')
- Moisture content
- Transportable moisture limit
- Any other information relevant to the cargo

REFER the Appendix 5 of the BLU Code or Section 4 of the IMSBC for further details

Documents required

- Enhanced survey report file
- For carriage of grain;
  - Document of authorization
  - Grain loading manual and
  - Grain code

- Shipper's declarations (refer the IMSBC Code for a sample form)
- Bulk Carrier Booklet/manual
- Document of compliance with the special requirements for ships carrying dangerous goods (this lists down the cargoes that can be carried on board)
- A list or manifest setting forth the dangerous goods on board and the location thereof
- Certificate of moisture content and transportable moisture limit
- Weathering certificate (this is a certificate, which states that the cargo was stored under cover but exposed to open air for not less than certain number of days. It is required only when the IMSBC Code says so. Refer Ferrosilicon & Silicomanganese in the Code. This is issued by the shipper) – if required
- Exemption certificate (exempting a substance or material from the provisions of the IMSBC Code, provided similar precautions are obtained. This to be issued by a competent authority) – if applicable
- Certificate of fumigation (if applicable)
- IMSBC Code
- IMDG Code (This is required when carrying dangerous goods in package form. The table in Chapter 9.3.3 of the IMSBC to be referred when carrying Group B cargoes and dangerous goods in package form, but, need to refer the IMDG Code as well for additional requirements with regards to stowage segregation of package dangerous goods)
- Medical First Aid Guide (MFAG)
- BLU Code (included in the supplement to the IMSBC)
- BLU Manual (included in the supplement to the IMSBC)
- Hold inspection certificate (pre-loading certificate) (this is issued by a surveyor after inspecting the holds to ensure that the holds are in a suitable condition to load the intended cargo)
- Load/discharge sequence plan
- Ballasting/de-ballasting sequence plan
- Ship/shore safety check list

Document of compliance

Chief Officers are required to have a good knowledge about the Document of Compliance (DOC) with regards to the loading of dangerous goods in bulk. Refer the below DOC and study it thoroughly to get a good idea. Remember this DOC is issued to a general cargo ship covering IMDG and IMSBC cargoes both.

The Appendix - I covers loading of solid dangerous goods in bulk. The categories of solid dangerous bulk cargoes that can be loaded in different holds are provided in the Appendix - I.

Refer the page 6 of the DOC for a detailed reference for 'Type' which is provided in the column two.

The information with regards to the loading of IMDG cargoes under deck and on deck ('weather deck' as stated in the DOC) are provided in the 3rd and the 4th pages (Appendix - II). Again, refer the page 6 of the DOC for a detailed reference for 'Type' which is provided in the column two.

Carefully read through the general notes provided in the page number 7 on handling of dangerous goods.

Document of Compliance

Special Requirements for Ships Carrying Dangerous Goods

Issued in the pursuance of the requirements of regulation II-2/19.4 of the International Convention for Safety of Life at Sea, 1974, as amended under the authority of the Government of the Hong Kong Special Administrative Region of the People's Republic of China by

	Particulars of ship
Name of ship	
Distinctive number or letters	
Port of registry	**HONG KONG**
Ship type	**General Cargo**
Gross tonnage	**14,859**
IMO number	
Date on which keel laid	**22 November 2010**

This is to certify:

1. that the construction and equipment of the above mentioned ship was found to comply with the provisions of regulation II-2/19 of the International Convention of Safety of Life at Sea, 1974 as amended; and

2. that the ship is suitable for the carriage of those classes of dangerous goods as specified in the appendix attached hereto, subject to any provisions in the International Maritime Dangerous Goods (IMDG) Code and the International Maritime Solid Bulk Cargoes (IMSBC) Code for individual substances also being complied with.

Important:

Possession of this Document does not absolve the Master from his responsibility to comply with safe operational procedures including those laid down in the International Maritime Dangerous Goods Code and the International Maritime Solid Bulk Cargoes (IMSBC) Code

This Document is valid until **11 March 2017**

Date of completion of the survey on which this Document of Compliance is based **12 March 2012**

Issued at **Nanjing** on **12 March 2012**

Surveyor

Note: There are no special requirements in the above-mentioned regulation II-2/19 for the carriage of dangerous goods of classes 6.2 and 7, or for the carriage of dangerous goods in limited quantities as defined in chapter 3.4 of the IMDG Code.

Appendix I

Cargo spaces carrying Solid Dangerous Goods in bulk

Name of cargo space	Type*	Classes of Dangerous Goods permitted to be carried	
Cargo Hold 1, 2, 3 (Bulk)	**4**	**4.1**	**Flammable solids(readily combustible solids and solids which may cause fire through friction)**
		4.2	**Substances liable to spontaneous combustion**
		5.1	**Oxidising substances (agents)**
		6.1	**Toxic Substances (solids)**
		8	**Corrosives (solids)**
		9	**Miscellaneous Dangerous Substances and Articles**

** Type of cargo space, regulation 19.2.2 (see notes)*

Form 1599a (2012.01)

Appendix II

Cargo spaces carrying Dangerous Goods except Solid Dangerous Goods in bulk

Name of cargo space	Type*	Classes of Dangerous Goods permitted to be carried	
Cargo Hold 1 (Packaged)	**1**	**1.1-1.6**	**Explosives**
		1.4S	**Explosives, Division 1.4 Compatability group 'S'**
		2.1	**Flammable Gases**
		2.2	**Non Flammable, Non Toxic Gases**
		2.3	**Toxic Gases Non Flammable**
		3	**Flammable liquids - low and intermediate flashpoint, less than 23 C**
		3	**Flammable liquids - high flashpoint, greater than or equal to 23 C but less than or equal to 60 C**
		4.1	**Flammable solids, self-reactive substances and solid desensitized explosives**
		4.2	**Substances liable to spontaneous combustion**
		4.3	**Substances which, in contact with water, emit flammable gases (liquids)**
		4.3	**Substances which, in contact with water, emit flammable gases**
		5.1	**Oxidising substances (agents)**
		6.1	**Toxic Substances (liquids) - low and intermediate flashpoint, less than 23 C**
		6.1	**Toxic Substances (liquids) - high flashpoint, greater than or equal to 23 C but less than or equal to 60 C**
		6.1	**Toxic Substances (liquids) - non flammable**
		6.1	**Toxic Substances (solids)**
		8	**Corrosives (liquids) - low and intermediate flashpoint, less than 23 C**
		8	**Corrosives (liquids) - high flashpoint, greater than or equal to 23 C but less than or equal to 60 C**
		8	**Corrosives (liquids) - non flammable**
		8	**Corrosives (solids)**
		9	**Miscellaneous Dangerous Substances and Articles**
Cargo Hold 2 & 3 (Packaged)	**1**	**1.4S**	**Explosives, Division 1.4 Compatability group 'S'**
		2.1	**Flammable Gases**
		2.2	**Non Flammable, Non Toxic Gases**
		2.3	**Toxic Gases Non Flammable**
		3	**Flammable liquids - low and intermediate flashpoint, less than 23 C**
		3	**Flammable liquids - high flashpoint, greater than or equal to 23 C but less than or equal to 60 C**
		4.1	**Flammable solids, self-reactive substances and solid desensitized explosives**
		4.2	**Substances liable to spontaneous combustion**
		4.3	**Substances which, in contact with water, emit flammable gases (liquids)**
		4.3	**Substances which, in contact with water, emit flammable gases (solids)**
		5.1	**Oxidising substances (agents)**
		6.1	**Toxic Substances (liquids) - low and intermediate flashpoint, less than 23 C**
		6.1	**Toxic Substances (liquids) - high flashpoint, greater than or equal to 23 C but less than or equal to 60 C**
		6.1	**Toxic Substances (liquids) - non flammable**
		6.1	**Toxic Substances (solids)**
		8	**Corrosives (liquids) - low and intermediate flashpoint, less than 23 C**
		8	**Corrosives (liquids) - high flashpoint, greater than or equal to 23 C but less than or equal to 60 C**
		8	**Corrosives (liquids) - non flammable**
		8	**Corrosives (solids)**
		9	**Miscellaneous Dangerous Substances and Articles**
Weather Deck	**6**	**1.1-1.6**	**Explosives**
		1.4S	**Explosives, Division 1.4 Compatability group 'S'**
		2.1	**Flammable Gases**
		2.2	**Non Flammable, Non Toxic Gases**
		2.3	**Toxic Gases (flammable)**
		2.3	**Toxic Gases (non-flammable)**
		3	**Flammable liquids - low and intermediate flashpoint, less than 23 C**
		3	**Flammable liquids - high flashpoint, greater than or equal to 23 C but less than or equal to 60 C**
		4.1	**Flammable solids, self-reactive substances and solid desensitized explosives**
		4.2	**Substances liable to spontaneous combustion**
		4.3	**Substances which, in contact with water, emit flammable gases (liquids)**
		4.3	**Substances which, in contact with water, emit flammable gases (solids)**
		5.1	**Oxidising substances (agents)**
		5.2	**Organic Peroxides**
		6.1	**Toxic Substances (liquids) - low and intermediate flashpoint, less than 23 C**
		6.1	**Toxic Substances (liquids) - high flashpoint, greater than or equal to 23 C but less than or equal to 60 C**
		6.1	**Toxic Substances (liquids) - non flammable**
		6.1	**Toxic Substances (solids)**
		8	**Corrosives (liquids) - low and intermediate flashpoint, less than 23 C**
		8	**Corrosives (liquids) - high flashpoint, greater than or equal to 23 C but less than or equal to 60 C**
		8	**Corrosives (liquids) - non flammable**
		8	**Corrosives (solids)**

**Type of cargo space, regulation 19.2.2 (see notes)*

Appendix II (continued)

Cargo spaces carrying Dangerous Goods except Solid Dangerous Goods in bulk

Name of cargo space	Type*	Classes of Dangerous Goods permitted to be carried	
Weather Deck	**6**	**9**	**Miscellaneous Dangerous Substances and Articles**

Type of cargo space, regulation 19.2.2 (see notes)

Form 1599a (2012.01)

Appendix II (continued)

Cargo spaces carrying Dangerous Goods except Solid Dangerous Goods in bulk

Name of cargo space	Type*	Classes of Dangerous Goods permitted to be carried

*Type of cargo space, regulation 19.2.2 (see notes)

Form 1599a (2012.01)

Space Type Definitions

The Space Types listed in Appendices I and/or II of this Document of Compliance refer to the following types of cargo space in which dangerous goods may be carried:

1 Ships and cargo spaces not specifically designed for the carriage of freight containers but intended for the carriage of dangerous goods in packaged form including goods in freight containers and portable tanks.

2A Purpose-built container ships and cargo spaces intended for the carriage of dangerous goods in freight containers and portable tanks (Open and closed freight containers).

2B Purpose-built container ships and cargo spaces intended for the carriage of dangerous goods in freight containers and portable tanks (Closed freight containers and portable tanks only).

3A Ro-ro ships and ro-ro cargo spaces intended for the carriage of dangerous goods (Closed ro-ro cargo spaces not capable of being sealed).

3B Ro-ro ships and ro-ro cargo spaces intended for the carriage of dangerous goods (Closed ro-ro cargo spaces capable of being sealed).

3C Ro-ro ships and ro-ro cargo spaces intended for the carriage of dangerous goods (Open ro-ro cargo spaces).

4 Ships and cargo spaces intended for the carriage of solid dangerous goods in bulk.

5 Ships and cargo spaces intended for the carriage of dangerous goods other than liquids and gases in bulk in shipborne barges.

6 Weather decks, space types 1 to 5 inclusive.

General Notes

A Goods of Class 1 should not be stowed within a horizontal distance of 6 metres from any fire, machinery exhausts, galley uptakes, lockers used for combustible stores or other potential sources of ignition and not less than a horizontal distance of 8 metres from the bridge, living quarters and life saving appliances. Classs 1.1 to 1.6 Dangerous Goods are to be stowed 3m from the machinery space boundary in all cases.

Class 1.1 to 1.6 (except division 1.4, compatibility group 'S'), 2.1, 2.3 flammable and Class 3, 4.3, 6.1 & 8 liquids with flash point under 23 C dangerous goods are not to be carried in a hold at the same time as reefer containers.

D Stowage and segregation of freight containers of different classes of dangerous goods in the hold and on the upper deck in compliance with the applicable requirements of the IMDG Code remain the responsibility of the Master.

F The Special Requirements for each product, as stated in the International Maritime Solid Bulk Cargoes Code (IMSBC Code), should also be complied with.

G There are no special requirements in regulation II-2 for the carriage of Class 7 (Radioactive Materials) dangerous goods.

As per the IMDG Code carriage of Class 5.2 Dangerous Goods, underdeck is prohibited.

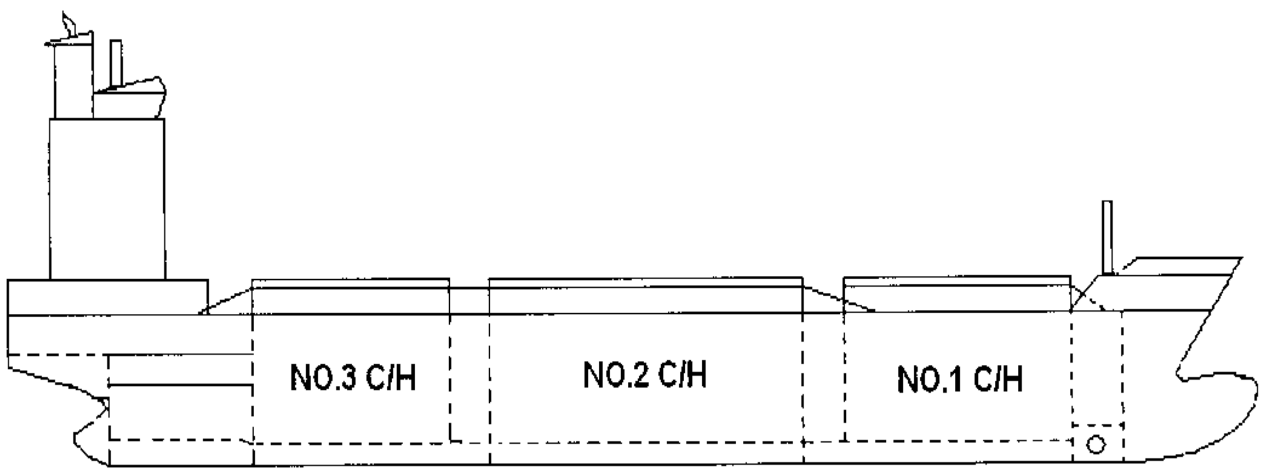
Dangerous goods of class 8 with a subsidiary risk category of 6.1, as per the IMDG Code, not to be carried underdeck.

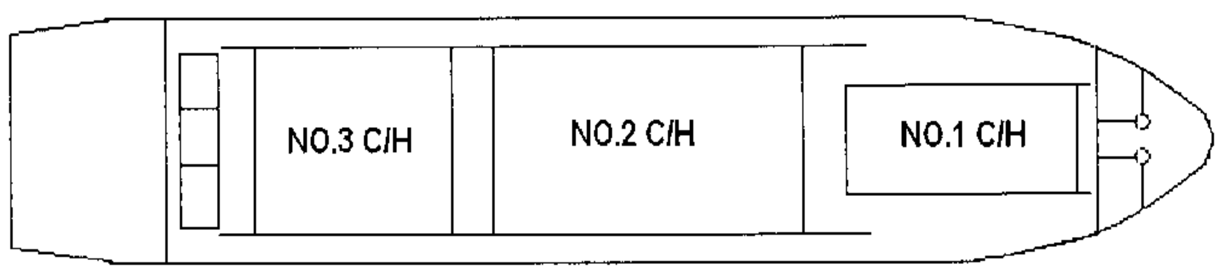
Goods of class 4.3 which, according to the IMDG Code having a flash point of less than 23 C not to be carried in packaged form underdeck.

Class 1 cargoes (excluding class 1.4S) cannot be carried in Cargo Holds at the same time as: Class 6 liquids and Class 3 & 8 liquids with flash point under 23 C.

Dangerous goods requiring electrical equipment of a standard greater than IIC/T5 in hold 1 and IIC/T4 in holds 2 & 3 should not be carried underdeck.

Ship Layout





Cargo planning procedure

Take BCSN from shipper's declaration

Refer Appendix 3 of the IMSBC Code, is it cohesive?

No

Yes

Check the angle of repose

No need to worry about angle of repose

If angle of repose $\leq 30^0$:

- refer the grain code

If, $30^0 <$ angle of repose $\leq 35^0$:

- The vertical distance (Δh) between the highest & lowest levels of the cargo surface should not exceed B/10 (B= beam of the ship in metres), with a maximum allowable Δh = 1.5 m or
- Loading is carried out with trimming equipment approved by a competent authority.

If, angle of repose $> 35^0$:

- The vertical distance (Δh) between the highest & lowest levels of the cargo surface should not exceed B/10 (B= beam of the ship in metres), with a maximum allowable Δh = 2 m or
- Loading is carried out with trimming equipment approved by a competent authority.

Refer the Appendix 1 of the IMSBC code for specific instructions & comply with them

For stowage & segregation of Group B & IMDG in package form;

- Refer the Section 9.3.3 of the IMSBC for segregation
- Refer the IMDG Code for stowage of IMDG in package form

Segregation between Group B cargoes;

- Refer the Section 9.3.4 of the IMSBC

Actual moisture content must be **below** the TML. If not need to comply with Section 7 of IMSBC

Plan loading complying with stability & stress requirements of the vessel

- If the cargo is a dangerous good (Group B cargo):
  - Refer the table "Segregation between solid bulk cargoes possessing chemical hazards" (in section 9.3.4) of the code for the purpose of segregating different types of dangerous goods
  - If dangerous goods in bulk and also IMDG to be carried, refer the table "Segregation between bulk materials possessing chemical hazards and dangerous goods in package form" (in section 9.3.3) for segregation
  - Refer the "special requirements" (in section 9.3.2) provided in the same section if it is applicable for the cargo

- If the BCSN is not in the Appendix 1 of the Code:
  - Master may accept cargoes, provided that:
    - ➢ Certificate stating the characteristics of the cargo and the required conditions for the carriage and handling of cargo is issued by a competent authority of the port of loading. These conditions will be prepared by the competent authority in consultation with:
      - ❖ the ship's flag state and a competent authority at the port of discharge – for Group A or Group B cargoes
      - ❖ a competent authority at the port of discharge

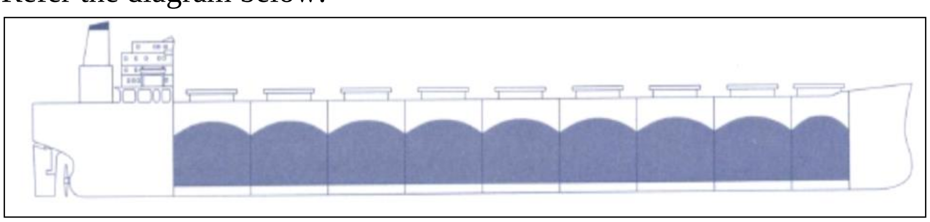
- Refer the Appendix 2 of the BLU Code for a sample loading & unloading plan and worked examples

  NOTE : TO BECOME MORE COMPETANT, REFER THE IMSBC CODE, BLU Code and BLU Manual

i) Selection of the holds[29]

Homogeneous hold loading

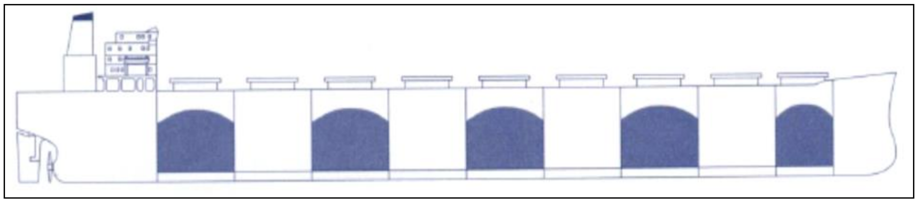
Distribution of cargo evenly in all cargo holds is known as homogeneous hold loading. This is a very common system in carrying low density cargoes such as grain, coal etc. Refer the diagram below:



[29] Bulk carriers - Guidance and Information on Bulk Cargo Loading and Discharging to Reduce the Likelihood of Over-stressing the Hull Structure, IACS

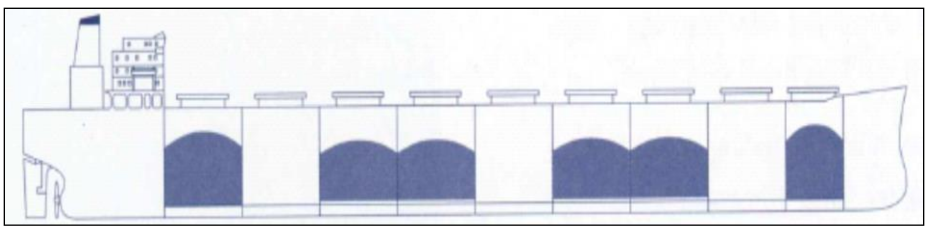
Alternate loading

This system of loading is helpful in reducing the GM while carrying high density cargoes, because without loading small amounts of cargoes in every hold, same volume of cargoes can be loaded in alternate hold. **Class approval is required for alternate loading**. This is mostly used on large bulk carriers when carrying high density cargoes. Refer the diagram below:



Block hold loading and part loaded conditions

This system is also helpful to improve the GM, to a certain extent. This method is usually used when the ship is to be partly loaded. Refer the diagram below:



Part loaded and block hold loading conditions are not usually described in the ship's loading manual unless they are specially requested to be considered in the design of the ship.

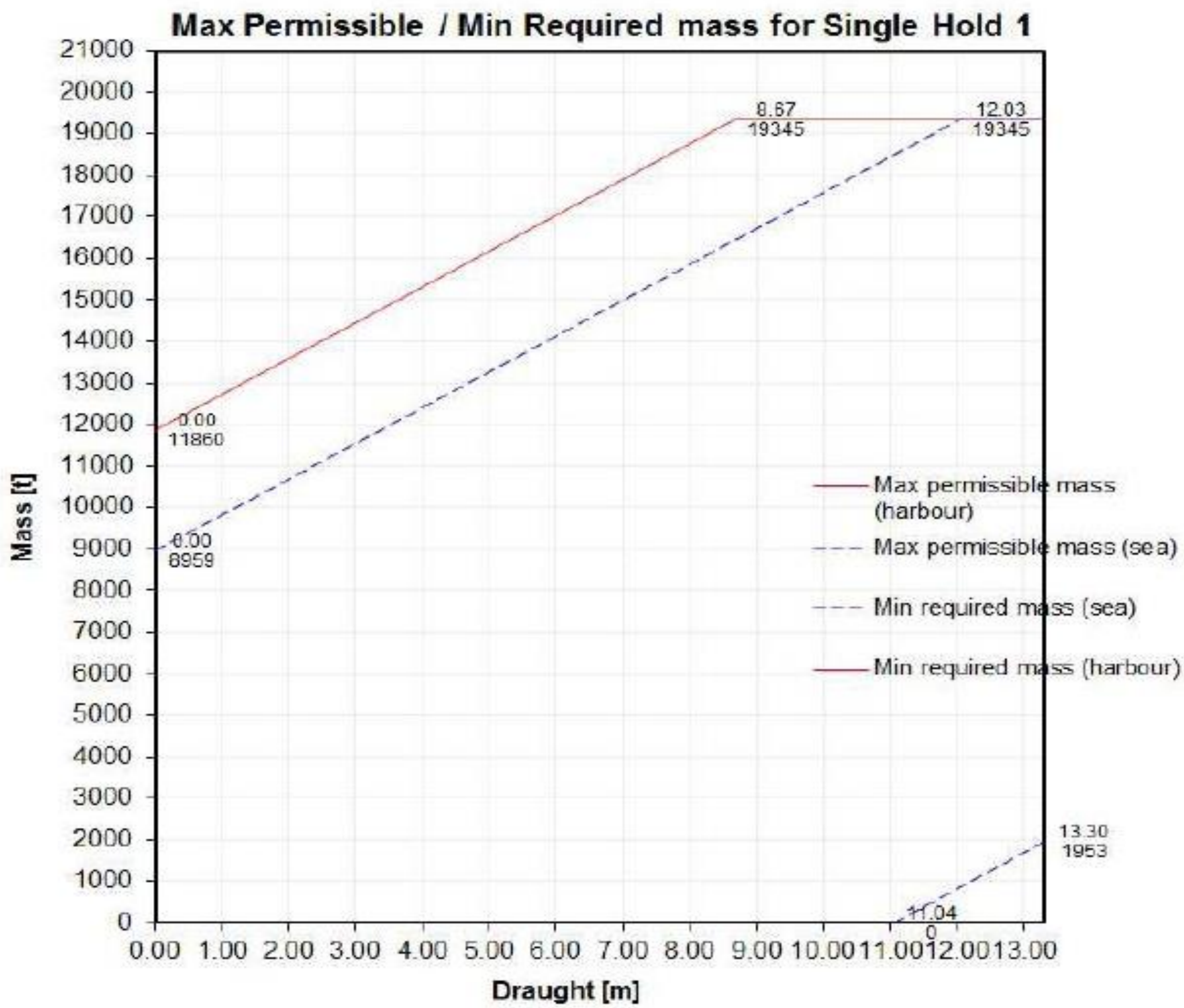
Allowable loading configurations in holds against the draught

To enhance safety and flexibility, all bulk carriers of 150 m in length and above are provided with local loading criteria which define the maximum allowable cargo weight in each cargo hold, and each pair of adjacent cargo holds (i.e. block hold loading condition), for various ship draught conditions. The local loading criteria is normally provided in tabular and diagrammatic form (hold mass curves).

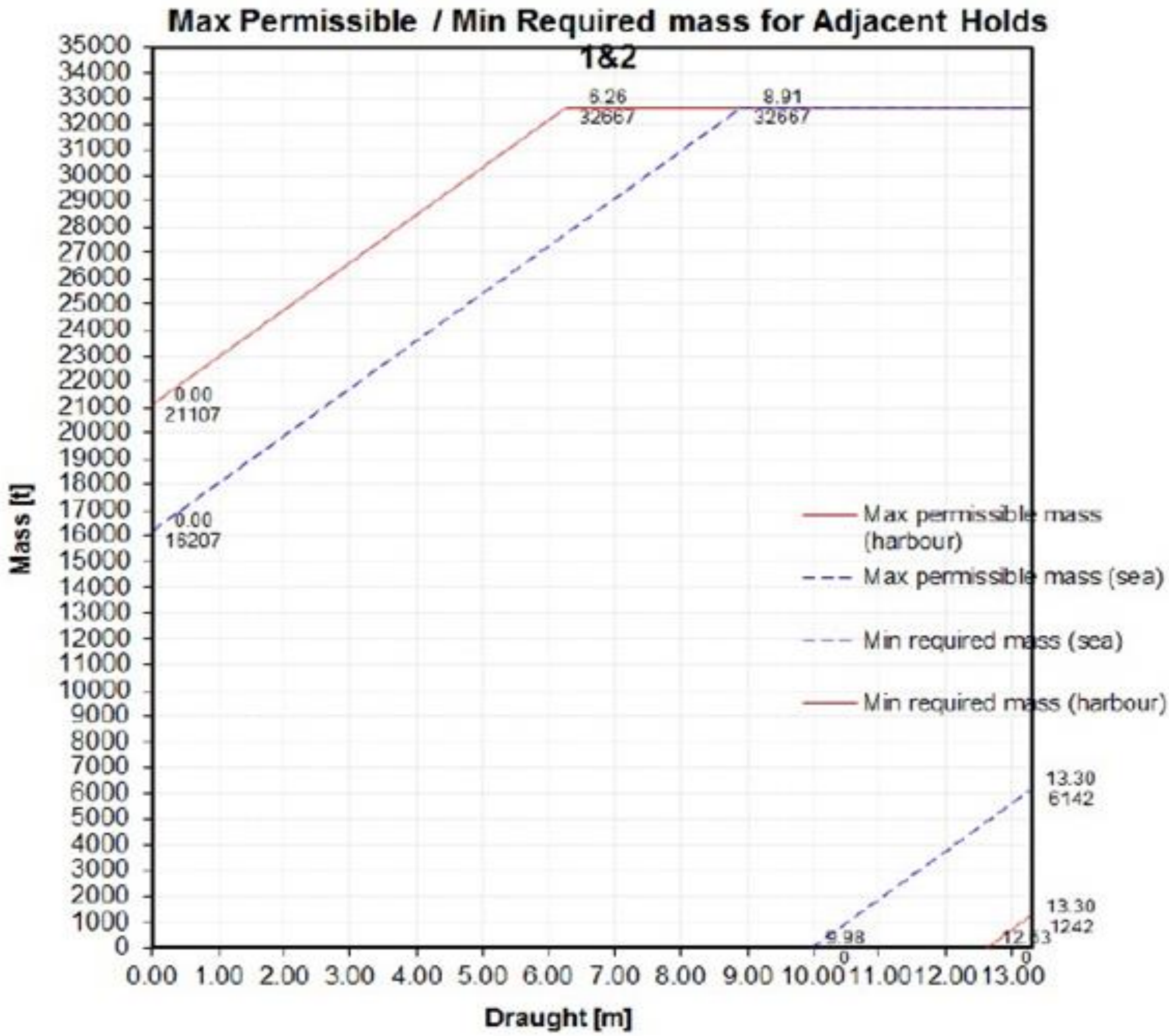
There are two sets of local loading criteria depending upon the cargo load distribution namely, **individual hold loading** or **two adjacent hold loading**.

In the case of **individual hold loading**, each cargo hold will have local loading criteria provided against the mean draught in way of the cargo hold(s). In the case of a single cargo hold, the ship draught at the mid-length of the hold should be used.

Refer the graph below for an example for an individual hold loading, which shows the maximum and minimum permissible weights that can be loaded in to hold number 1 against draft.



In the case of **two adjacent hold loading**, a vessel will be provided with local loading criteria for each pair of adjacent cargo holds against mean draught. With regards to **two adjacent hold loading,** mean draught is the average of the draught in the mid-length of each cargo hold. Refer the below graph for a sample two adjacent hold loading.



A hold and the adjacent holds shall not be loaded beyond the limits specified for the respective draught.

The above allowable cargo limits may include the weight of water ballast in the double bottom tanks and hopper tanks directly in way of the cargo hold. Therefore, if the water ballast also to be carried in such tanks the maximum cargo to be carried to be obtained by deducting the weight of water ballast to be carried.

Block hold or part loading shall be carried out only when:

- The loading distributions are described in the ship's loading manual **OR**
- The ship is provided with a set of approved local loading criteria which define the maximum cargo weight limit as a function of ship's mean draught for each cargo hold

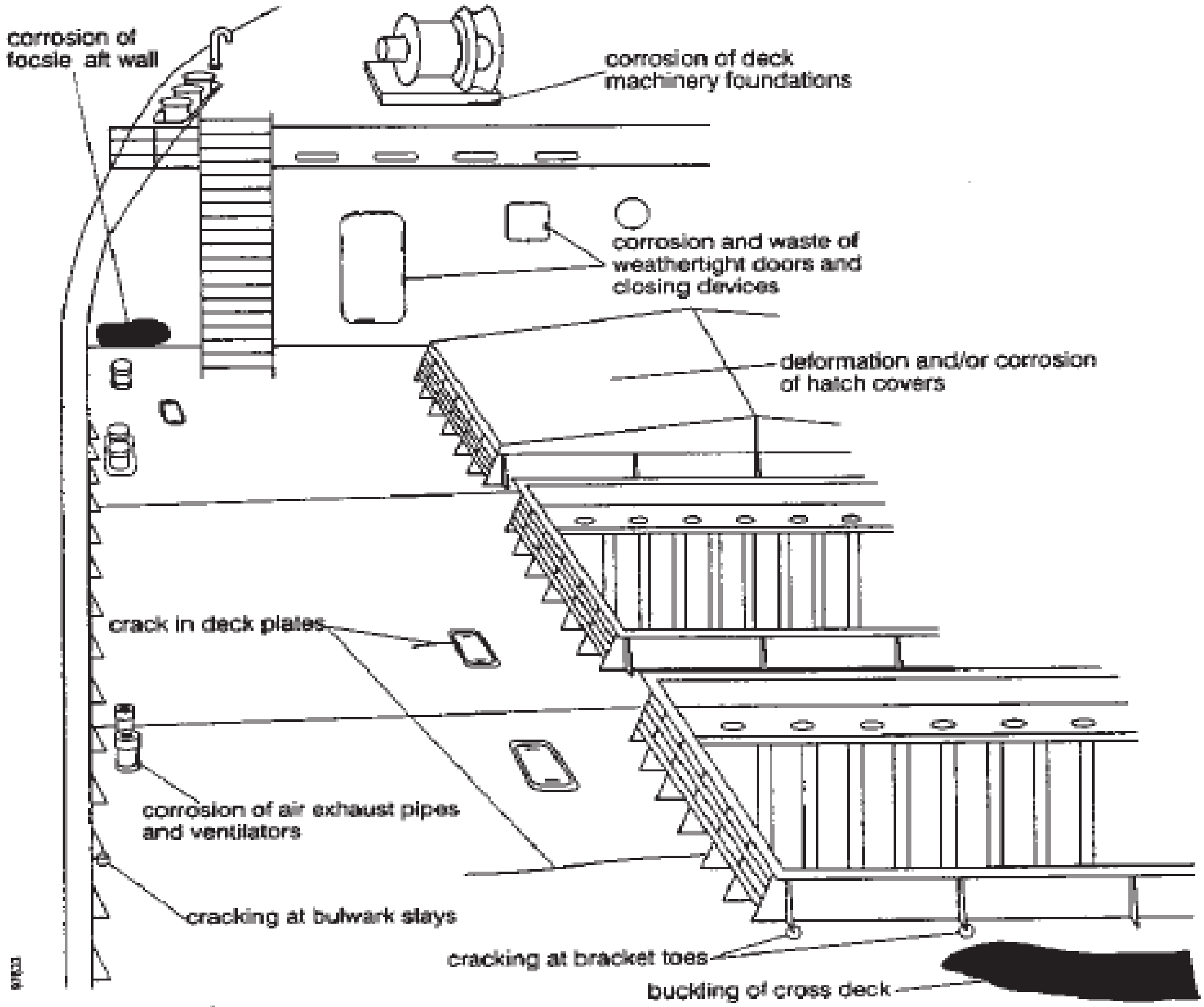
and block of cargo hold(s). In this case, it is necessary to ensure that the amount of cargo carried in each hold satisfies the cargo weight and draught limits specified by the local loading criteria and the hull girder SWSF and SWBM values are within their permissible limits.

Finally, loading cargo in a shallow draught condition can impose high stresses in the double bottom, cross deck and transverse bulkhead structures if the cargo in the hold is not adequately supported by the buoyancy force. If applicable, the cargo weight limits for each cargo hold, and two adjacent cargo holds, as a function of draught, (the local loading criteria) are not to be exceeded.

j) Hold preparation (in general)

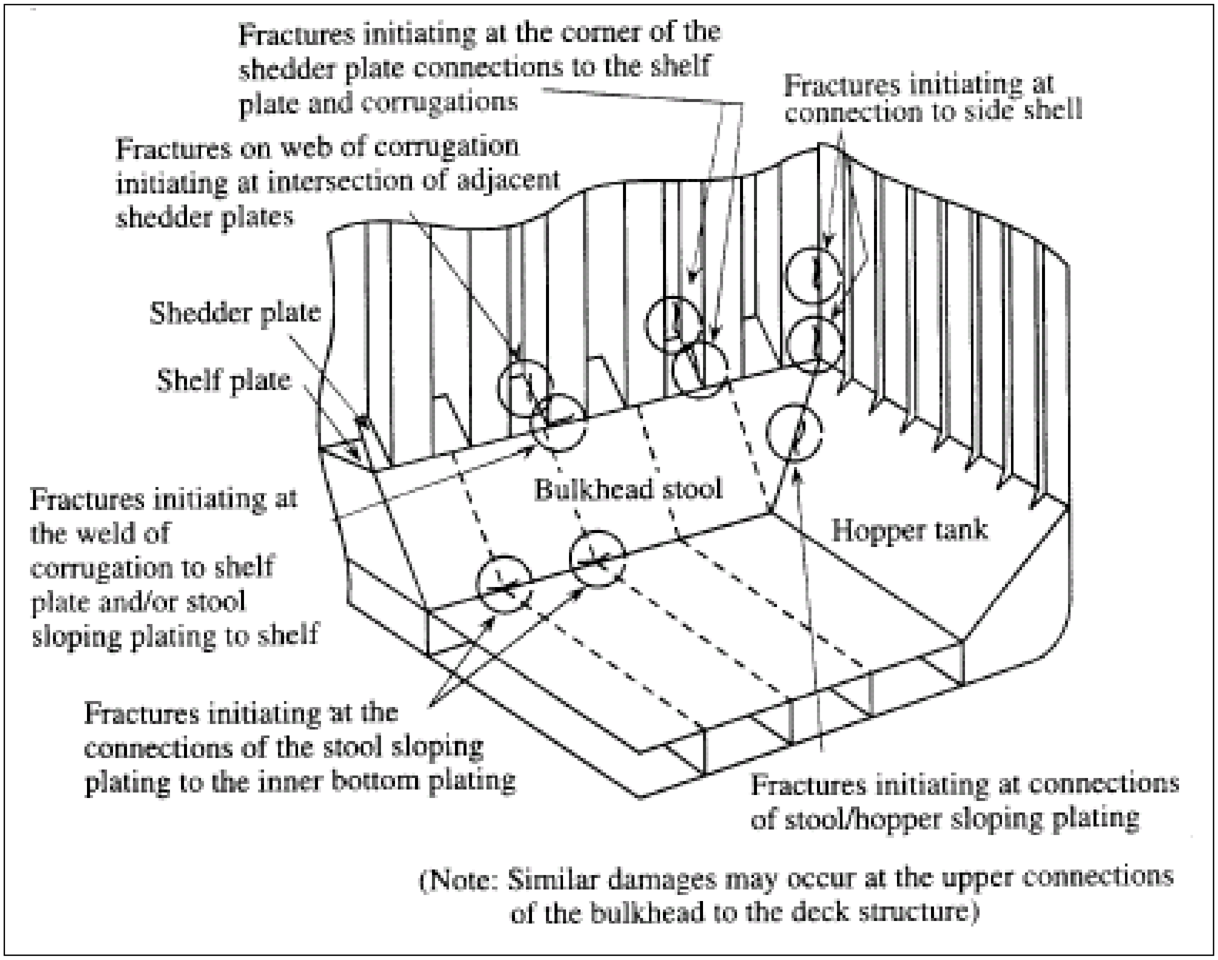
- Hatch covers to be in good condition including the rubber beadings.
- Hatch coamings to be cleaned.
- Make sure the drain valves at the hatch coamings are in order (hatches to be weather tight).
- Make sure the cleats are in order.
- Check the watertight integrity and easy opening of booby hatches to the holds.
- CO_2 systems (if fitted) must be working in order.
- Make sure the access ladders & the handrails are clean & safe for use.
- Holds to be clear of previous cargo residues and washed water.
- Check for grab, bulldozer damages and other damages caused due to corrosion and age of the vessel. The following two diagrams illustrate the most prone areas for damages on bulk carriers:

The deck areas[30]



[30] MGN 107 (M), MCA, UK

Under deck areas[31]



- If tank top manholes were opened for inspection purposes, ensure they are closed watertight
- Ensure no damages on sounding pipes, vent pipes etc.
- If fixed lightings or wirings available in the holds, ensure that they are in order (these to be isolated before commence loading)
- Check the bilge wells, bilge covers, strum boxes, including non-return valves.
- Try out the bilge system.
- Ensure the bilge high water alarms are in order
- Check for cracks
- Clean the holds as required by the trade/charterparty.
- Holds to be totally dry including the bilges.
- Holds to be odourless when carrying certain types of cargoes
- No insects, bugs (dead or alive) etc. when carrying certain types of cargoes
- Cleaning requirements may vary according to the previous cargo. If coal, petcoke (petroleum coke) etc. are carried, detergents are required to clean the holds.

[31] IACS Guidelines for Surveys, Assessment and Repair of Hull Structure – Bulk Carriers

k) Use of lime wash (calcium hydroxide)

This is a type of a “prewash” which creates a barrier between the cargo and the vessel’s steel structure. Therefore, this reduces cargo clinnage on bulkheads/tank top, reduces corrosion and also makes the cargo hold cleaning easy after discharging.

Lime wash is frequently used when loading bulk salt and sulphur to reduce corrosion effects. This is not transparent and little difficult to remove after discharging the cargo. Better the paint condition of the hold, less lime is required.

This will not eliminate the corrosion totally. It will only delay the corrosion. Therefore, if the bare metal is exposed, paint them first. The lime wash act as a physical barrier between the cargo and the ship’s structure and also it acts as an acid neutralising agent. If the cargo has acidic elements this neutralising effect will decay the lime wash, which may cause the cargo to touch the bare metal after a certain time period. One layer of lime wash will remain for about 30 days. Ensure the applied lime wash is totally dry before loading the cargo. Lime wash can be prepared by adding the following into a 200 litre drum & mix it well:

- 50/75 Kg of lime
- 2.5 Kg of sugar
- Warm fresh water

A lime wash may be applied by a roller brush or spray gun and bare metal should not be visible after applying. Apply a second coat if required.

Need to use high pressured water and caustic or citric acid cleaning chemicals to remove lime wash after discharging the cargo.

l) How to prepare stowage plan and a loading plan on a bulk carrier

‘Stowage plan’ means a plan showing the final loaded condition of a vessel, before departure. ‘Loading plan’ or a ‘loading sequence plan’ means a plan which shows intermediate steps of loading. The loading plan is very important to ensure the vessel is not over stressed at any stage during the loading operation. In case of discharging operation, needs to have a ‘discharging plan’ to ensure the vessel is not over stressed at any stage of the discharging process. A cargo loading/discharging plan may have:

- Amount of cargo to be loaded/discharged at each stage along with the hold number. This is called as ‘Pour’. The exact definition of ‘Pour’ is the quantity of cargo poured through one hatch opening as one step in the loading plan, i.e. from the time the spout is positioned over a hatch opening until it is moved to another hatch opening (in the stability computers used on board bulk carriers, amount of cargoes to be loaded or discharged can be calculated by using pour numbers.)

- Amount of ballast to be taken in or pumped out along with corresponding tank numbers.
- Ship's draughts and trim at the end of each stage.
- Calculated values of SF and BM at the end of each stage.
- Estimated time for completion of each stage of the cargo operation.
- Expected rate of loading/discharging and de-ballasting/ballasting.
- Time periods required to stop cargo operations for the purpose of completing ballasting or de-ballasting when cargo handling and the ballast water handling rates are not equal.
- Stoppages for trimming and draught surveys.
- Bunkering (if applicable).

Refer the samples of loading and unloading plans shown below[32]

[32] IMSBC Code

Example Loading/~~Unloading~~ Plan

The loading or unloading plan should be prepared in a form such as shown below.
A different form may be used provided it contains the essential information enclosed in the heavy line box.

LOADING OR ~~UNLOADING~~ PLAN Version No. 1	Date 96-03-24	Vessel BARBICAN				Voyage No. 044
Load/~~Unload~~ Port BOCA GRANDE	Cargo(es) IRON ORE	Assumed stowage factor of cargo(es) FINES 14 cft/t, LUMP 16 cft/t	Ballast pumping rate 4000 t/hr	Dock water density 1.025	Max draught available (HW) 17.88 m	Max air draught in berth N/A
To/~~From~~ Port JAPAN F.O.	Last cargo IRON ORE & COAL	No. of loaders/~~dischargers~~ 1	Load/~~discharge~~ rate 4500 t/hr		Min draught available (LW) 9.42 m	Max sailing/~~arrival~~ draught 17.88 m

	11	10	9	8	7	6	5	4	3	2	1
Tonnes			14756	17000	17382	16382	16382	16900	15382	15766	13050
Grade			FINES	LUMP	LUMP	LUMP	LUMP	FINES	LUMP	LUMP	FINES

Totals: Grade: FINES = 44706 Tonnes Grade: LUMP = 98294 Tonnes Grade: Tonnes Total: 143000 Tonnes

Pour No.	Cargo Hold No.	Cargo Tonnes	Ballast operations	Time required (hours)	Comments	Calculated values Draught Fwd	Calculated values Draught Aft	Maximum BM*	Maximum SF*	Calculated values Air draught	Calculated values Draught mid	Calculated values Trim	Observed Values Draught Fwd	Observed Values Draught Aft	Observed Values Draught Mid
1	4	10000	GO 123 UWT's	2.22	FINES	9.99	10.77	73	49		10.38	0.78			
2	1	7000	GO Upper Fore Peak PO 2 hold	1.56	FINES changeover 2 Hold	10.14	10.48	66	53		10.31	0.34			
3	9	8000	GO 5 UWT's PO Aft peak	1.78	FINES	9.42	12.15	63	59		10.79	2.73			
4	4	6900	PO 1DB's	1.53	FINES	10.12	12.50	80	43		11.31	2.38			
5	9	6756	PO 5DB's	1.50	FINES	9.56	13.74	80	45		11.65	4.18			
6	1	6050	PO Lower FP GO 2 UWT's	1.36	FINES	9.61	13.57	75	49		11.59	3.96			
					Change grade to LUMP										
7	7	10000	GO 6 Hold to 50%	2.22	LUMP	8.94	14.38	-58	55		11.66	5.43			
8	5	10000	PO 6 Hold	2.22	LUMP	9.63	13.63	-67	49		11.63	4.00			
9	7	7382	Educt 6 Hold	1.64	LUMP changeover 6 Hold	9.57	15.24	-64	47		12.41	5.67			
10	3	10000	PO 2&3 DB's	2.22	LUMP	10.41	14.65	-49	38		12.53	4.24			
11	8	10000	GO 4 UWT's	2.22	LUMP	9.58	16.66	-50	43		13.12	7.08			
12	5	6382	PO 4 DB's	1.42	LUMP	10.28	16.24	58	37		13.26	5.96			
13	8	6000	Educt as required	1.33	LUMP	9.90	17.88	53	38		13.89	7.98			
14	2	8000	Educt as required	1.78	LUMP	12.51	16.68	-65	46		14.60	4.17			
15	6	9000	Educt as required	2.00	LUMP	13.14	17.80	42	-21		15.47	4.66			
16	2	6000	Educt as required	1.33	LUMP	15.06	16.98	33	-14		16.02	1.92			
17	6	7382	Educt ballast lines	1.64	LUMP	15.59	17.88	48	-30		16.74	2.29			
18	3	5382	Shut down ballast	1.20	LUMP	16.95	17.54	44	-27		17.02	0.59			
					Trim check										
19	8	1000		0.22	LUMP	16.94	17.72	49	-30		17.33	0.79			
20	2	1766		0.39	LUMP	17.51	17.51	46	-27		17.51	0.00			
			DRAUGHT SURVEY		SEAGOING CONDITION	17.51	17.51	62	-36		17.51	0.00			
	TOTAL	143000													

Signed Terminal *G Goldstein*

Signed Ship *A. Smith*

NO DEVIATION FROM ABOVE PLAN WITHOUT PRIOR APPROVAL OF CHIEF MATE
Pours to be numbered 1A, 1B, 2A, 2B, etc when using two loaders
Abbreviations: PI - Pump In GI - Gravitate In F - Full PO - Pump Out GO - Gravitate Out MT - Empty
All entries within the box must be completed as far as possible. The entries outside the box are optional.

*Bending moments (BM) & shear forces (SF) are to be expressed as a percentage of maximum permitted in-port values for intermediate stages, and of maximum permitted at-sea values for the final stage. Every step in the loading/unloading plan must remain within the allowable limits for hull girder shear forces, bending moments and tonnage per hold, where applicable. Loading/unloading operations may have to be paused to allow for ballasting/deballasting in order to keep actual values within limits.

Example ~~Loading~~/Unloading Plan

The loading or unloading plan should be prepared in a form such as shown below.
A different form may be used provided it contains the essential information enclosed in the heavy line box.

~~LOADING OR~~ UNLOADING PLAN Version No. 1	Date 96-05-15	Vessel BARBICAN				Voyage No. 044
~~Load~~/Unload Port CHIBA	Cargo(es) IRON ORE	Assumed stowage factor of cargo(es) FINES 16 cft/t LUMP 16 cft/t	Ballast pumping rate 6000 t/hr	Dock water density 1.025	Max draught available (HW) 17.35m	Max air draught in berth 60m
~~To~~/from Port BOCA GRANDE	Last cargo IRON ORE & COAL	No. of ~~loaders~~/dischargers 2	~~Load~~/discharge rate 1250 t/hr per grab		Min draught available (LW) 7.59m	Max ~~sailing~~/arrival draught 17m

	11	10	9	8	7	6	5	4	3	2	1
Tonnes			14756	16910	17382	16382	16382	16900	15382	15470	13050
Grade			FINES	LUMP	LUMP	LUMP	LUMP	FINES	LUMP	LUMP	FINES

Totals: Grade: FINES = 44706 Tonnes; Grade: LUMP = 97908 Tonnes; Grade: — Tonnes; Total: 142614 Tonnes

Pour No.	Cargo: Hold No.	Cargo: Tonnes	Ballast operations	Time required (hours)	Comments	Calculated values: Draught Fwd	Draught Aft	Maximum BM*	Maximum SF*	Calculated values: Air draught	Draught mid	Trim	Observed Values: Draught Fwd	Aft	Mid
1A	2	15470	GI 1&2 DB's PI 2 UWT's	13.2	LUMP 2&6 Holds MT	13.82	16.29	-72	48			2.47			
1B	6	16382													
2A	5	10000	GI 4 DB's PI 4 UWT's	8.0	LUMP	13.44	14.54	71	56			1.10			
2B	8	10000													
3A	3	9000	GI 3 DB's	7.2	LUMP	12.19	13.68	77	78			1.49			
3B	7	9000													
4A	5	6382	GI 5 DB's	5.5	LUMP 5&8 Holds MT	12.67	15.22	68	38			2.55			
4B	8	6910	PI 6 Hold to 0.5m ullage												
5A	3	6382		6.7	LUMP 3&7 Holds MT	11.05	13.94	-91	59			2.89			
5B	7	8382													
			Draught survey and change grade to FINES												
6A	1	6000	PI 1&5 UWT's	4.8	FINES	9.75	14.01	83	42			4.26			
6B	9	6000													
7A	4	8756		7.0	FINES	9.38	10.64	80	52			1.26			
7B	9	8756													
8A	1	7050	GI & PI Lower Forepeak	6.5	FINES	7.59	11.30	84	-82			3.71			
8B	4	8164	PI Upper Forepeak & 3 UWT's												
					SEAGOING CONDITION	7.59	11.30	84	-82			3.31			
TOTAL		142614													

Instructions ① Please empty No.6 Hold and leave as clean as possible. This will then be used for ballast during stage 4.
② Grab and bulldozer blades must not be allowed to strike the ship's structure. Please instruct drivers to take special care.
③ Please note there are bilge and edutor plates in the after corners of each hold. Care required in these areas.
④ All damage to be reported. Holds to be surveyed on cargo completion.

Signed Terminal [signature]

Signed Ship A. Smith

NO DEVIATION FROM ABOVE PLAN WITHOUT PRIOR APPROVAL OF CHIEF MATE
Pours to be numbered 1A, 1B, 2A, 2B, etc when using two loaders
Abbreviations: PI = Pump In GI = Gravitate In F = Full PO = Pump Out GO = Gravitate Out MT = Empty
All entries within the box must be completed as far as possible. The entries outside the box are optional.

*Bending moments (BM) & shear forces (SF) are to be expressed as a percentage of maximum permitted in-port values for intermediate stages, and of maximum permitted at-sea values for the final stage. Every step in the loading/unloading plan must remain within the allowable limits for hull girder shear forces, bending moments and tonnage per hold, where applicable. Loading/unloading operations may have to be paused to allow for ballasting/deballasting in order to keep actual values within limits.

First of all, the chief officer has to complete the stowage plan. This is to be completed by spreading the expected amount of cargo to be loaded, between the holds available. A chief officer may have to shuffle the cargo between holds few times until the following conditions are complied with, for the departure condition:

- Complied with the stability criterion;
- GM_f is within the comfortable range (not stiff and not tender);
- Required draughts attained and upright;
- Load density is not exceeded;
- The estimated final weights of each cargo can be accommodated in the respective holds when considering with the stowage factor & load density; and
- SF and BM are within the safe limits for the 'Sea' condition.

Ensure the above criteria also complies with, at the time of arrival at the port of destination and also at any other critical stages of the voyage by adjusting the bunker, fresh water and other consumables as appropriate to the respective stages of the voyage. If so, the stowage plan can be finalized.

After preparing the stowage plan, the chief officer has to make a loading plan along with a de-ballasting sequence plan. Calculate the amount of cargo to be loaded along with the hold number and the amount of ballast to be discharged along with the tank number for each pour number. At the end of each pour number, make sure that:

- Has a sufficiently positive fluid GM;
- SF and BM are within the safe limits for 'Harbour' condition.
- Vessel is upright

While making a loading plan also, the chief mate will have to shuffle the amounts of cargoes to be loaded and amounts of ballast to be de-ballasted few times during each pour to ensure the above criteria are complied with.

Bulk carriers are provided with 'loading & discharging sequences manuals' which includes amount of cargoes to load, amount of ballast water to be discharged, estimated draughts at the end of each pour for couple of loading conditions. Select a loading condition similar to your cargo weight to be loaded & apply similar stages for each pour.

In the case of discharging cargo, need to have a discharging plan along with a ballasting sequence plan. Same as during loading, the chief officer has to ensure the above criteria are complied with at the end of each pour number.

A former loading plan or a discharging plan may be used as a guidance in making a loading or a discharging plan, but, ensure that the above criteria are complied with at the end of each pour number. The best option is to refer the loading & discharging sequences manual, select sequence similar to the required loading / discharging amount at present, prepare a loading or discharging sequence plan manually and input the figures into the stability computer to ensure everything is in order.

m) Carriage of ballast in bulk carriers

Bulk carriers are required to have ballast water in **ballast tanks alone** during the ballast passage to ensure a better fuel efficiency, propeller immersion, maintain a proper visibility from the bridge, maintain stability and stresses. This is known as **light ballast condition**.

Sometimes, may require carrying ballast water in **cargo holds** in addition to the ballast water tanks during the ballast passage. This is usually known as **heavy ballast condition** and used when bad weather is expected or when required to reduce the air draught. Usually this is achieved by filling the centre most cargo hold. You need to refer the **loading conditions** provided in the ship's stability book as well as the ship's ballast water management manual to identify the cargo hold that is allowed to ballast and also to see whether the cargo hold to be ballasted fully or partly.

No ballast water to be taken to cargo holds unless allowed by the loading manual.

Sailing with partially filled **ballast holds** shall be avoided unless the approved loading manual allows such practices. Cargo holds designed for partially filled in harbour for the purpose of reducing the ship's air draught are not to contain any water ballast while at sea.

Where a ship has been specially designed for partially filled ballast tanks and/or hold(s) whilst at sea, the filling levels specified in the ship's loading manual are to be followed.

Ballasting procedure of a **cargo hold (taking heavy ballast)** depends upon the system onboard the vessel, but, generally the below procedure to be followed:

- Ensure the cargo hold is sufficiently clean and no any cargo residues which may block the de-ballasting lines while de-ballasting
- Open the ventilators of the cargo hold.
- Bilge suction to be sealed to avoid accidental water leaking through the bilge line.
- Open the cover plate of the filling line in the cargo hold.
- Seal the CO_2 line to the hold.
- Open the pad lock used in securing the ballast valve in the engine room. This valve is kept sealed in the close position by means of a pad lock during the loaded passage to avoid accidental opening of the line.
- Once the pipe lines are set, the ballast pump can be started.

n) Ballast water exchange at sea

All ways follow the safety procedures provided in the ship's SMS, ship's stability manual and the ship's ballast water management manual.

The necessary stability calculations to be carried out at each intermediate step of the ballast water operation to ensure:

- Adequate intact stability is maintained.
- The permissible *seagoing* SWSF and SWBM are not exceeded.
- For each cargo hold and block of cargo hold(s), the combined weight of the cargo in the hold(s) and the water ballast in the double bottom and hopper wing ballast tanks directly in way of that hold(s) does not exceed the allowable *Seagoing* limits for all intermediate draught conditions (local loading criteria explained above for each hold shall not be exceeded).
- The present and forecasted sea and swell conditions must be favourable to ensure that no significant sloshing loads, which could cause structural damage to holds or tanks, could be developed.

To minimise the risk of structural damage, the exchange of water ballast at sea should always be carried out in calm weather conditions. All available weather forecasting should be utilised to determine that the weather condition is likely to stay calm within the '*weather window*' of the ballast water exchange operation. This '*weather window*' should be determined based upon the ballast water exchange sequence and the achievable ballasting/deballasting rates. A sufficient time margin should always be included to allow for any unexpected circumstances such as the breakdown of ballast pumps etc.

Ballasting and deballasting of each pair of symmetrical port and starboard wing and double bottom ballast tanks should always be carried out simultaneously, such that the amount of water ballast carried in each tank is always the same.

The progress of the ballast/deballast operation and the weather and sea condition should be closely monitored throughout the ballast exchange operation. The ballast water management manual may specify the upper limits of wind forces, swell heights and sea states where the ballast water exchange is not to be carried out.

The ballast water Convention describes three methods to exchange ballast water at sea as described below;

<table>
<tr><th>Methods</th><th>Procedures</th><th>Remarks</th></tr>
<tr><td>Sequential method</td><td>Tank is first emptied and then refilled with replacement ballast water to achieve at least a 95% volumetric exchange</td><td></td></tr>
<tr><td>Flow-through method</td><td>Ballast water is pumped into a ballast tank, allowing water to flow overflow</td><td rowspan="2">The flow-through method and the dilution method are considered as "pump through" methods.

Pumping through to be continued until three times the volume of the tank is overflown</td></tr>
<tr><td>Dilution method</td><td>Ballast water is filled through the top of the ballast tank with simultaneous discharge from the bottom at the same flow rate and maintaining a constant level in the tank throughout the ballast exchange operation</td></tr>
</table>

Refer the ballast water management manual of the vessel to identify the ballast water exchange methods which are allowed for your vessel. No other methods to be used.

If there is any difficulty in establishing a safe ballast exchange sequence, or if there is any doubt in the interpretation of an approved procedure or the stress limits imposed on the ship, **no attempt should be made to exchange water ballast at sea.**

Ensure not to reduce the draughts fwd and aft less than the minimum values stipulated in the ballast water management manual.

9) Grain cargoes

Before loading, holds shall be in 'grain clean' condition. That means:

- Remove all cargo residues from tank tops, bulk heads and deck heads of the cargo holds
- Remove loose paint, rust/scale particles
- Wash the cargo holds with sea water thoroughly
- Wash the holds with fresh water thoroughly

Whether the holds are partly full or 100% full, if the vessel is complying with the stability criteria provided in the International Grain Code no any methods are required to avoid shift of grain. Below mentioned methods may be used to avoid shift of grain if the vessel is not complying with the stability criteria provided in the Grain Code.

d) Methods available to reduce the shift of grain in a filled compartment

- By means of longitudinal subdivisions
- Using saucers
- The wings & ends of the compartments are to be tightly stowed with bagged grain.

e) Methods available to reduce the shift of grain in a partially filled compartment

- By means of longitudinal subdivisions
- Over stow with bagged grain
- Use of saucers
- Bundling
- By covering the surface of grain with a tarpaulin and a timber platform, then secure with overall lashings

10) Hazards and safety precautions to be observed when carrying certain types of solid bulk cargoes

a) Coal

- The dangers involved with coal includes:
  - Some types of coals emit methane in considerable amounts
  - Some types of coals are liable to spontaneous heating
  - Some types of coals are liable for spontaneous heating as well as emission of methane.
  - Some types of coal emit sulphuric acid ("Pond-Coal")
  - Cargo liquefaction ("fine-particle coal" and "coal slurry")
  - Some types of coal emit carbon monoxide

- Don't use mechanical blowers as it may create sparks.
- Natural ventilation is recommended and never do through ventilation.
- As per the IMSBC Code, ventilate continuously for 24 hrs after departure from port. It should be stopped when the methane concentration is considerably law. In fine weather conditions hatches could be left open, but don't open at once, as the sudden ingress of oxygen may lead to dangerous situations.
- If methane is mixed in a proportion of 5% - 16% by volume with air constitutes an explosive atmosphere which may be ignited by a spark. Therefore, surface ventilation must be carried out, if the methane concentration is closer to the above limits.
- While loading, arrange means to take the temperatures during the passage.
- The electrical cabling in cargo and adjacent spaces to be free from defects.
- If the temperature exceeds 55º C and is rising rapidly, seal ventilation, start boundary cooling and seek for expert advice. Do not use water directly on the cargo. Consider about diverting the vessel to a port of refuge.
- When going into tropical areas, try to cool the deck area by using tarpaulin, limber boards, deck water etc.

- Check the pH value of hold bilges before pumping out. If it is acidic, it will increase corrosion.
- Since methane is lighter than normal air, it may leak into adjacent places and adjoining tanks. Therefore, check the gas levels before entering into enclosed spaces.
- Some types of coal are shipped in wet condition (coal slurry), will turn out about 3% less than in weight. Therefore, records of bilge pumping should be kept, and B/L's should be claused to adequately protect against claims for short delivery.
- Ensure no smoking in unauthorized areas
- Do not stow adjacent to hot bulkheads or any heat sources.
- Trim the cargo

b) Concentrates

Concentrates are usually in small granular or powder form. Generally, concentrates are very dense and may be liable to act as a liquid, but, remember that different types of concentrates may behave differently. There are different types of concentrates such as iron ore concentrates, copper concentrates etc.

- Usually powdery in form and liable to have a high moisture content.
- Under certain conditions, have a tendency to behave almost like a liquid.
- Sometimes appear to be in a relatively dry condition when loading, but at the same time, contain sufficient moisture to act as a fluid due to the movement and vibration of the vessel.
- If the moisture content is above the TML cargo may shift as a result of liquefaction. Cargo may flow to one side of the hold with one roll but not flow fully back with the next roll, thus increasing the list and the possibility of capsizing.
- As this is a powdery material, it may affect the people engage on deck work and also the deck machinery.
- Ensure to cover all the deck machinery, provide face masks to the deck watch keepers. Most probably the AC has to be put on recirculation mode.
- If the concentrate is a high-density cargo:
  - consider about alternate loading system, to avoid higher GMs. Make sure to follow the instructions given by the loading manuals if doing so.
  - trim level to avoid structural damages and cargo shifts during passage
  - start at a slow loading rates and avoid higher free fall to avoid localized impacts

c) Cargoes that may liquefy

- Do not ship any cargoes with moisture contents above TML.
- No cargo containing liquids to be stowed in the same space, except canned foods.

- Avoid ingress of fresh water.
- Do not use water to cool the cargo but if unavoidable use a spray.
- All cargoes liable to liquefy should be trimmed level on completion of loading.
- The cargo should be properly sampled, and a copy of results should be kept on board.
- Refer the IMSBC code for details of sampling procedures.
- If the master doubts the condition of the cargo for safe carriage, refer the IMSBC Code for details of approximate tests which can be carried out on board the vessel.
- May have to use shifting boards.

d) Sulphur

There are two types of sulphur having completely different characteristics. The first type (Group C, as categorised in IMSBC) is not considered as hazardous, no corrosion effects and not dangerous for human tissue or vessel. But, the other one (Group B, as categorised in IMSBC) is flammable; dust explosions may take place during loading/discharging and hold cleaning. At the same time, the second type of sulphur is toxic, very irritating and suffocating gas when involved in a fire. The second type of sulphur shall not be transported in bulk when in fine grain form. Refer the IMSBC Code for further details. In general, following precautions shall be taken:

- Emits small volumes of hydrogen sulphide, therefore, need to follow entry in to enclose space procedures.
- May emit SO_2 if exposed to heat
- Dry sulphur is not corrosive. But the wet sulphur is corrosive
- Fire might occur due to static electricity generated on loading pipes. These fires can be extinguished by using sulphur itself and or freshwater spray
- Since, some countries consider the sulphur dust as an air pollutant, they use water spray over bulk sulphur while handling, to avoid releasing of sulphur dust into the atmosphere.
- Ensure the holds are thoroughly cleaned to maintain the purity of the cargo. Usually, need ‘grain clean’ standards. Washing with fresh water is required to achieve grain clean standards and also to remove salt, as the corrosive effect is higher with the presence of salt.
- Ensure the paint condition is sufficient to avoid corrosion
- Lime wash if required
- Cover the bilges with burlap to avoid bilges being choked
- Check the bilges daily after loading and pump out if required. Maintain the records of the same.
- Clean and wash down the decks after the completion of cargo operations

- After discharging the cargo, clean the holds thoroughly and ensure no cargo residues in the holds

e) Direct Reduced Iron (DRI, also known as sponge iron)

Direct reduction of iron is the removal of oxygen from iron ore, without melting in a furnace. In simple terms, DRI means concentrates of iron ore. DRI is a raw material used in the production of steel in electric arc furnaces, which form the majority of the steel production facilities. At present the industry has identified three types of DRI cargoes:

- DRI (A)
- DRI (B)
- DRI (C)

The hazards and safety precautions vary with the type of the DRI to be loaded. The following provides safety precautions to be observed when carrying DRI in general. Refer the IMSBC code for further details.

- Dangers include:
  - Some types produce heat while oxidizing. This process will be faster when in wet condition, especially with sea water.
  - Emits hydrogen when considerably heated.

- Prior to loading, the shipper shall provide the Master with a certificate issued by a competent person recognized by the national administration of the port of loading stating the cargo is suitable for shipment and that it conforms with the requirements of the IMSBC Code in terms of particle size, moisture content and temperature.
- The shipper shall provide comprehensive information on the cargo and safety procedures to be followed in the event of an emergency.
- Cargo shall not be accepted when its temperature is in excess of 65°C, or its moisture content exceeds the permitted value, or if the quantity of fines exceeds the permitted value, where appropriate.
- Cargo holds to be well cleaned and dry, without salt and previous cargo residues
- Combustible material to be removed from holds
- No loading during precipitation
- Cargo temperatures shall be monitored during loading and recorded
- Cargo to be trimmed
- Adjacent tanks other than double bottom tanks shall be kept empty (to avoid accidental water ingress)
- Safety precautions to be observed against dust

- "NO SMOKING" signs shall be posted and no naked lights or other ignition sources permitted
- Enclosed space entry procedures to be followed when entering into cargo spaces
- Cargo temperatures and hydrogen concentrations in hold atmospheres shall be measured at regular intervals during the voyage
- If the hydrogen concentration exceeds 1% or the cargo temperature exceeds 65°C, appropriate safety precautions shall be taken. If in doubt, expert advice shall be sought.
- Bilges to be checked and pumped out if found water
- All records of temperature, hydrogen and oxygen measurements, where appropriate, are to be retained on board for 2 years.
- The hydrogen concentration shall be measured in the holds prior to opening the hatch covers at the port of discharge.

f) Heavy density cargoes (high density cargoes)

IMSBC Code defines High-density solid bulk cargo as solid bulk cargo with a stowage factor of 0.56 m^3/t or less, in which case the density of the cargo will be 1.780 t/m^3 and these cargoes include iron ore, pig iron, steel, bauxite, cement etc. Iron ore is a common cargo with high density. The general precautions that need to be taken while loading heavy density cargoes include:

- Avoid loading from higher positions.
- Loading rates to be considered as it may damage the fittings in the cargo holds.
- Even though, the angle of repose is higher than 35^0, trim the cargo to avoid concentrated weights in the holds.
- Distribute the cargo in the vessel properly (longitudinally and transversely) to avoid over stressing of the hull.
- Ensure the load densities are not exceeded.
- Do not make the vessel stiff (high GM). Refer the stability book and if it allows different cargo distributions such as alternate hold loading or block loading or any other options consider one of them which suits best to the vessel.
- It is preferable always to load in lower holds than on tween decks.

11) Carriage of timber

Carriage of timber cargoes under deck is not regulated by the Timber Deck Cargo Code. Therefore, when carrying timber underdeck, preparation of the holds, loading, lashing, carriage and discharging of cargoes shall be carried out in accordance with the requirements of the lashing manual, stability book, cargo owner and good seamanship.

Carriage of timber cargoes on deck is discussed below. Remember, the reduced stability criteria as stated in the Timber Deck Cargo Code can be applied when;

- the vessel is timber classed;
- carrying timber on deck;
- loaded in accordance with the Timber Code and
- lashed in accordance with the Timber Code

a) Information required

- Amount of deck cargo to be loaded
- Type of timber cargo (such as swan wood or round wood or cant etc.)
- Dimensions of the cargo
- Number of bundles (if in bundles)
- Stowage factor of the cargo
- Density of timber
- Friction factor (dry, wet and winter condition)
- Whether the timber is covered by plastic covers or not. If the timber is not covered with plastic, need to consider about the water absorption by the timber deck cargoes. If the timber deck cargoes are covered by plastic covers, no need to consider about the water absorption by the timber deck cargoes)
- If covered with plastic, type of cover of packages and whether non-slip type and the friction factor of the covers
- Racking stress (in case of carrying timber in packages)

b) Documents required

- Timber Deck Cargo Code
- Documents related to above information from the shipper
- Certificates for all lashing materials to be used
- Cargo securing manual
- Timber load line requirements

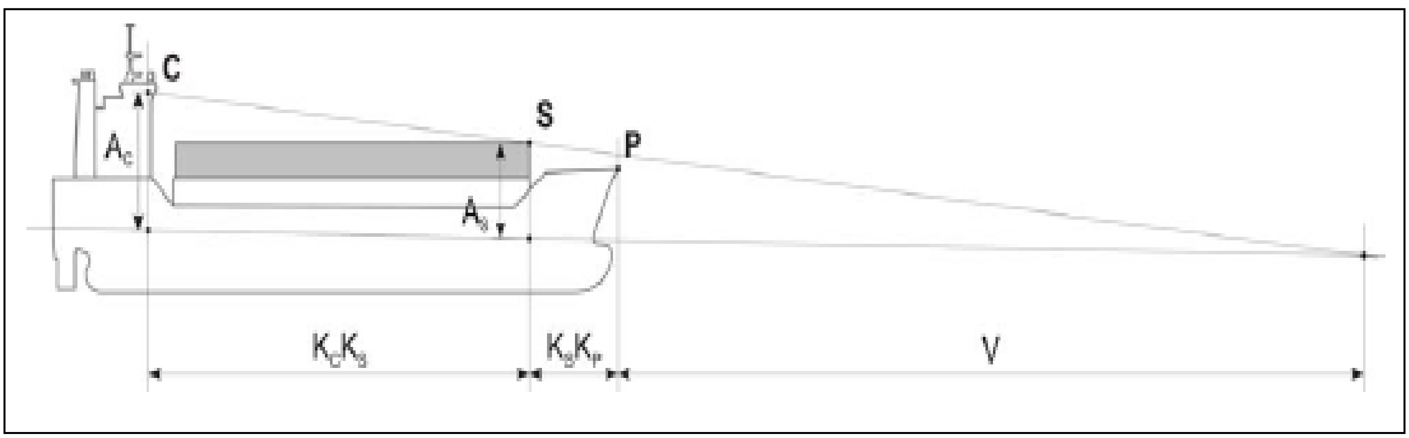
c) Safety precautions to be observed before, during & after cargo handling

Loading

- Refer the Timber Deck Cargo Code and also the ship's cargo securing manual for technical instructions to be followed while loading and stowing the deck cargo.

- When calculating the stability, consider about the following:
  - Amount of water absorption by the deck cargoes
  - Possibility of ice accretion
  - Consumables during the voyage
  - The FSE at the time of loading and during the passage

- Before the commencement of deck cargo loading, ensure to secure holds properly.
- Remove all objects on deck which are left in the areas where the cargo to be loaded. The loading area on deck should be firmed.
- Ensure to keep safe accesses for all ventilators, sounding pipes, safety equipment etc and also keep all emergency escapes free for immediate use.
- Minimize FSE.
- If any obstructions by lashing or securing points (not by the timber itself) to any escape routes, access to safety equipment or sounding pipes are unavoidable, they shall be clearly marked.
- Dunnage (if used) should be rough lumber, shall lay them in such a way to spread the load and not to accumulate water.
- The maximum height shall not affect the visibility requirements provided in SOLAS Chapter V, which states that the view of the sea surface from the conning position should not be obscured by more than two ship lengths, or 500 m, whichever is the less, forward of the bow to 10° on either side under all conditions of draught, trim and deck cargo). The following formula can be used for calculating bridge visibility[33].



[33] Code of safe practice for ships carrying timber deck cargoes, 2011

$$V = \frac{K_C K_S \cdot A_S}{A_C - A_S} - K_S K_P$$

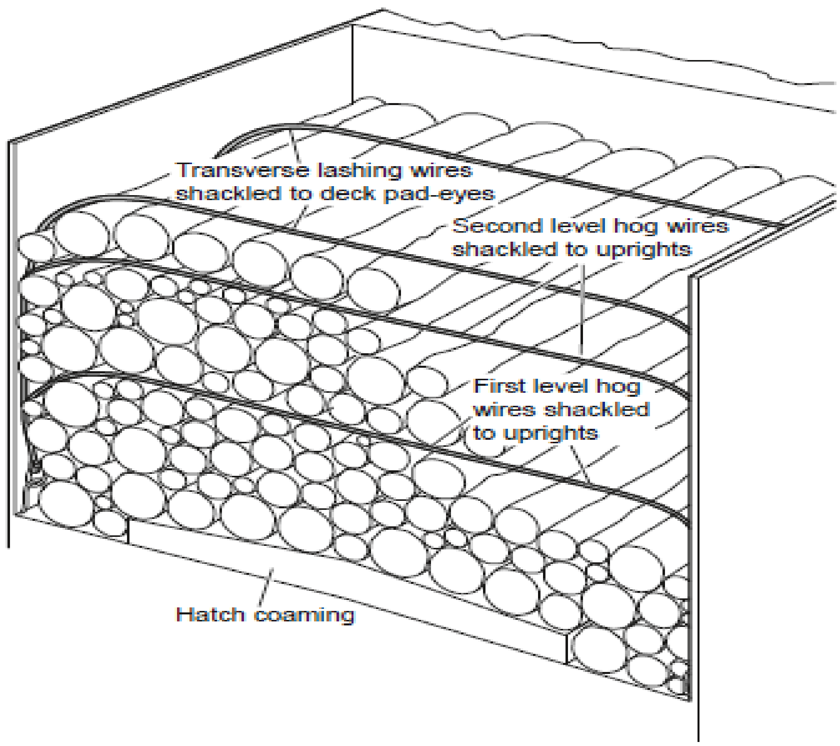
Where:

$K_C K_S$	*Horizontal distance from conning position to position 'S'*
$K_S K_P$	*Horizontal distance from position 'S' to position 'P'*
A_C	*Airdraft of conning position*
A_S	*Airdraft of position 'S'*

- If any list is encountered during loading operations, due to any unexplainable reasons, stop loading until the stability condition of the vessel is assessed.
- If there are reasonable grounds to believe that the weight provided by the shipper is incorrect, samples of the timber cargo should be weighed.
- Cargo shall be stowed compactly in such a way not to slacken the lashing.
- In case of loading packaged timber, damaged timber packages shall be rejected.
- Loading on layers of ice shall be avoided as the friction will be reduced.
- People working on cargo stowed at heights of 2 m and above, within 1 m of an unguarded edge, if required shall wear safety harness with fall resistant device.
- Ensure safe access is available to the top of, and across, the cargo stow.
- Cargo shall not be loaded over hanging on the ship sides.
- GM should preferably not exceed 3% of the breadth of the vessel.

Lashing

- Refer the Timber Deck Cargo Code and also the ship's cargo securing manual for technical instructions to be followed while securing the deck cargo.
- All lashings and components used for securing shall comply with the criteria given in the Timber Deck Cargo Code.
- All lashing tightening devices shall comply with the criteria given in the Timber Deck Cargo Code.
- All lashing equipment should be visually checked in accordance with the cargo securing manual before use.
- Lashing gang should be informed about the lashing requirements.
- The uprights that are going to be used must comply with the ship's cargo securing manual.
- Uprights should be connected by hog lashings, running between each pair of uprights on opposing sides of the stow (refer the diagram below).



Always rig hog wires when using the deck side uprights for logs, packages and loose timber[34]

- If any extra lashing points are to be used, they should be approved by the Administration.
- Turnbuckles should have sufficient threads remaining to permit lashings to be tightened during the voyage as needed.

During the voyage

Apart from the normal activities such as sounding the tanks, checking lashing etc. following shall be checked:

- The rolling period of the ship should be regularly checked in order to establish that the metacentric height is still within the acceptable range.
- Since vibrations and working of the ship will cause the cargo to settle and compact, lashing equipment should be retightened to produce the necessary pre-tension, as needed.
- Uprights should be checked for any damage or deformation.
- Supports for upright should be undamaged.
- Corner protections should still be in place.

[34] Carefully to carry, consolidated edition 2018, Timber deck cargoes, https://www.ukpandi.com/fileadmin/uploads/uk-pi/LP%20Documents/Carefully_to_Carry/C2C_Articles_2018/Timber_Deck_Cargoes.pdf

DRY DOCKING

1) Docking interval

A vessel’s outside of the bottom and the associated equipment are required to be inspected at least twice every 5 years during the validity period of the safety construction certificate. That means outside the bottom to be inspected every 30 months (2.5 years). But, in all cases the interval between any two such inspections not to exceed 36 months. An extension of inspection of the ship’s bottom of 3 months beyond the due date can be granted in exceptional circumstances such as:

- unavailability of dry-docking facilities;
- unavailability of repair facilities;
- unavailability of essential materials, equipment or spare parts;
- delays incurred by action taken to avoid severe weather conditions

The interval between examinations of the outside of the ship's bottom and related items for ships operating in fresh water and for certain harbour or non-self-propelled craft may be increased than above with the flag approval.

2) In water survey (IWS)

Under normal conditions the outside bottom of a cargo vessel is to be inspected twice every five years, at intervals of not exceeding 36 months. One of these inspections may be replaced by an IWS. But, if the IWS is not carried out for the satisfaction of the attending surveyor, the outside bottom must be inspected in a dry dock.

Ships of less than 15 years of age are allowed for IWS, but, ships above 15 years of age also be allowed provided, agreed by the Flag and the ship’s classification after special considerations. IWS is not allowed for tankers and bulk carriers of more than 15 years of age undergoing the Enhanced Survey Programme.

If a ship owner is expecting to comply with the IWS programme, he must take necessary steps to prepare his vessel for IWS, from her last dry dock itself. There are lot of areas to be considered in the dry dock, but only few are listed below to give you an idea:

- The cathodic protection system must be sufficient enough.
- Hull is properly de-rusted and good quality paint is applied.
- The colour of the underwater paint matters as well since a successful underwater inspection may not be possible with some colours.
- The hull should be permanently marked externally to indicate the positions of transverse primary members, transverse and longitudinal bulkheads or frame numbers.

- Special consideration is required for areas where the divers do not have accesses.
- Need to have arrangements to:
  - inspect sea chests (require having hinged gratings). Refer the figure below:

  - access to rudder bearings and determine the condition and clearance of the rudder bearings.
  - access the seal assembly of the stern bearings of oil lubricated bearings to make sure they are intact and determine the clearance of wear down.

After the dry dock, following records are required to be maintained onboard if expecting for an IWS next time:

- A record of all suspected or actual hull damage and all contacts occurred between the last dry dock and the IWS.
- Oil usage for propeller shaft seals and thrusters to indicate the condition of the seals.
- Records of regular oil analysis and temperature of bearings.

Before the IWS:

- The ship owner is required to make an application to the classification society of the vessel indicating the date and place of the expected IWS. This application must include the following as well:
  - Master's declaration of all suspected or actual hull damage and all contacts occurred between the last dry dock and the IWS,
  - Records of oil usage for propeller shaft seals and thrusters and
  - Records of regular oil analysis and temperature of bearings.
- If required, the hull should be cleaned before the IWS so that the actual condition of the hull can be inspected.

At the time of the IWS, the vessel shall be;

- at a suitable draught and trim;

- in ballast condition specially, for large vessels; and
- the rudder, propeller, and fittings may be above the water in ballast condition on large vessels and the trim of the ship should be arranged to give the best results for the survey.

Procedure of IWS

- A meeting to be arranged between all the parties to make a plan for the IWS.
- All safety precautions to be observed, such as locking of propellers, rudders & thrusters, stopping of all pumps etc.
- Appropriate signals are displayed (flag – A).
- Ensure proper communications are established.
- A permit to work system is to be used for the safety of the diver(s).
- Following areas will be inspected:
  - The above water part of the hull.
  - The actual and suspected contacted areas (as per the master's records) will be inspected from outside as well as from inside if it is accessible.
  - Propeller (cracks, pitting etc.) and "propeller stern shaft clearance" or "propeller wear down" or "stern bush clearance" to be Measured by using a poker gauge.
  - Under water shell coating.
  - Rudder, rudder "pintle clearance", rudder bearings and bearing clearances (jumping clearance).
  - Sea chests and their arrangements.

3) Extended dry docking (EDD)

The above-mentioned dry-docking intervals may be extended till 7.5 years if a vessel is qualified for the EED. That means, when a vessel is delivered, the first two bottom inspections (at 2.5-year intervals) have to be carried out in the form of an In-water survey. The first dry docking will be after 7.5 years. Again, next two bottom inspection has to be carried out by means of In-water surveys at 10 years and 12.5 years. The second dry docking will be at the age of 15 years. The EDD is not applicable after the age of 15 years. Even the existing vessels can join EDD till the age of 10 years, but it will be terminated when she reaches 15 years of age.

Vessels which are expecting to enter into EDD are subjected to classification society requirements and flag state regulations. According to the DNV-GL requirements, for new buildings, the following criteria to be complied with (but not limited to), to be eligible for EDD:

- A Planned Maintenance Scheme for Hull and Machinery shall be implemented.
- Dry film thickness of primer coating for 7.5 years has to be an average of 300 µm.

- Anodes (alu/zinc) shall be sufficient for 7.5 years or impressed current system is to be installed and maintained.
- Ballast water tanks shall have a corrosion prevention system with "Good" coating condition.
- The vessel's Flag State authority has to approve the EDD programme.

Certain types of vessels such as passenger ships, ships subjected to enhanced survey program (ESP) etc. are not qualified to follow the EDD programme.

EDD programme will be terminated when:

- A vessel reaches 15 years of age
- Ship's owner or the management is changed
- Administration is changed
- If the class decides that the conditions for maintaining the EDD scheme are not complied with

4) Documents required for dry docking

- Docking plan
- Plug plan (may be combined with the docking plan)
- Shell expansion plan
- Midship section plan
- General arrangement plan
- Tank arrangement plan
- Gas free certificate (for tankers only)
- Cargo plan (if docking with cargo)
- Repair list
- Rigging plan
- Capacity plan

5) Duties of a chief officer when dry docking

Well before entering:

- Arrange meetings with heads of departments and prepare the repair list. Make sure no repairs are overlapped with engine department.
- Send the required documents to the dock/superintendent (as per SOLAS, now the copies of certain above plans to be kept at the shore office as well, therefore those plans may not be required to send).

- Prepare watch schedules for duty deck officers and deck crew.
- Have a briefing with the officers and the crew. Points to address during the briefing are listed below.

Just before entering:

- All hatches, beams, derricks, cranes, cargoes (if docking with cargo onboard) to be well secured.
- Vessel to be upright.
- Free surface in tanks to be reduced.
- Stability should be adequate, so that the virtual loss of GM does not affect the vessel.
  - ➢ Virtual loss of GM = P x KM / W or GM = P x KG / (W – P);
    Where,
    P = up thrust,
    W= displacement)
  - ➢ P = MCTC x t / L or, P = TPC x reduction in water level
    Where,
    t = trim in centimetres on entering the dock
    L= distance between COF and the vertical line of action of the P force in m.
- The virtual loss of GM can be reduced by reducing the trim, if required.
- Draft & trim as per the requirements of the dock.
- Sound all tanks.
- Lock toilets (this is not required in some docks).
- Ensure fenders are available if required.
- Ensure to take in the equipment which are protruding outward from the hull, such as speed logs, stabilizer fins etc.
- When entering a dock, a stern trim is more preferable because;
  - Easy to handle a ship with a stern trim.
  - The dock bottom is compatible with a stern trim (the declivity).
  - The stern area is strengthened with a “sole piece”, so that it is better to touch the sole plate first.

- Note down the following times:
  - Bow passing dock gate
  - Vessel entered dock
  - Dock gate closed
  - Dock pumping out commenced
  - Time of stern touching the keel blocks
  - End of critical period (when touching the fwd end of the vessel with blocks)
  - Dock empty

When inside the dock:

- If used, ensure shores are rigged at correct positions (at the intersections of frames & stringers). This is not a common practice with large ships
- Before the power is switched to shore power, switch off all navigational equipment (note down the gyro heading before switching off).
- When the vessel is sitting on the keel blocks, sound all the tanks again.
- Obtain telephone, electricity, garbage bins, portable heating for cabins (in case of cold climates) and water for the fire line.
- Obtain emergency contact numbers as well as the dock regulations which are specific to the dock (if available) and display them in prominent places onboard.
- If possible, arrange two gangways.
- Ensure the ISPS requirements are complied with.
- Keep the life buoys which are on deck at a safe place.
- When bottom plugs are removed, name them and keep in a safe place.
- Ensure to apply grease on transducers and port holes which are closer to painting areas.
- Ensure to isolate the fixed CO_2 system to avoid dangers in case of accidental release.
- Ensure the repairs are done as per the repair list.
- Ensure fire watches are been carried out and appropriate fire extinguishers are available at places where welding works are carried out. These fire extinguishers will be brought by the dock people.

6) Instructions and orders to be given to officers and crew at the time of briefing

- Adhere to safety regulations issued by the dock authorities.
- They should be told about the watch schedules, emergency contact numbers, regulations which are specific to the dock.
- They must have a good idea about the repair items.
- Appropriate PPE to be worn.
- Strict and frequent fire rounds must be carried out (be very cautious during tea times, lunch times and when the work is ceased at the end of the day).
- Proper illumination must be available before starting work.
- They must have a thorough knowledge about daily work while the vessel is in the dock.
- The commencement and the end of each repair item must be informed to chief officer.
- They also must be given a summary of a repair list. So that, it can be tick-off at the end of each work.
- All the important times must be noted down (commencement and completion of each work, work ceasing times, raining time periods-specially, in case of hull painting etc.)
- Always the hull painting must be carried out during appropriate weather conditions. Must ensure that the previous paint coating is properly dry before applying the new coat.

- If any ship's equipment is given to dock workers, make sure to take them back.
- Strict enclosed space entry regulations must be carried out.
- Strict ISPS regulations must be carried out.
- If in any doubt the chief officer or the master must be informed.

7) Inspections to be carried out in a dock

- Shell plating and openings on the shell
- Plate thickness measurements
- Inspection of critical areas on the hull
- Under water coating and hull marking
- Sea chests & gratings
- Anchor cables
- Chain lockers
- Hose test on hatch covers
- Hull corrosion preventive system
- Rudder bearing and bush clearances
- Propellers
- Stern bush clearance
- Oil gland

8) The contents of a repair list

Standard items:

- Hull cleaning, surface preparation, painting.
- Inspection of anchors and cables, including ranging and marking.
- Inspection, cleaning and painting of cable lockers.
- All sea valves and sea chests to be inspected.
- All anodes to be inspected (the location and weight or size to be ascertained).
- Survey of ship's bottom.
- Inspection & maintenance of rudder.
- Stern frame inspections.
- Inspections and maintenance of propeller.

Repair items may include (this depends upon the type of the vessel, age of the vessel, damages experienced during service period etc):

- Renewal of piping.
- Maintenance & repairs of cargo-handling equipment.
- Maintenance & repairs to hatch-closing arrangements.
- Bulkhead, deck and hull plates changes.
- Maintenance of fire detection and fixed firefighting systems.
- Replacement of parts of longitudinal and transverse frames.
- Repairs for damages caused due to heavy weather and contacts with jetties etc.
- Replacement of parts of the stringer plates in the fore peak tank.

Modification items (this also depend upon the age of the vessel and also the new amendments entered into force):

- Modifications required due to changes in regulations which are required to be complied with at the time of next dry dock.
- Conversions or restructuring of the vessel.
- Modifications to improve the efficiency of a vessel.

9) Critical period and the critical instant

The critical period starts from the first touch with the keel blocks and ends after lying the length overall. The critical instant is the instant that a vessel is just about to touch the length overall. There will be a virtual loss of GM till the critical instant which may affect the stability of a vessel; therefore, to have a successful docking operation, a vessel shall have a positive GM at the time of the critical instant.

10) Inspections to be made in forepeak and after peak tanks

- Ensure the ladders are in position and no damages.
- Check the stringer plates, shell plating, girders and beams for cracks, bends and corrosion.
- As many as welds as possible should be checked.
- Check the sacrificial anodes.
- Check the condition of the paint.
- Check the fore peak isolation valve.
- Check the sounding pipes and striker plates.
- The middle portions (vertically) of the tanks are more prone for wear and tear than the top and the bottom areas of the tanks. Therefore, pay more attention to the middle areas of the tanks.
- Check the longitudinal stiffeners and brackets at the collision bulkhead to shell junction.

- Check the condition of the collision bulkhead, the area where the fore peak ballasting line is coming through.
- In the after-peak tanks, check the longitudinal shell stiffeners, particularly in areas adjacent to bulkheads and web frames.

11) Inspections to be made in double bottom tanks

- The paint conditions.
- Sacrificial anodes.
- Ensure the lightening holes are not blocked.
- Check the sounding pipes and the striker plates.
- Check the under deck longitudinal. Wastages are usually more severe close to the deck head. This may result in the fillet welds, attaching longitudinal to the deck, being wasted thus leading to detachment of the longitudinal and consequent buckling of tank top plates.
- The plate thicknesses must be checked.

12) Ranging a cable

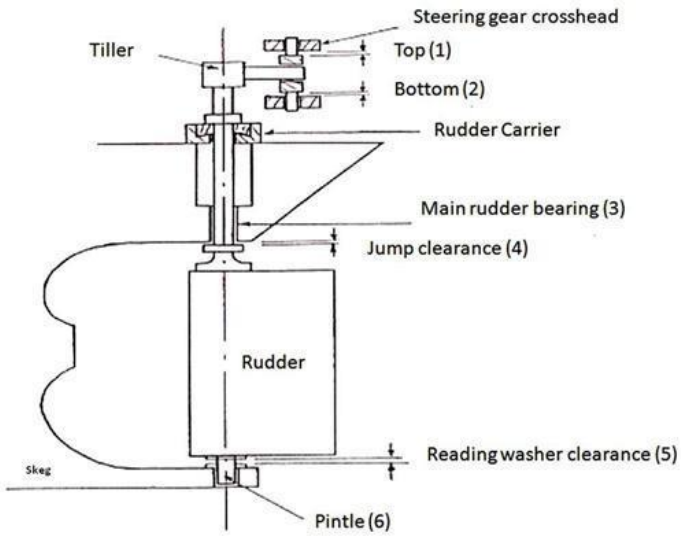
The laying of the cable on the dock bottom is done with the help of a shore crane. Cable must be lowered under power throughout the operation. In certain docks the total operation is done by the dock yard crew. If it is the case, your staff should observe the operation. In certain docks, this is done with the assistance of the ship staff.

Cable ranged (look at the bottom of the dock)

13) Inspections of the rudder

Rudder to be inspected for:

- Cracks
- Deformations
- Loose nuts
- Rudder pintle clearance (by inserting a filler gauge)
- Jumping bar clearance (by inserting a filler gauge)



Source[35]

- Leaks (if there are any leaks when the drain plug is opened water should come out)
- Sacrificial anodes and draught marks must be in good condition. Refer the picture below;

After fitting anodes and after painting

[35] https://marinesurveypractice.blogspot.com/2013/01/rudder-rudder-stock-and-pintle-survey.html

14) **Checks to be made on a propeller**

- Check oil leakage from stern tube.
- The clearance in the stern bush and the efficiency of the oil gland should be ascertained.
- Inspect blade surfaces for erosion, pitting, corrosion and bending.
- Check stern tube for leakages.
- Inspect propeller for cavitation damages.
- In the case of a CPP (Controllable Pitch Propeller);
  - check for blade movements and zero pitch settings with respect to wheelhouse;
  - check hydraulic oil leakages
  - check securing arrangements for blades and carrier

15) **Maintenance works done on anchor cables**

- Check the diameter of the shackles (usually, 11% of wear down in bar diameter is allowed before replacement).
- Transpose two or three shackles to the inner end of the cable.
- Hammer test or ultrasound test to be done on the cable to identify cracks. Penetrating oil also can be used to detect cracks.
- Joining shackles to be painted.

16) **Thickness measurements on the hull plates and the allowance given prior changing of such plates**

Plate thicknesses are checked by using an Ultrasonic Thickness Gauge (UTG). The UTG consists of a probe connected to a digital indicator and the probe consists of an ultrasonic sound transmitter and a receiver. Once the probe is kept on a steel plate, the ultrasonic sound will penetrate through the plate which needs to be measured and the ultrasonic sound will turn back at the other end of the plate. The digital indicator monitors the time taken by the ultrasonic sound to leave the probe and return back to the probe (uses the same principle used in an echo sounder). Finally, the thickness can be measured as the speed of the ultrasonic sound is known.

Before use UTG apply lubrication (greasy lubrication) on the probe and calibrate it by measuring the thickness of a steel plate which the thickness is known (such a plate is attached to the UTG). If the measurement is correct, it can be used to check the thickness and each and every time, the probe to be lubricated.

The allowable thickness depends upon the classification society requirements, the place of the plates, size of the ship etc. classification societies use a "**minimum thickness table**" in deciding whether to change the plates or not. Generally, for tankers and bulk carriers of 10 years of age or more, maximum of 10% diminution is allowed.

17) Hull painting in dry dock

Hull painting shall be carried out in a proper manner to ensure it lasts long till the next dry dock. Make sure no precipitation and the steel surface is properly prepared for painting purposes.

Before the commencement of hull painting, need to ensure the surface of the hull is prepared for painting. This is done by means of water blasting or grit blasting. Ensure the hull is washed after the completion of grit blasting and completely dry. Double check the areas where grease was applied to ensure still the grease remains before start painting.

To calculate the amount of paint required, need to calculate the surface area of the hull. This can be calculated by the following formula:

$$S = 2.58 \sqrt{\Delta L}$$

Where:

S = surface area (m^2)
Δ = displacement (t)
L = length of the ship (m)

Then divide the area by the coverage of the paint selected (this of course depends upon the type of the paint and the brand of the paint) and determine how many litres per coat is required. Multiply the litres per coat by the number of coats to calculate the total volume of the paint required. Need to order some extra amount of paint to compensate for lost factor which is unavoidable during painting. This information can be obtained from the paint manufacturer.

Required paint thicknesses and drying periods

The required paint thickness depends upon the brand of the paint and as well as the expected date of the next dry docking, since the paint is required to last long till that date. The paint manufacturer should give this information in the paint manual (generally known as Onboard Maintenance Manual or Technical Data Sheet). For Chugoku Marine Paints (CMP), the thicknesses are as follows,

- In wet condition : 160 – 320 microns
- In dry condition : 75 – 150 microns

The time period required to dry the applied paint depends upon the surrounding temperature and also the brand of the paint. This information is also given in the paint manual. For Chugoku Marine Paints (CMP), drying times are as follows,

- at 5º of temperature : 24 hrs
- at 30º of temperature : 10 hrs

Now computer programmes are available where you can get the volume of paints required by inserting the relevant information such as area to be applied (m^2), dry film thickness, volume of solids etc. The dry film thickness and the volume of solids can be obtained from the information given regarding the individual paints that need to be applied in various places of the vessel.

18) Checks to be carried out before flooding a dock

- Ensure the hull painting is completed and dried.
- Ensure the Zinc anodes are fitted as planned.
- Ensure the transducers not painted and grease removed.
- Ensure bottom plugs are in position.
- Check with chief engineer & dock master, whether the propeller, thrusters, stabilizer fins and rudder are fixed properly and sea chests, sea valves are fixed in position.
- Check the tanks for any rubbish left by dock workers.
- Make sure all the tanks are in the same condition as arrived.
- Secure all cargo gears, hatches, beams etc.
- Ensure all required surveys and repairs are completed.
- Check whether there is sufficient crew onboard.
- Ensure the mooring lines are passed & secured.
- Ensure that all garbage and refusals are taken away by the dock.
- Inform the master and with his permission, sign the “authority to flood certificate” with date & time.
- Ensure all LSA and FFA equipment are in proper order and in their original locations.
- Write down all the timings.
- When the vessel is re-floated, start generators, disconnect shore power supply & fire lines.
- Check with chief engineer, whether all in order in the engine room.
- Re-start bridge equipment & check whether the gyro is indicating the same heading as she came in once it is settled.
- It is advisable to keep a check list for “completion of work in dock”.

19) Precautions to be taken when docking with cargo on board

- Ensure no perishable or dangerous cargoes on board. If available on board, they must be discharged before docking.
- Proper fire watches to be maintained in the cargo holds by taking fire rounds and by the detectors.
- Ensure cargo is properly lashed and the vessel is upright.
- Ensure the cargoes are evenly distributed and cargo plan should be given to the yard.
- Reduce free surface effect.
- If possible, advisable to press up double bottom tanks
- Ensure the vessel has sufficient GM throughout the critical period.
- Discuss the docking requirements, such as trim and draught with the dock master.
- Have a briefing with officers, engineers and crew.
- If possible, try for water borne docking (without emptying the dock completely)

ANCHOR, ANCHOR CABLE AND ANCHORING

1) General information

a) Contents of an anchor certificate

- Certificate serial number
- Name of the certifying authority
- Name of the testing establishment
- Weight of the anchor
- Type of anchor
- Length of the shank in millimetres
- Length of arms in millimetres
- Diameter of trend in millimetres
- Proof load applied in tonnes

b) Contents of an anchor cable certificate

- Type of cable
- Diameter in mm
- Total length in metres
- Total weight in Kg
- Length & breadth of a link in mm
- Tensile breaking load applied in tonnes
- Tensile proof load applied in tonnes

c) Markings on anchor and cable

Anchor markings;
- Certificate number
- Letters representing the certifying authority
- Weight

Cable markings;
- Certificate number
- Letters representing the certifying authority

d) The maximum weight that can be heaved-up by a windless

The size, the weight of the cable and the anchor depend upon the size of the ship. None of the regulations specify about a maximum weight that can be heaved-up by a windless. Generally, the windless power is sufficient to heave up the weight of anchor plus weight of 4 shackles. Therefore, it may be dangerous to lower more than 4 shackles without touching the bottom. This may not be applicable if the vessel is allowed or has a class notation for deep water anchoring.

e) Deep and shallow water anchoring

Anchoring in depths of less than 35 m may be considered as shallow water anchoring and anchoring in depths of more than 35 m may be considered as deep water or deep-sea anchoring. Refer your company SMS for the exact definitions of shallow water anchoring and deep-water anchoring.

Anchor to be walked-backed throughout the operation in case of deep-water anchoring irrespective of the size of the vessel. At the same time, anchor to be walked-backed on large ships whether it is shallow or deep-water anchoring.

f) Scope of the cable

The ‘scope’ of the cable is the ratio of the length of cable paid out, to the depth of water.

Usually it is 5 (minimum) to 10 (maximum), but this depends upon number of factors such as the length of the stay, possibility of bad weather, rate of current/wind etc. following formulas may be useful when deciding the length of the cable to be paid out:

- Number of shackles of cable = $1.5\sqrt{D}$
- Length of cables in ‘m’ = 6 to 10 x D
- For special steel cable:
  Length of cable used in ‘m’ = $39 \times \sqrt{D}$
  (D=Depth in ‘m’)

2) Selecting a good anchoring ground

Need to consider the following in selecting a good anchoring ground:
- Should not be an anchoring prohibited area.
- Clear of underwater cables, obstructions etc.

- Even seabed (a flat seabed)
- Good holding ground (Mud or Clay).
- Availability of landmarks during day & night (if possible) to monitor the ship's position.
- Away from busy waters
- It should be a sheltered area.
- Less current & tidal effects.
- Avoid if there is a possibility of bad weather.
- Availability of swinging room (this will depend upon the number of shackles that will be paid out and the length of the own ship.)

3) Anchoring procedure

- Prepare the anchoring plan.
- Carryout a risk assessment.
- Ensure the anchor is cock-o-bill, on the breaks and ready for letting go, in the case of shallow water anchoring and on medium to smaller ships.
- Approach the anchoring position with a head wind or current. If both are present, head the strongest. This can be identified by referring to the headings of the other vessels at anchor in the area.
- Once the vessel is at the anchoring position, stop her in relation to the ground.
- Put the engines astern.
- When she gathers stern way, i.e. when the propeller wash comes to about half-way up the vessel's length, let go the anchor. On smaller vessels, let go the cable when the propeller wash passes the accommodation.
- Stop engines and let go the cable or start walking back.
- Note down the anchor dropping position.
- While laying the cable, ensure not to pile up the cable at the same place with the aid of the brakes.
- Once the planned number of shackles are out, apply the brakes and wait until the v/l is brought-up.
- Once the vessel is brought-up, put the anchor signals/lights.
- Note down the position again and make the swinging circle of the vessel.
- Put the gelatine on and tight the brakes.

4) How do you know she is brought-up?

Just after the breaks are applied the cable will become tight due to the stern momentum of the vessel. Once this stern movement of the vessel is stopped, she will move towards the cable again due to the weight of the cable. Then the cable will become slack. Due to wind or tide (since the vessel is heading into it), she will start moving stern again making the cable a little tight again. This fwd and aft movement of the vessel may happen few times and it will stop. It is known as the vessel is brought-up. If the cable continuously becomes tight and slack, that means she is not brought-up, but dragging the anchor.

5) The precautions to be taken while heaving up the cable and how do you know the anchor is aweigh while heaving up the cable

Precautions to take while heaving up:

- Need to have a good communication with the bridge.
- Open the anchor wash.
- If the cable is very tight and not coming up, do not use the windless continuously as it may stop the windless due to overheating. Inform the bridge, because need to use engines to ease down the weight on the cable.
- If there is a strong current or wind, may have to use engines throughout the operation.
- If the cable is crossing the bow, advisable not to heave up the cable as it will damage the paint on the bow. May have to use engine with the rudder or the bow thrusters to turn the vessel.
- Inform the bridge as soon as the anchor is aweigh (When the anchor is aweigh, suddenly the cable will become up and down with a little pendulum movement).
- Inform the bridge again when the anchor is sighted.

6) Open moor

Open moor is used to increase the holding power of the cable and to stop dragging. Refer “Seaman Ship Techniques” by D.J. House for the procedure of the operation.

7) Running moor

This is good when anchoring in restricted areas (especially, restricted by land) and when excessive yaw is expected, to reduce the swinging circle. Students must understand that this moor will not increase the holding power as she will be riding to one cable always. Refer “Seaman Ship Techniques” by D.J. House for the procedure of the operation.

8) **Standing moor**

The advantages and disadvantages are the same as running moor, but theoretically required less engine movements during this manoeuvre. Practically, depending upon the circumstances engines may be required. Refer "Seaman Ship Techniques" by D.J. House for the procedure of the operation.

9) **Baltic moor**

Refer "Seaman Ship Techniques" by D.J. House for the procedure of the operation.

10) **Mediterranean moor**

Refer "Seaman Ship Techniques" by D.J. House for the procedure of the operation.

11) **Clearing foul hawse**

Foul hawse means the port and starboard cables are crossed when both cables are used. Refer "Seaman Ship Techniques" by D.J. House for the procedure of the operation.

12) **Controlling a vessel's behaviour while at anchor.**

a) **Following actions could be used to control heavy yawing**

- Drop the second anchor under foot.
- Use engines
- Use rudder (not during severe weather conditions)
- Use open moor, Mediterranean moor etc.

b) **When dragging the anchor**

- Get the engines ready.
- Call the master & anchor party.
- Inform other ships around (security message).
- Hoist the "Y" flag and remove the anchor ball. If it is night, switch off anchor lights and switch on the navigational lights

- Inform port authority if required.
- Try to stop the dragging by dropping the second anchor under-foot.
- If the vessel is dragging towards another vessel, prepare fenders, inform the other ship and use the rudder to cant the ship away from the other vessel.

13) Foul anchor, clearing a foul anchor and slipping the cable on deck

Foul anchor means the anchor is entangled with an underwater obstruction. In some cases, the anchor may not be able to heave up at all and sometimes it may be possible to heave up the cable with the fouled object. If the anchor cannot be heaved-up at all and if the berth is available for the vessel, you may:

- Inform the port authority, agents, owners, class and P & I
- Connect the anchor buoy to the cable
- Slip the cable on deck
- Log down the position and time

A vessel may be allowed to sail with one anchor provided that the situation is informed to the vessel's classification society. Usually, they will allocate a time period to fix the anchor again. The Cargo Ship Safety Construction Certificate will not be suspended if the anchor is fitted within this period.

Cargo Ship Safety Construction Certificate will be suspended if both the anchors are lost and the vessel will not be allowed to sail until rectified.

An anchor cable may be slipped either from the bitter end or by slipping on deck. Detaching the cable through a joining shackle is known as slipping on deck. In case of slipping the cable on deck, follow the procedure bellow:

- Make the cable up and down.
- Heave or lower the cable until the next joining shackle is on deck (if heaved up, ensure the cable is not tight).
- Pass a wire rope [with a sufficient SWL and with a length of about three times the depth] through the shackle fwd of the joining shackle. The SWL of the wire rope may be calculated as below:

  Depth of the water = L metres
  Weight of a shackle = W tons
  Diameter of the rope = D millimetres
  Minimum SWL of the rope = (L x 1.5 x W)/27.5 tons

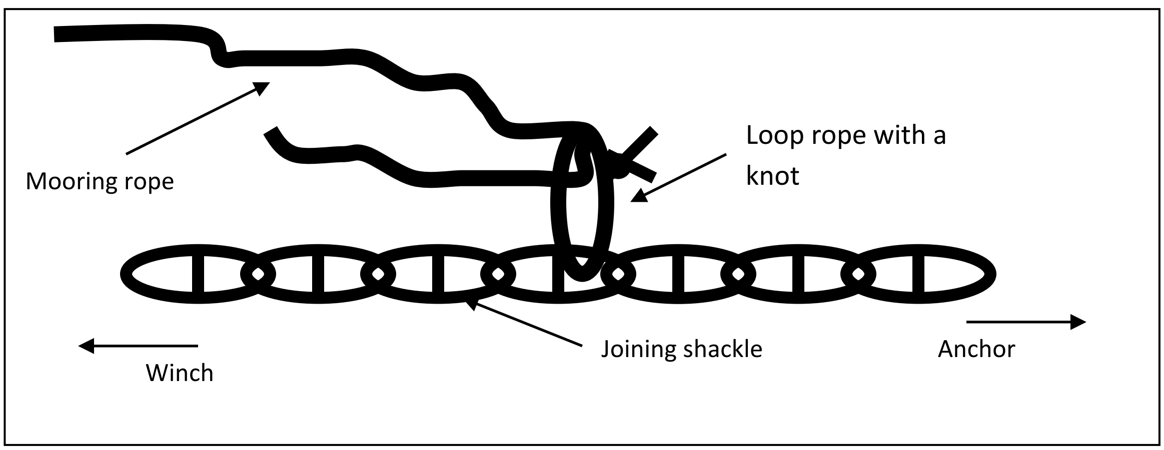
  For a 6x12 wire rope,

Breaking stress = $(15\ D^2)/500$
SWL = (Breaking stress)/5
Therefore SWL = $(15\ D^2) / (500 \times 5)$

Therefore,
$(15\ D^2) / (500 \times 5$ = $(L \times 1.5 \times W)/27$
D^2 = $(L \times W \times 1.5 \times 500 \times 5) / (27.5 \times 15)$ (mm^2)

Generally, on medium sized ships 20 to 24 mm diameter rope is sufficient.

- Made fast one end of the wire rope on a bollard.
- Put the other end of the wire over a warping drum.
- Lower the chain until the weight is taken by the wire.
- Connect the anchor buoy to the cable forward of the joining shackle with a rope having a length little more than the depth of water
- Disconnect the joining shackle.
- Slack the wire until it loses its weight.
- Once the wire is fully slack, remove the end which is on the bollard and start heaving up.
- If you don’t have a wire rope, use a good mooring rope. Since the mooring rope cannot pass through a shackle, use a loop wire to attach the mooring rope to the shackle (see the figure below).



SHIP HANDLING AND MANOEUVRING

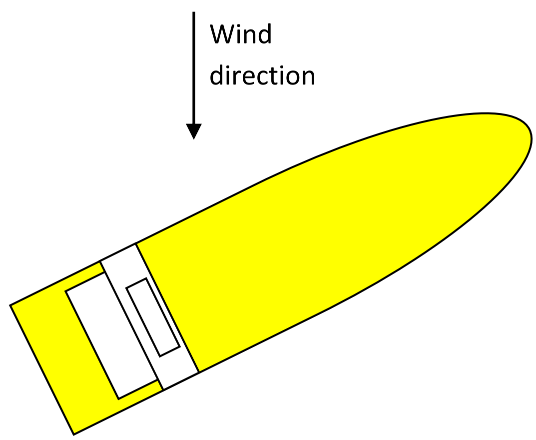
Note:

It is very important to observe the behaviour of the current and the wind in handling a vessel. As a rule of thumb keep the following points in your mind.

In a channel when there is a current, the maximum rate of the current occurs at the centre of the channel and very close to the banks of the channel, the rate of current is almost zero. This can be used to the advantage of ship handling.

A good idea about the current may be obtained by means of a Doppler log, GPS (when there is a difference between course over ground & course steered) and also the fixed objects such as buoys (by referring to the water turbulence at the buoy).

When a vessel is exposed to wind, the area which is having the largest windage area will be pushed away from the wind. In the case of aft accommodation ships, aft windage area is larger than the forward windage area. Therefore, an aft accommodation vessel drifting at sea will face the wind diagonally. Refer the diagram below:



A good idea about the wind can be obtained by anemometer (relative direction), funnel smoke (relative direction), sea clutters on the radar (true direction), by referring to the sea waves (this may not be very accurate if the vessel is in waters covered by land).

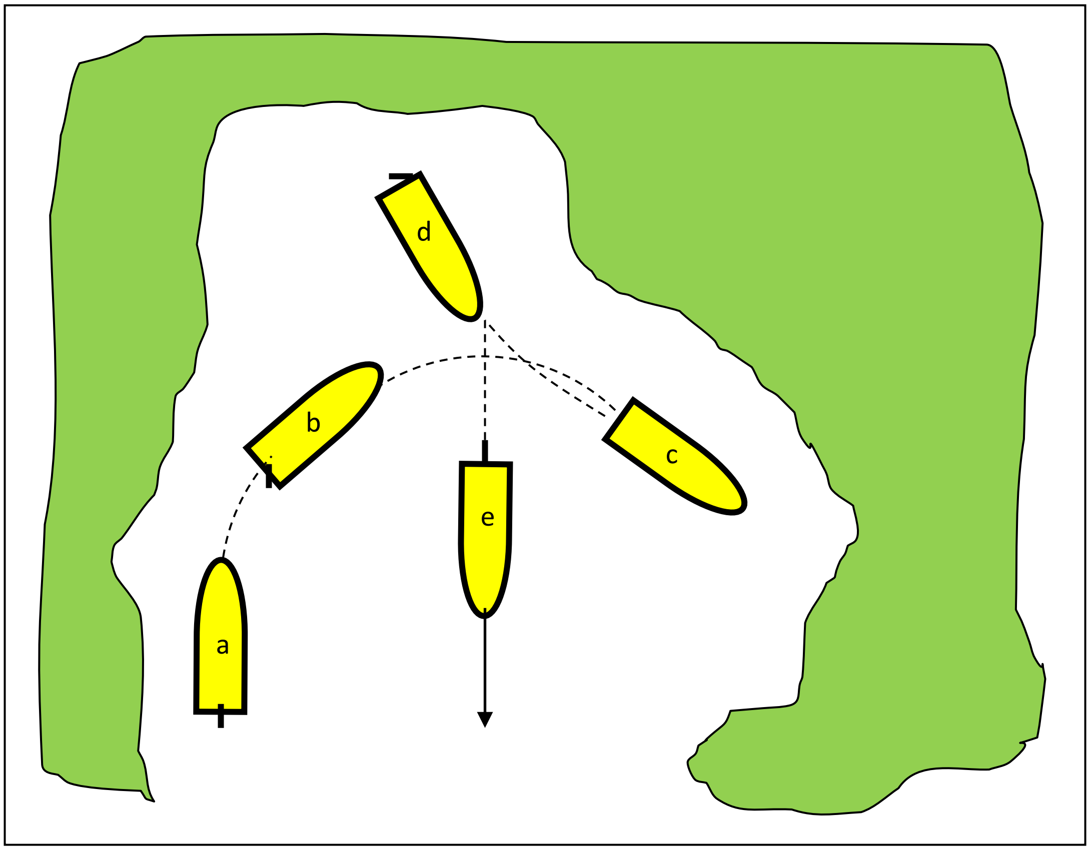
You need to know whether the propeller of your vessel is right-handed or left-handed.

When a half ahead or a fuller ahead kick (depending upon the loaded condition of the vessel) is given with the rudder hard over, vessel will start turning rather than start going ahead.

1) Turning short round

Turning short round means, turning a vessel within her own length. But, practically, she may go beyond her own length due to the manoeuvring characteristics of the vessel, wind, current and the experience of the handler.

Turing short round with a right-handed crew propeller



With a right-handed propeller; the turn should be made to starboard side as shown in the above diagram so that the effect of transverse thrust, when the engines are going astern is of assistance. Approach the turning point, keeping to the port side of the channel with engines slow ahead and make sure to leave enough room at the port side for the stern to swing. The below letters refer to the letters in the above diagram.

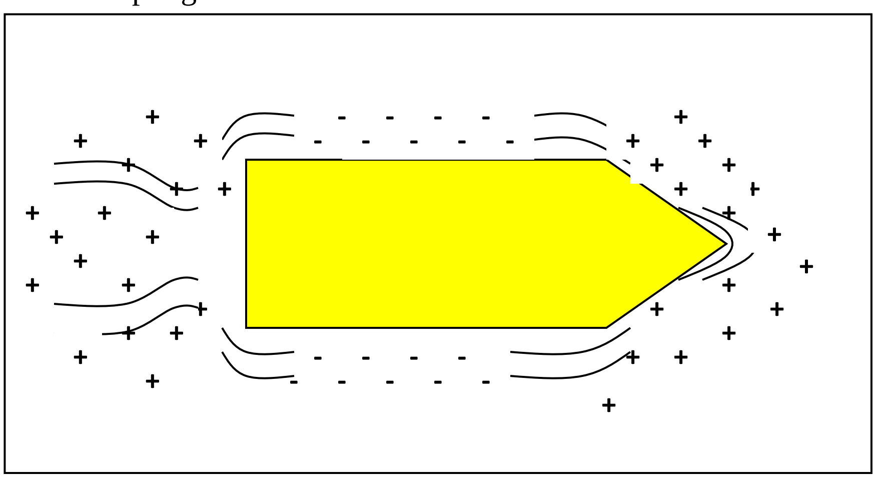
a) Start the manoeuvre from the port side of the channel to provide the maximum distance for the head reach of the vessel.
b) Rudder hard a-starboard, main engines full ahead. Stop engines. Do not allow the vessel to gather headway.
c) Rudder amidships, engines full astern.
d) As sternway is gathered, the bow of the vessel will cant to starboard side owing to the effects of the transverse thrust. Stop engines. Rudder to starboard, engines ahead.
e) Steady the vessel and steer on the reciprocal course.

If a tide is running, it usually has a greater rate at the centre than at the side of the channel. This may be used to help the manoeuvre by keeping towards the starboard side of the channel, if the tide is initially astern. Keep to the port side of the channel if the tide is initially ahead, so that the faster running water in mid channel helps to turn the vessel in the required direction. It should be noted that a head wind will also assist this manoeuvre.

Think of turning the vessel around an anchor, if the turning short round is impossible due to weather effects, manoeuvring characteristics of the vessel and also due to available sea room.

2) Interaction between ships

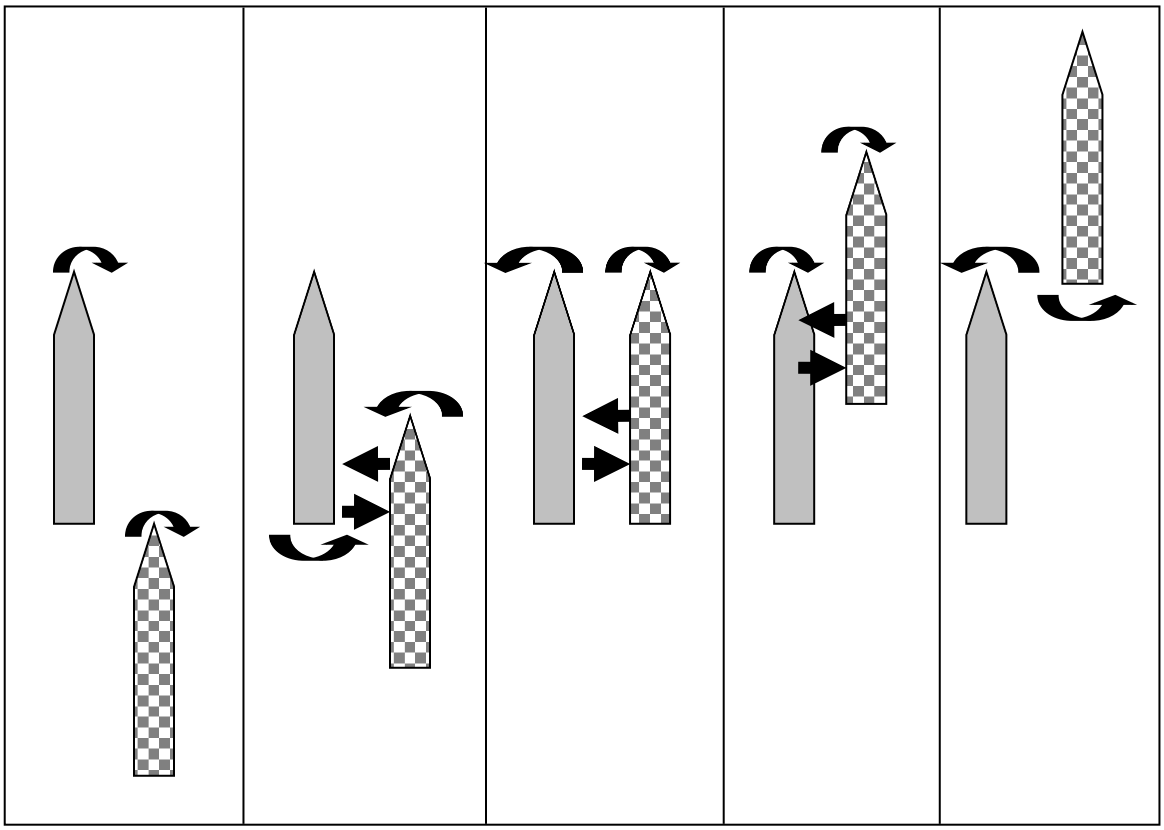
Hydrodynamic interaction may occur between ship - sea bottom, between ship - ship and ship - bank. The effect caused by the ship & bottom interaction is called as smelling the ground. The effect caused between the ship & river bank is called as bank cushioning effect. The effect caused by ship to ship interaction is known as interaction or interaction between ships. When a ship moves forward, there is a region of high pressure at the bow and the stern. **The stern high pressure region is of lower magnitude due to frictional loses**. The water displaced by the ship at the bow flows around and under the hull towards the stern and creates negative pressure in the mid-ship region.



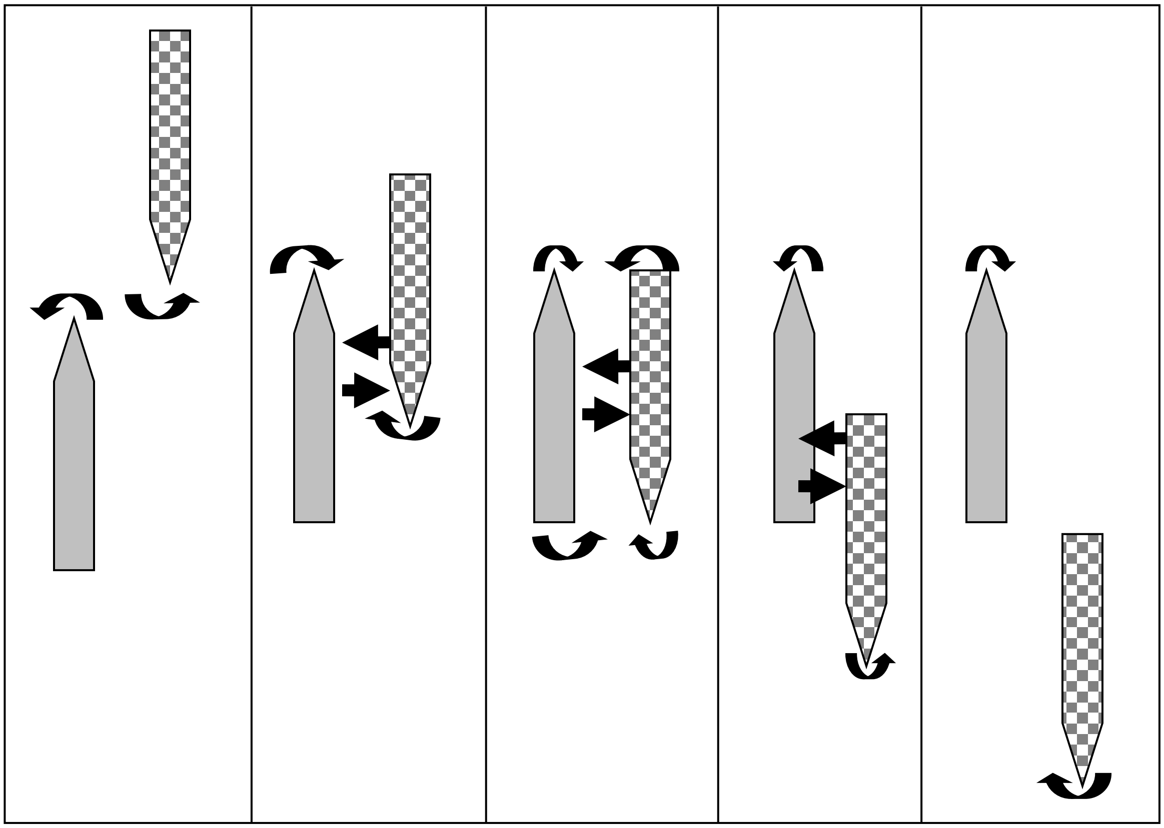
Hydrodynamic interaction between ships occurs at any depth but it is amplified in shallow water and it is proportional to the ships passing speeds. i.e. if the speed is more, interaction between ships is more and vice versa. When different sizes of ships pass close to each other, effects of interaction are more on the smaller vessel. When a large vessel and a small vessel passing closely, there is a possibility of capsizing of the smaller vessel due to interaction effects.

3) Interaction between ships when over taking

Students must understand that these effects depend upon the sizes of the ship, their speeds, distances between them and other effects from surrounding areas, such as the bank cushioning effects, weather condition etc. The most important thing is to understand the pressure distribution system around a vessel. Once it is understood, all these can be predicted up to a certain accuracy.



4) Interaction between ships when passing close by in reciprocal courses



5) Squat effect

When a ship is moving forward, a depression of the water line is occurred at the amidships region, which moves with the ship, and a wave-like water rise in the bow and the stern. This depression causes a reduction in the under-keel clearance of the vessel and this is known as squat. Although the same thing happens in deep waters as well, deep water squat is not that important as there is sufficient water available below the keel. Squat is more prominent when the depth is less than 1.5 times the draught of a vessel.

Therefore, the squat is the result of hydrodynamic interaction between ship and bottom. It is not an increase in draft. Therefore, the mean draught remains the same. Water flow around box-shaped ships is more restricted and it is expected that these vessels squat will be more pronounced. If the vessel is even keel, squat will cause a trim by the bow for box-shaped vessels. Squat will cause a trim by stern for fined hull vessels. In case the vessel is already trimmed, squat will make her further trimmed in the same direction. When a vessel encounters squat;

- steering will be sluggish
- she may encounter higher vibration

- there will be RPM fluctuations
- discolouration of water at the stern may take place
- change of trim will occur

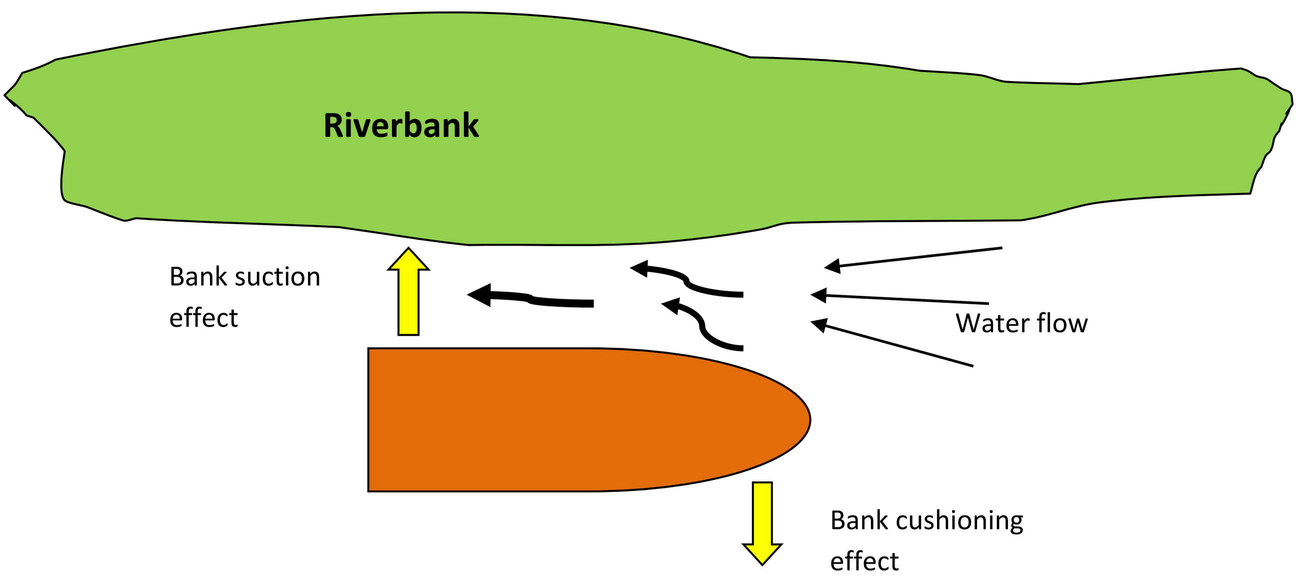
The only available method to reduce the squat effect is to reduce the speed.

6) Smelling the ground

This occurs when a vessel is coming close to a very shallow water area. A vessel coming closer to such a shallow water area will experience a sudden sheer towards the shallow area and then violently away from the shallow area. That is why it is known as smelling the ground.

7) Bank cushioning and bank suction effects

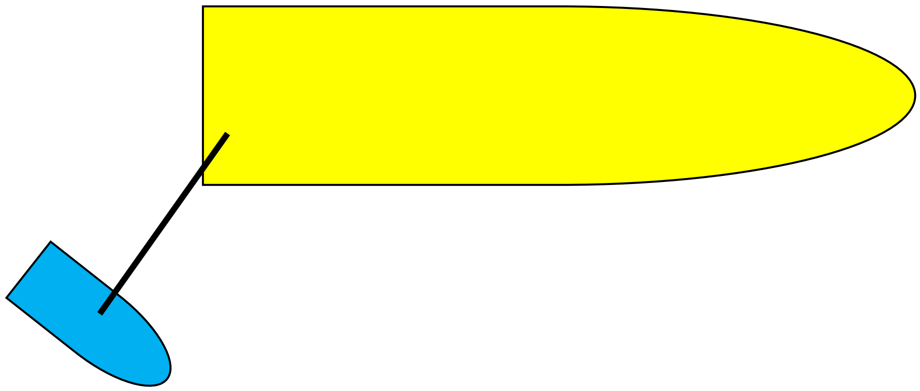
When a vessel is moving close to a bank, high pressure develops between the bank and the bow of the ship making the bow to push away from the bank. This is known as bank cushioning effect or the bow cushioning effect. The width of the black colour arrows indicates the speed of the 'water flow' in the diagram below.



Due to the loss of pressure and the increased speed of the water along the hull of the ship, her stern will be sucked towards the bank and this effect is known as bank suction effect.

8) Girting

Girting occurs on tugs when the tow line is secured on the midship area of the tug and when the tow line is perpendicular (or nearly perpendicular) to the fore and aft direction of the tug.



When the force on the tow is higher than the righting moment of the tug, she will continue to heel without coming back to the upright position. This is known as girting, girthing, tripping or girding. A tug may capsize due to girting.

9) Towing and being towed

Ships are required to have an emergency towing booklet which contains at least:

- Ship name, call sign, IMO number
- Details of anchor and anchor cable
- Diagrams showing the arrangements of mooring facilities with their SWL. This include fwd & aft mooring arrangements as well as the bollards, winches, fairleads etc. around the deck.
- Various towing patterns
- List of duties and responsibilities of the staff onboard in case of a towing operation.
- Methods/procedure of connecting towing line to the own vessel

Copies of the emergency towing booklet shall be available at least:

- with the ship owner/operator
- on the bridge
- in the forecastle space and
- in the ship's office or cargo control room

Apart from the emergency towing booklet, a plan for communications shall be available onboard for contacting a tug or salvor. Usually, this plan is included in the ship's emergency towing booklet. This plan shall contain at least the following:

- Condition of damage and the seaworthiness of the vessel

- Status of ship’s steering
- Status of ship’s propulsion
- Availability of power on deck
- Towing equipment onboard
- Availability of quick release system of the tow rope
- Towing locations in fwd and aft
- SWLs and capacities of points and equipment used for towing operations
- Ship particulars

The rigging procedure of a tow line and the towing procedure will be ship specific and need to refer the emergency towing booklet for the procedure of the rigging and the safety precautions to be followed. Common safety precautions to be adhered are listed below:

- Carryout the reporting as required
- Select a towing pattern (refer your towing booklet) in consultation with the ship’s master and the tug. The emergency towing booklet contains various towing patterns. One of the most suitable towing patterns can be selected depending upon the damaged positions on board the ship.
- Carryout a risk assessment
- Crew to be briefed about the operation
- Proper communication to be established during the rigging operation between the fwd / bridge and bridge / tug.
- Wear correct personal protective equipment
- Use correct equipment as listed in the emergency towing booklet otherwise, failures may occur due to impeding the SWLs.
- Try to avoid large turns with the towing lines.
- Ensure no chaffing of the towing line.
- Ensure the towing line is rigged in accordance with the towing pattern selected from the emergency towing booklet.
- Monitor the rigged equipment for some time period once the towing operation is started to ensure all are functioning correctly. Keep away from the snap back zones.
- Wear-out condition in Panama chock should be constantly checked.
- It is necessary to grease up continuously in order to prevent wear of ropes in Panama chock when wire ropes are used as towing lines.
- Rudder should be operated to improve the ship's movement in accordance with the tug’s requirements, if necessary.
- It should be confirmed with the engine room if there is a problem of free propeller rotation. It is necessary to determine in advance how to lock the propeller shaft.
- Consider of having additional tugs when entering narrow areas.

Bollard pull (BP) of the tug[36]

When a tug is hired the chartering party requires knowledge of the BP of the tug i.e. the pulling capability of the tug. The specification given to the charterer will usually be as per the BP certificate. The tug will have on board documentation, including a certificate issued by a competent authority proving the BP. It is not unexpected that as the tug gets older, the efficiency of the main engines and equipment will decrease the BP. It is generally accepted that if the BP certificate is less than 10 years old the BP rating is as stated on the certificate.

If the BP certificate is older than 10 years, the accepted BP rating should be reduced by 1% per year of age greater than 10 years i.e. a tug with a 20 year old BP certificate of 50 tonnes will effectively have a BP rating of 50 tonnes less 10 x 1% = 45 tonnes.

For tugs less than 10 years old with no valid BP certificate, the BP can be estimated by the following formula:

Rough BP = (1 tonne /100) x Brake Horse Power (BHP) of the main engines

For tugs over 10 years old without a valid BP certificate, the BP value can be estimated by the following formula:

Rough BP = 1 tonne/100 x BHP reduced by 1% per year of age greater than 10 years.

If the own vessel's SWL of the bollards are required, it can be taken from the own vessel's towing booklet.

[36] Tugs and Tows – A Practical Safety and Operational Guide – ship owners club, https://www.shipownersclub.com/media/2015/08/PUBS-Loss-Prevention-Tug-and-Tow-Safety-and-Operational-Guide_A5_0715.pdf

SEVERE WEATHER CONDITIONS

1) **Heavy weather**
   d) **Preparing a vessel for heavy weather**

- Make sure to follow and complete the heavy weather check list.
- Avoid slack tanks and eliminate free surface. If required (in consultation with the master), consider about changing the trim to reduce shipping seas over the fwd deck.
- Rig lifelines from Fwd to Aft if required.
- Warn all departments of the expected heavy weather.
- Close all hatches, ventilations and manholes, forecastle stores etc.
- Ensure the cargo lashings are all right.
- Check securing of lifeboats, & life rafts.
- Make sure the water-tight doors are closed.
- Secure all cargo gears.
- Secure all side scuttles and dead lights.
- Secure all the loose gear on the deck.
- Put additional lashings on anchors (if required), close Spurling pipe watertight (with cement), secure mooring ropes.
- Slack the signal and flag halyards.
- Drain swimming pool.
- Establish heavy weather work routine.
- Check securing on accommodation ladder.
- Secure bridge against heavy rolling/pitching.
- Organise meal relief's and watches.
- Ensure the LSA equipment which are in open areas are in appropriate positions (may have to stow/secure them with the master's permission).
- Enter a statement on the deck logbook for the compliance of the heavy weather checklist.
- Following to be considered by the master:
  - Update weather report and plot storm movement.
  - Verify vessels position and consider of re-routeing.
  - Reduce speed in ample time to avoid pounding.
  - If the predicted weather is different from the weather routeing or ocean routeing (if the navigational instructions are taken from third parties), inform them about the actual weather conditions.
  - Consider of steering weather courses to avoid severe pitching and/or rolling.
  - Change the settings on the autopilot accordingly or engage manual steering as appropriate.

- During heavy weather try to avoid beam swell/wave (may cause rolling synchronization), head swell/wave (may cause heavy pitching, panting and pounding) and in the case of stern swell/wave (may cause pooping)
- Revise ETA if appropriate.

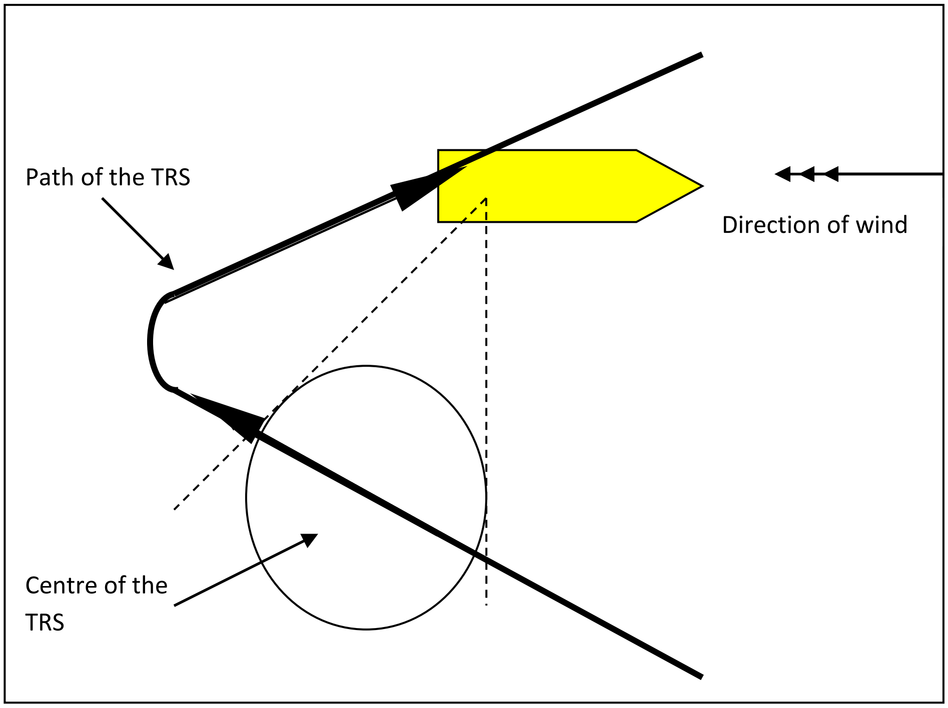
e) Approaching signs of a TRS

- If the barometric pressure drops more than 5 mb (after correction for index error, height above sea level and semi diurnal variation)
- The vessel's position is an area where TRS occur and during a TRS season.
- Increase of wind force when the pressure drops.
- Bands of Cirrus clouds directed towards the centre of the TRS.
- Threatening appearance of heavy clouds on the horizon.
- Sometimes frequent lightening may occur.
- Succession of squalls with or without rain.

f) Avoiding actions of a TRS

- The most important thing is to ascertain the ships position against the position of the TRS.
- This can be identified by the Buys Ballet law or by observing the change of the direction of the wind.
  - As per the Buys Ballet law, in the northern hemisphere, the low pressure is on 8 to 12 points on the right-hand side when you face the wind. In the southern hemisphere, the low pressure is on 8 to 12 points on the left-hand side when you face the wind.
  - In the northern hemisphere, if the wind is veering you are on the dangerous semi-circle and if the wind is backing you are on the navigable semi-circle.
  - In the southern hemisphere, if the wind is veering, you are on the navigable semi-circle and if the wind is backing, you are on the dangerous semi-circle. If the wind direction is steady, you are on the path of the TRS on both the hemispheres.

- In theory, to observe the change of the wind direction, the vessel may be stopped, and it will take some time. This may not be possible due to the prevailing weather conditions.



Application of the Buys Ballet law in the Northern hemisphere

- In the northern hemisphere, if you are on the dangerous semi-circle, keep the wind on 1 to 4 points on the starboard (if the vessel's speed is less than 12 knots keep the wind closer to one point and if the speed is more than 12 knots keep the wind closer to four points) on the bow. Alter the course as the wind veers (in the southern hemisphere keep the wind on the port bow).
- In the northern hemisphere, if you are on the path or on the navigable semi-circle, keep the wind on 1 to 4 points on the starboard quarter and alter the course as the wind backs (in the southern hemisphere keep the wind on the port quarter).
- Use the maximum possible speed in doing so. Sometimes you may have to "heave-to" (having a speed just enough to climb up the waves. Past tense is "hove-to"). When heave-to the vessel will be stopped in relation to ground. This will reduce pitching and pounding. But you will not be able to move away from the TRS when heave-to.

2) Ice navigation

When polar classed vessels are navigating in polar regions, need to comply with the Polar Water Operations Manual (PWOM), which is a ship specific document. General precautions to be taken while navigating in ice areas are described below.

- To avoid risk of damage to ballast & fresh water tanks due to freezing, the usual practise is to keep the tanks not more than 90% full to allow for expansion. Usually when the temperature of a liquid is increased, the volume will be increased to a certain extent. But the water acts differently when the temperature is increased. If the temperature of a sample of water (which is at 0º C) is increased, the volume will be reduced from 0º C to 4º C. there after the volume will be increased like other liquids. Due to this reason, if the temperature of water which is at 30º C is reduced, from 30º C to 4º C the volume will be decreased and from 4º C to 0º C, the volume will increase. If the tanks are kept full, this increase of volume may create structural damages.

- Fresh water tanks in the lifeboats should be kept no more than 75% full. Keep additional fresh water ready inside the accommodation and assigned crew to carry them into the lifeboats in an emergency.
- The master needs to consider of taking additional fuel, stores and fresh water that may require due to delays.
- Ensure the search lights are working in order.
- Ensure the crew are supplied with warm clothing.
- Add anti-freeze to lifeboat engine cooling systems.
- Ensure a sufficient trim is available, but, excessive trim by the stern is not recommended, as it cuts down manoeuvrability and increases the possibility of ice damage to the more vulnerable lower area of the exposed bow.
- Make sure the hot water system for the bridge windscreen is working in order or keep ready de-icing liquids or spray cans.
- Additional shovels, scrappers and crow bars may be required to remove accumulated ice on deck.
- Keep the fire lines running or drain it completely.
- Do not keep the cargo lashings and wires of cargo gears too tight as they may break due to contraction.
- Ensure the heaters inside the accommodation are working in order.
- May require to keep running the hydraulically operated equipment such as mooring equipment to avoid freezing.
- Add anti-freeze for PV valves on tankers.
- Make sure to keep the water seals of the scrubber and deck water seal warm on tankers.
- If the anchor is housed, it may not be able to let go the anchor due to ice accretion on the anchor handling equipment and in the hawse pipe. Therefore, it is a good practice to leave anchors slightly lowered in the hawse pipe in order to free them from ice accretion (to be done when started to encounter ice).
- If ice accretion on deck occurs, check the rolling period frequently and calculate the GM. This is important to ensure that she is not coming to a negative stability condition.

Preparations with regards to safety of navigation

Master is the person in charge of the navigation of a vessel. Therefore, following to be considered by the master.

- Watch keeping personnel should be aware of the dangers, problems that may encounter and safety precautions to be observed during ice navigation.
- After encountering ice, speed should be reduced to minimum but not too slow & not too fast.
- Keep engines ready for manoeuvring all the time (if at a berth).
- Keep additional personnel to keep visual lookouts and may need to engage hand steering at short notice.
- Keep ready the search lights.
- Try to collect more information with regards to ice.
- Give a wide berth to ice bergs.
- Enter ice at right angles.
- If possible, move with the movement of ice, without moving against it.

Reports to be made on encountering ice

On encountering air temperatures below freezing point, that are associated with gale force winds and causing severe ice accumulation on ships, the master is obliged under SOLAS to send a report to the ships in the vicinity and to the nearest coast station covering,

- Air and sea temperatures
- Force and direction of wind
- Position of the ship and
- UTC time and date of observation

The masters of every ship which meets with dangerous ice, are required to report the following information,

- The kind of ice
- Position of ice and
- The time and date in UTC of the last observation

Pre-warnings of the presence of ice

- Sea and swell lower than expected for the existing wind speed may indicate the presence of significant ice to windward.
- Animals and or birds far from land may indicate the presence of large ice sheets.
- When steaming up wind, small pieces of ice may forewarn of larger formations to windward.
- When steaming down the wind large ice formations may be approached directly without forewarning.

The navigational errors that you may encounter

- GPS is reliable, provided the correct datum is applied. But, may encounter errors due to tropospheric delays and ionospheric refraction in the auroral zone.
- Radar should be used with caution as ice may significantly change the effectiveness of the coastline.
- Radar scanner may become frozen.
- Ice particles on the radar scanner will reduce the transmitting & receiving pulse energy.
- Visual fixes with identified objects are the best.
- Light colours of navigational aids may be affected by ice.
- Light sectors & ranges may be affected by ice. Sometimes it may be totally obscured.
- Gyro compass errors may occur due to large course & speed alterations.
- Ice on the compass will make taking bearings difficult.
- After 70º latitude, gyro is not reliable and after 85º latitude it is totally useless.
- Above 70° latitude, the magnetic compass will not settle unless the ship remains on the same heading for a prolonged period.
- Echo sounder may not give correct reading due to false echoes.
- Radio communications may be difficult due to ice formation on the aerials.
- Buoys may be moved or removed in the ice seasons.
- Stars of below 10º of altitude are the best for celestial navigation.

Anchoring in ice areas

It is not advisable to anchor in ice areas except in emergencies. If, anchoring is extremely necessary, use minimum amount of cable and ensure the windless power is available, to heave up the cable. Keep the engines running slowly to avoid freezing.

3) Rolling synchronization

Rolling synchronization occurs when the vessel's natural rolling period equals with the encounter wave period. This happens when a vessel is experiencing beam seas and when the rolling synchronization occurs; vessel's rolling angle will be increased with each wave. She will experience vigorous rolling movements and there is a high possibility of capsizing the vessel. Rolling synchronization can be avoided simply by altering the course. Change of ship's speed is not effective in reducing the rolling synchronization at all.

4) Pitching synchronization

Same as rolling synchronization, pitching synchronization occurs when a vessel's natural pitching period equals the encounter wave period. This happens when a vessel is experiencing head seas and when the pitching synchronization occurs; vessel's pitching will be increased with each wave. When a vessel is experiencing pitching synchronization, she will experience violent pitching movements and bow will start digging more and more into head seas.

Reduction of ship's speed is the most suitable action to reduce this effect. The second option available is to alter the course. Speed shall not be increased to avoid this, as it may start pounding the vessel. The slamming effect of the forward section against the sea is known as pounding. This is also dangerous as she may encounter structural damage.

5) Parametric rolling

Parametric rolling means sudden, unstable, unsymmetrical (unsymmetrical means stbd rolling angle does not equal to port side rolling angle) and large rolling motions of a vessel while encountering head or stern seas. This is a dangerous phenomenon and could occur with rough weather as well as moderate weather conditions. A vessel may experience parametric rolling even though she is complying with the required stability criteria.

Parametric roll is a **threshold phenomenon** as a combination of **environmental**, **operational** and **design parameters** needs to **come together** before it is encountered[37]. Which means, a vessel may encounter parametric rolling with any stability conditions provided the environmental and design parameters are tallying with the present stability condition of the vessel.

Parametric rolling may occur in two different situations[38]:

- The stability varies with an encounter period T_E that is about equal to the roll period T_R of the ship (encounter ratio 1:1). Compiler's comment – In simple terms, what it means is vessel's pitching period is equal to rolling period.
- The stability varies with an encounter period T_E that is approximately equal to half the roll period T_R of the ship (encounter ratio 1:0.5). Compiler's comment – In simple terms, what it means is that the vessel experiences two rolling motions within one pitching period.

The other factors which increases the risk of parametric rolling includes[39];

[37] Gard guidance on freight containers, Gard, http://www.gard.no/Content/20940752/GardGuidanceContainers_optimised3.pdf
[38] MSC.1/Circ.1228, IMO
[39] Gard guidance on freight containers, Gard, http://www.gard.no/Content/20940752/GardGuidanceContainers_optimised3.pdf

- the ship travels with a small heading angle to the predominant wave direction (head or stern seas)
- the wavelength is comparable to the ship length
- wave height is large and
- the ship's roll damping characteristic is low

Parametric rolling is very common with container ships as they have parallel hull around the mid length of the vessel and large flares at the fwd and aft ends.

Hull form of a container ship[40]

Parametric rolling may be experienced by certain generations of Pure Car & Truck Carriers (PCTC) as well as they are also having similar hull forms[41].

With regards to transverse stability;
KM = KB + BM

When a ships draught is less, KB will be less. When the water plane area is less BM will be less and finally, KM will be less. By keeping this in mind refer the diagram below;

Wave crest is amidships[42]

[40] As investigation of head-sea parametric rolling and its influence on container lashing systems, https://www.steamshipmutual.com/ParametricRoll.pdf
[41] Evaluation of vulnerability to parametric rolling, Anders Sjule, http://www.diva-portal.org/smash/get/diva2:1057139/FULLTEXT01.pdf
[42] Gard guidance on freight containers, Gard, http://www.gard.no/Content/20940752/GardGuidanceContainers_optimised3.pdf

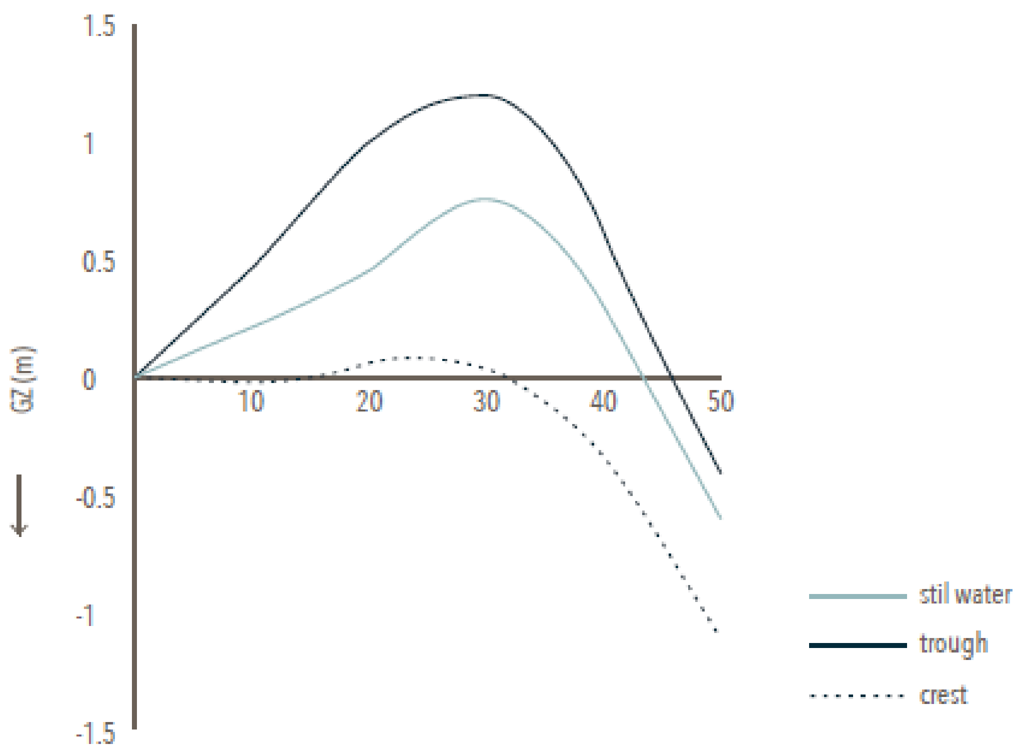
In the above situation, KM is reduced as water plane area is reduced. But, KG does not change. Therefore, when the midship section of a vessel is on a crest of a wave, GM will be virtually reduced, because;
GM = KM – KG

When the opposite happens with a container vessel;

Wave trough is amidship[43]

Since the container vessel are having large flares fwd and aft, the water plan area will be increased. This will increase the KM virtually and that will cause the GM to increase virtually.

Refer the GZ curve below for both the above situations above:



Source – Gard guidance on freight container

[43] Gard guidance on freight containers, Gard, http://www.gard.no/Content/20940752/GardGuidanceContainers_optimised3.pdf

Therefore, when a vessel is experiencing parametric rolling, the stability of the vessel will be improved when the wave trough is amidships, and the stability will be worsening when the wave crest is amidships. At the same time, higher the wave height, higher the virtual loss of GM and if the vessel is not having a sufficient GM for that particular threshold phenomenon, she may encounter a negative GM as well.

Actions to be taken to avoid parametric rolling and damages

- Master is required to select the course and the speed in such a way to avoid the encounter ratios of 1:1 and 1: 0.5 as mentioned above[44]. To avoid this, need to know the rolling period before hand.
- Have a higher GM but without making her stiff, so that the GM will not become negative while experiencing parametric rolling.
- Ensure the GM is similar to the GM used in the cargo securing manual (CSM) in defining the lashing arrangements. Parametric rolling cannot be avoided by this, but, damages due to rolling and pitching can be avoided. The stresses acting on lashing material will be increased during rolling and pitching. If the vessel's GM is not similar to the GM used in CSM, the stresses on the lashing material will be further increased causing damages to lashing materials and then the cargoes.
- Master to make proper route planning by referring to the forecasted weather.
- Reduce the FSE as this will increase the loss of GM virtually during parametric rolling.
- Follow the instructions provided in the stability book in avoiding parametric rolling.

6) Pooping

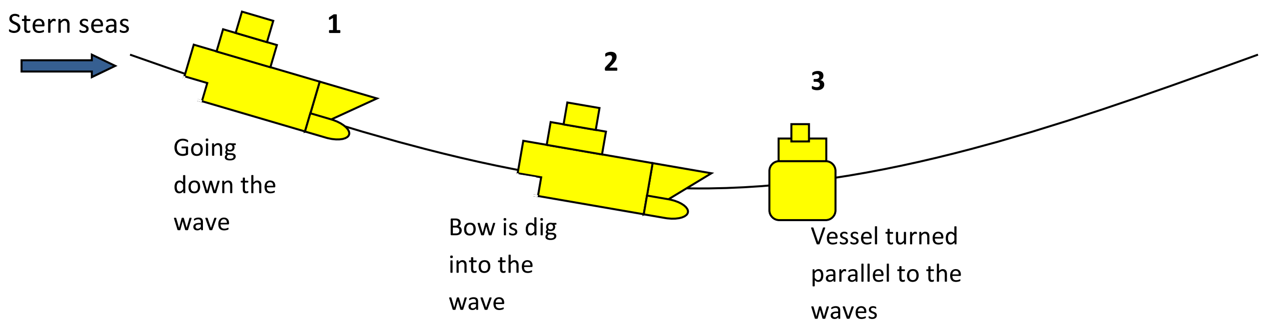
Pooping means shipping spray and seas over the poop deck. Pooping occurs when a vessel is experiencing following or quartering seas and when the speed of the swell/wave is higher than the speed of the ship. While the wave/swell is trying to overtake the vessel, shipping seas may take place from the poop deck. This is a dangerous phenomenon with smaller ships than with large ships. Pooping is dangerous mainly due to two reasons. First one is that as there are more openings around the poop deck than in the forecastle, therefore possibility of flooding is higher and the second reason is that no much control over the manoeuvring of a vessel when pooping occurs. The only option available to avoid pooping is to alter the course.

7) Broaching

Same as pooping this also occurs with the stern seas. A vessel riding down a wave is known as surfing or surf riding. This will accelerate the speed of the vessel considerably causing the bow

[44] MSC.1/Circ.1228, IMO

to dig into the wave ahead and finally, the forces acting behind the vessel may swing the stern violently either to port or stbd side creating a severe list. This phenomenon is known as broaching. A vessel may capsize due to severe broaching. This is a dangerous phenomenon on smaller ships rather than on larger ships. This could be avoided easily by altering the vessel's course.



8) Altering course in heavy weather

If a vessel is turned in to the seas or away from the seas in heavy weather, carelessly, she may encounter excessive damages. Therefore, a careful observation must be done about the sea condition, which needs experience and good seamanship. Always try to turn her in a relatively calm area. When turning, the speed must be minimized to maintain steerage and large helm will be required. To initiate the turn full helms and the short but full engine movements may be required. Always try to avoid pooping and broaching effects and rolling synchronization.

When turning away from the seas or when turning in to the seas an experienced mariner would initiate it in a trough of a wave than on a crest of a wave. When turning away from the seas the latter half of the turn should be completed faster to avoid broaching and rolling synchronization. When turning into the seas, again the letter half of the turn should be completed as soon as possible to avoid heavy rolling and swaying.

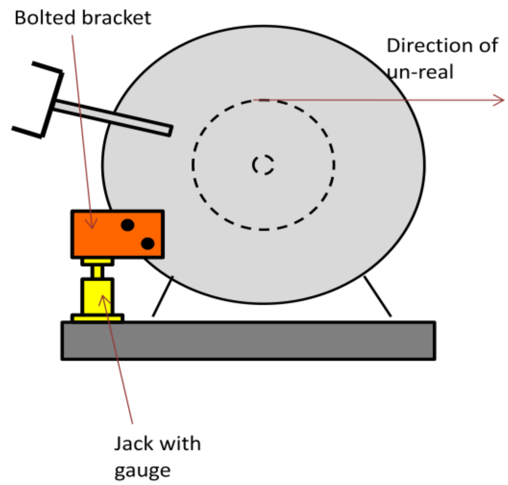
DECK AND ACCOMMODATION MAINTAINNACE

1) Maintenance of mooring winches, windless and anchor

The maintenances to be carried out on mooring winches depend upon the type (hydraulic or electric or steam powered) of the mooring winch and the manufacturer's instructions. Therefore, a chief officer has to refer the PMS and also the manufacturer's instructions for ship specific maintenance procedures. A general list of items to check and general maintenance works to be carried out on a mooring winch are listed below:

- Ensure that the anchor shackle and the shackle pin is in place.
- Shackles to be marked and/or painted if required.
- Ensure that the bitter end of the cable is free to let go in an emergency.
- Ensure that the bow stopper and the other securing devices of the anchor cable are in good condition.
- Transpose shackles backwards when the vessel is in a dry dock.
- Check the diameter of the shackles (11% of wear down in bar diameter is allowed before replacement) when dry docked.
- Hammer test or ultrasound test to be done on the cable when dry docked.
- Check the oil level in the oil tank (preferably before starting each time).
- Check the viscosity of the hydraulic oil and change if required.
- Carryout greasing of all the grease nipples and the hinged joints.
- Ensure the drain cap of the dip tray is in order.
- Check the base (for deformations, cracks, welding intact etc.) of the mooring winches to ensure it is in good order.
- Check the brake liners.
- Ensure the safety pins of engaging/disengaging levers are usable and connected to levers.
- Ensure that the paint condition is acceptable and the markings on the winches and the windlass are legible.
- Ensure the snap back zones are properly and clearly marked and are legible.
- Check the insulation of the motor. Due to the sea water and spray the insulation may get damage which will cause the motor to overheat. This should be checked with a mega-meter.
- Ensure the mooring ropes/wires are in good condition. If the mooring ropes show excessive wear and tear or if more than 10% of the visible strands in a length of a wire equal to 8 diameters are broken, the wire or the rope shall be replaced immediately.
- Carryout brake rendering test annually. Mooring lines will be parted if the load on the mooring ropes exceed MBS (Maximum Breaking Stress) endangering those who are working around when a vessel is moored at a berth. To ensure the MBS is not exceeded, the brake is set to slip when the load on a mooring rope equals to a certain percentage of the MBS. Usually, brakes are set to slip when the load exceed 60% of the MBS of the ropes. Brake rendering test is carried out to ensure that the brake slip when the load on the

rope equals to the set load. The procedure of carrying out the brake rendering test is given below. A test kit (which contains bracket to attach to the collar of the winch, bolts to attach the bracket to the collar and a jack) is available on board the ship:



- Disengage the winch.
- Fix the bracket to the collar of the winch.
- Turn the winch by hand until the bracket touches the jack (refer the diagram above)
- Tight the brake up to the marked position.
- Keep pumping the jack until the brake slips.
- Measure the gauge at that moment.
- It should be equal to the set values (usually, 60% of the MBS of the rope).

2) Maintenance of Cargo lifting appliances

a) Documentation with reference to maintenance of cargo lifting appliances

Ships are required to maintain a "Register of lifting appliances and loose gear" which is also referred as "Register of Lifting appliances and Cargo Handling Gear".

Loose gear means items that are not attached to the lifting appliances permanently, but, items that use to attach the load to the lifting appliances. Loose gear also known as lifting accessories and may include wire ropes, hooks, blocks, chains, shackles, swivels, rings, links, slings, grabs, spreaders, lifting beams and lifting frames etc. Practically, it is not that difficult to identify whether any item is a loose gear or not as all the loose gears are listed under the loose gear section of the register.
Register of lifting appliances and cargo handling gear should be maintained in an approved form. This has two parts;

- Part I – this contains thorough examinations of lifting appliances

- Part II – this contains the regular inspection of loose gear

All the loose gears shall have certificates issued by the manufacturer and these certificates to be attached to the Register of lifting appliances and loose gear (Part – II). These certificates shall contain at least:

- the distinguishing number or mark applied on the loose gear
- description of particular loose gear,
- date of test,
- proof load applied and
- safe working load

b) Thorough examination of cargo lifting appliances[45]

Cargo lifting appliances including the loose gears are required to be thoroughly examined by a competent person every 12 months. This requirement may be changed by the ship's flag administration, therefore, need to refer flag state regulations and / or ILO Convention 152 (this will be applicable, if the flag state has ratified this Convention only).

Above ILO Convention provides only a general definition of the "competent person", therefore, some flag states leave it to the vessels technical managers to identify the competent person. Because of this, some companies has appointed the chief engineer or the chief officer as the competent person, but, when you go through the below mentioned procedure which gives a general idea of a thorough examination, you will realize that, it cannot be carried out any of the onboard personnel as they are not correctly trained for it. The most suitable person would be a class surveyor.

The competent person may require the following documents during a thorough examination:

- Existing certificates of lifting appliances, loose gear and ropes
- Survey history
- Outstanding problems from the last thorough examination
- Serviced and maintenance history
- General arrangement plan

Following items of the cranes and derricks may be checked by the competent person:

[45] Survey and Examination of Ship's Lifting Appliances by Lloyd's Register / UK P&I Club, 2011

Cranes	Derricks
Loose gear	Loose gear
Ropes	Ropes
Protection and limitation devices	Protection and limitation devices
Winches, brakes and drums	Winches, brakes and drums
Built-in sheave units	Deck fittings
Hydraulic cylinders and pins (ram luffed cranes)	Derrick booms
Jibs	Mast fittings
Jib heel pins (the pin which attaches the jib to the crane. The jib is lowered or heaved vertically around this pin)	Masts, derricks posts and guy posts
Slewing columns (the cabin and the structure that rotates when the jib is swung horizontally) and machinery deck	
Slew bearings (bearings at the base that rotates horizontally) and bolts	
Pedestal and foundation	

The wear and tear of slew bearings can be monitored by:

- Rocking test (this measures the play or the relative movement between the inner and outer bearing race, to give an indication of the wear taking place). This is an onboard testing procedure and the procedure will be given by the manufacturer of the appliance or
- Grease sampling data (wear and tear of a component can be identified by the metal content in the grease used to lubricate the component). Grease samples to be tested in a laboratory but not onboard. This is an alternative to the rocking test.

The inspection of the loose gears may be carried out by:

- Hammer tests – to identify the extent of corrosion
- Non-destructive examination (by using electronic devices such as ultrasonic sound measurements) – to identify the cracks
- Dismantling of moving parts – to identify the wear and tear
- Visual inspection of wire ropes – to identify damages, corrosion, chaffed areas etc.

As the meaning of the word a thorough examination means it is a thorough examination. Therefore, the surveyor will inspect even the hard to reach places of the cargo lifting appliances. Therefore, make sure to arrange suitable means of access to all the areas including the hard reach areas of the cargo gears.

The limits of allowed wear down and corrosion depend upon the class requirements or the flag state requirements. These wear down and corrosion allowances are not important for a chief officer to remember, but, the wear down and corrosion allowances required by the Lloyd's Register are provided below to gain additional information:

Item	Limit
Structural members of the lifting appliances	Reduction of 10% maximum at any point, based on the material thickness
Loose gear	Reduction of 5% on any diameter Reduction of 2% on any diameter of a pin in a hole
Wire ropes	5% of broken, worn or corroded wires in any length of 10 rope diameter[46]

After a successful thorough examination of lifting appliances and loose gears, a certificate or report shall be issued on the appropriate form by the competent person. These certificates shall be kept on board for at least 2 years from the date of receipt of the next certificate.

During a thorough examination, if the competent person finds defects, he may:

- Instruct to take out of service or
- Impose conditions of class or recommended withdrawal of class (if it is a classed item)
- Restrict the use of the appliances, depending upon the type of the deficiency

c) Proof load testing

In accordance with the flag state requirements a proof load testing of all cargo lifting appliances shall be carried out:

- After manufacturing or installation.
- After any repair or modification which is likely to alter the SWL or affect it's strength.
- At 5 yearly intervals.

Following proof loads shall be used while testing cargo gears:

- SWL up to 20t : 25% in excess of the SWL
- SWL 20t – 50t : add 5t to SWL
- SWL greater than 50t : 10% to SWL

[46] This is the requirement of Lloyd's Register. The customary practice is the rope to be discarded if more than **10%** of strands are broken in a length of **eight times the diameter** in any place of the rope

- Hand operated pulley blocks to be proof load tested with a test weigh of 1.5 x SWL
- Various other proof loads will be used in testing loose gear depending upon the type of the loose gear.

Usually, cement blocks (with known weights) having sufficient weights are used for proof load testing, but, also water bags having the required weights can be used as an alternative to cement blocks.

Load testing for twin crane operation

Load testing for single crane operation

d) Use of cargo gears to embark or disembark people

This again depends upon the flag state regulations. The MGN 332 issued by the MCA, UK states that no person should be lifted except where;

- the equipment is designed or
- specially adapted and equipped for the purpose or
- for rescue or
- in emergencies

There are no regulations from the flag state relevant to this does not mean that cargo gears can be used for lifting persons. Chief Officers and deck officers should take due care not to use cargo gears for lifting people during normal operations.

e) General maintenances to be carried out

- Refer the PMS for ship specific maintenance procedures.
- Ensure the deck areas are oil and grease free.

- Machinery rooms and the controlling cabins shall be free of water accumulation.
- Cable sealing arrangements of junction boxes, switches and terminals shall be checked frequently for water ingress.
- Make sure the SWL and the other important makings on the jib or boom is clearly visible.
- Frequent visual inspections to be carried out to identify possible defects.
- All greasing points shall be greased with the correct type of grease periodically.
- Wires to be lubricated periodically with the correct wire rope lubricant.
- Wire ropes shall be replaced if:
  - Excessive corrosion is found or
  - Crushed badly or
  - Chaffed badly or
  - More than 10% of strands are broken in a length of eight times the diameter in any place of the rope.
- Limit switches and other safety devices which have sensors may damage very easily, therefore, need to check them frequently.
- Oil level and filters of the hydraulic cranes to be checked regularly.
- Ensure the oil coolers of the hydraulically operated cranes are clean.
- Check the magnet in the oil reservoir, if a magnet is fitted, check the build-up of ferrous debris in it. Oil to be renewed if lot of ferrous debris is found on the magnet.
- Ensure the general condition of masts, posts, booms, jibs including attachments such as eye plates, goosenecks are in good order.
- The loose gears shall be periodically checked for:
  - Condition
  - Corrosion
  - Damage
  - Excessive wear and tear
  - Legibility of distinguishing numbers stamped on them

3) Maintenances and inspections to be carried out in holds, ballast water tanks, freshwater tanks, cargo tanks and hatch covers

The inspection time intervals of ballast water tanks, freshwater tanks, cargo holds and cargo tanks may be defined by the flag administration or class or PMS. The PMS is developed taking into consideration of the requirements provided by the flag administration, class and the company. Therefore, chief officers shall adhere to the instructions provided in the PMS. The following table provides commonly practiced time intervals for ballast water tanks, freshwater tanks, cargo holds and cargo tanks inspections:

Type of ship	Areas to be inspected	Frequency
Oil & chemical tankers	Cargo tanks	Not exceeding 2.5 years
	Ballast tanks	Annually
Gas tankers	Ballast tanks, void spaces, cofferdams and cargo tanks	Annually
Bulk carriers	Cargo holds	Before loading and after unloading
	Ballast tanks	Depending upon the PMS
Container ships	Cargo holds	Depending upon the PMS
	Ballast tanks	Depending upon the PMS

a) Inspections to be carried out in cargo tanks

Following shall be checked when carrying out an inspection of ship's cargo tanks by the ship's crew:

- The condition of the access arrangements.
- The condition of cargo handling and monitoring equipment inside the tanks.
- The extent of sediment build up.
- Structural deformations (dents, cracks).
- The condition of the pipelines running through the tanks.
- The condition of the paint.
- Extent of corrosion, pitting and wastage.

b) Inspection and maintenance to be carried out in hatch covers

- Keep the hatch coaming clean always and ensure the non-return valves are working in order which are fitted to the hatch coamings.
- Ensure all the cleats are working in order and they are greased.
- Ensure the closing devices such as rollers fitted to pontoons, wires/chains, shackles, hydraulic machineries (if applicable) maintained well and in working orders.
- Check for cracks, dents, and welding cracks.
- Ensure the rubber beadings are in order and the holds can be closed watertight.
- If the pontoons are lift on / lift off type (by means of cargo gears), ensure the lifting sockets (eye plates on the pontoons) are in good order.
- Ensure the lashing points fitted on the hatch covers are in good usable condition.
- Ensure the makings on the pontoons such as bay numbers, safety signs etc. are legible.
- Make sure the general paint condition is acceptable.

c) Maintenances and inspections of cargo holds

- Ensure the access arrangements are in good working order along with proper safety fencing.
- Access openings shall be able to close watertight (rubber beadings must be in good order. Cleats and hinges must be greased and good working condition).
- Check for the condition of corrosion and the amount of rust scale.
- Check for welding cracks, cracks on steel plates and dents.
- Check for damages made by bulldozers/grabs (on bulk carriers, general cargo ships and multipurpose ships)
- Ensure the stress sensors and water ingress detectors are in working order (on bulk carriers).
- Ensure no damages to electrical cabling passing through the holds.
- Ensure no damages to fire detection and fixed firefighting systems and are in good order.
- Make sure the markings and safety signs are legible.
- Check for the proper functioning of lighting system.
- Check for any dents and deformations on cell guides (on container ships).
- Ensure the cargo securing points are in good order (on container ships, general cargo ships, multipurpose ships and car carriers).
- Ensure the watertight and gas tight doors are in good working order (on car carriers)
- Ensure the internal and the external ramps are lubricated and maintained in accordance with the PMS (on car carriers).
- Make sure to lubricate the wires used for opening and closing of ramps (on car carriers).
- If the holds to be painted, depending upon the type of the vessel and the type of the cargo to be carried, you may need to take permission from charters.
  Example – On car carriers, even a paint mark is present on a tier on a brand-new car, it is considered as damage. Therefore, charterers require painting to be completed in car decks some specified days before the commencement of loading.
- Ensure the scuppers in the tween decks are not blocked.
- Ensure the holds are cleaned according to the type of the ship (Examples - Holds shall be cleaned up to grain standards when carrying grain cargoes on bulk carriers. When carrying cargoes such as iron ore and coal on bulk carriers, sweeping or shovelling alone may be sufficient).
- Clean the bilges, check the strum boxes, ensure the suction is available and make sure the bilge cover is in good condition to avoid accidental falling of people into the bilge well.

d) Maintenances of freshwater storage facilities[47]

All elements of the freshwater production, treatment and delivery system including filters, pumps, calorifiers, pressure tanks etc should be inspected, cleaned, flushed out, or items replaced where appropriate, according to the manufacturer's instructions and the planned maintenance system. The following maintenance is recommended.

Persons inspecting or working in freshwater tanks should wear clean protective clothing and footwear which has not been used for any other work and they should not be suffering from any skin infection or communicable disease.

Fresh water storage tanks	
Actions	**Intervals**
To be thoroughly pumped out and where necessary hosed prior to refilling.	6 monthly
To be opened up, emptied, ventilated and inspected and thoroughly cleaned, recoated as necessary, aired and refilled with clean freshwater chlorinated to a concentration of 0.2ppm free chlorine. The cleaning process should include disinfection with a solution of 50ppm chlorine.	12 monthly
The system (from machinery space to furthest outlets) should be charged with super-chlorinated freshwater at a concentration of 50ppm for a period of 12 hrs and then completely flushed out and refilled at 0.2ppm residual free chlorine	Refit or dry dock
Pressure Tests on all FW tanks (After the pressure test, the system to be thoroughly flushed with water).	Intervals not greater than 5 years

Maintenances of distribution systems		
Parts	**Actions**	**Intervals**
Filters	Clean or change	Monthly or according to manufacturer's instructions
UV exposure area	Clean	According to manufacturer's instructions
Calorifiers	To be opened up, inspected scaled and cleaned. Before draining temperatures should be raised to 70^{o} C for at least an hour to ensure destruction of bacteria which may have colonised the lower and cooler zone of the unit	Periodically (general recommendation - annual inspection)
Shower heads	Particularly in accommodation that has been out of use for an extended period. Clean in a 50ppm chlorine solution.	3 monthly
FW Hoses	Flush and fill with 50ppm chlorine solution and allow to stand for at least an hour before emptying and stowage.	6 monthly or more frequent if required

[47] MSN 1845, MCA, UK

In addition to above, the same MSN states that:

Freshwater obtained from shore mains supply or water barge should be transferred by a designated freshwater hose. Hoses should be durable, with a smooth, impervious lining, and equipped with fittings, including adapters, to permit connection to the shore potable water hydrants and filling connections to prevent their use for loading other liquids. Hoses should be:

- clearly marked (generally coloured blue)
- stowed in a locker clear of the deck
- drained and capped at both ends after use
- flushed through and discharged to waste before loading.

Often ships use quayside hoses, in which case a designated crewmember should ensure that such hoses are in good condition and that they are routinely disinfected, safely stowed and capped in a clean environment.

Every potable water tank should have a filling line to which a hose can be attached. This line should not be cross connected with any line of a non-potable water system. Each line should be clearly identified as such and painted blue with a screw cap or plug fastened by a short chain so that the cap does not touch the deck when hanging free.

e) Testing of drinking water

There are few regulations adopted by WHO (World Health Organization) and ILO (International Labour Organization) with regards to drinking water, storage of drinking water and testing of drinking water. Refer the below requirements and Conventions and the brief description of requirements concerning fresh water as provided under each Convention and regulation.

- **International Health Regulations (IHR) 2005 by WHO**

  In accordance with the IHR 2005, The drinking water may be tested before issuing Ship Sanitation Control Exception Certificate or Ship Sanitation Control Certificate. Also, it says that under the supervision of a competent authority vessels are permitted to take water onboard.

- **MLC 2006**

  What this state is that the competent authority shall require that frequent documented inspections be carried out onboard ship, by or under the authority of the master with respect to drinking water.

- **Guide to Ship Sanitation, 3rd Edition, 2011 by WHO**

  In a nutshell, this says that;

  - the ship's operator must seek assurance as to the quality and nature of the source water before taking onboard.
  - the ship's master or officer responsible for taking water onboard must be responsible for ascertaining whether or not the source of the water is potable.
  - ships using ports where water treatment is unreliable must carry calibrated equipment for basic testing (turbidity, pH and disinfectant residual) and ensure capacity to dose disinfectant or filter to appropriate levels to provide a minimum level of safety.
  - regular verification and operational monitoring of pH and chlorination can be performed by appropriately trained and competent ship staff, sampling for complex chemical and/or microbiological analysis should always be performed by well-trained professional persons who are authorized by a certified laboratory
  - documentation of monitoring should be kept for assurance and analysis in the event of an incident. Documentation should be showed to the competent authority under the IHR 2005 whenever requested.

- **Guidelines for Drinking Water Quality 2008 by WHO**

  In brief, it says that;

  - the frequency of monitoring should reflect the probable rate of change in water quality. For example, monitoring of drinking-water on ships may be more frequent when the ship is new or recently commissioned, with frequencies decreasing in the light of review of results. Similarly, if the ship's water system has been out of control, monitoring following restoration of the system would be more frequent until it is verified that the system is clearly under control.
  - the port authority has responsibility for providing safe potable water for loading onto vessels. If water is suspected to have come from an unsafe source, the ship's master may have to decide if any additional treatment (e.g. hyperchlorination or filtration) is necessary.
  - independent surveillance is a desirable element in ensuring drinking-water safety on ships which may include periodic audit and direct assessment

None of the above requirements states any time frames to test drinking water or the methods of testing. But all the regulations are very concern on providing proper quality drinking water to seafarers. Therefore, need to refer the SMS and the flag state regulations about testing methods, frequencies etc. of drinking water.

f) Inspection of ballast tanks

Following shall be checked when carrying out an inspection of ship's ballast water tanks by the ship's crew:

- Existing coating condition
- Condition of anodes (if applicable)
- Extent of corrosion, pitting and wastage
- Condition of access arrangements
- Condition of sounding pipes
- Condition of the vent pipes
- Condition of ballast pipe condition
- Welding cracks
- Cracks & dents on plates
- Ensure the lightning holes are not blocked

4) Maintenances to be carried out in and around the accommodation

- Refer the PMS for ship specific maintenance procedures.
- If practicable, clean the deck after each departure from a port.
- Need to wash down the external surfaces of the accommodation if salt particles are accumulated around or if found dirty or soot dust or cargo dust is found.
- Ensure all fire doors are in proper order.
- Routinely grease all doors which are exposed to weather, ventilation flaps and ensure they are in working condition.
- Accommodation inspections to be carried out to ensure all the cabins, galley, food storage areas, common areas, toilets and alleyways are in good order and condition.
- Ensure the deck scuppers are not blocked.
- Ensure the condition of the paint outside the accommodation is in good order.
- Ensure all the watertight doors are in good working order.
- Periodically check the ship's hospital to ensure it is being maintained well. Ensure the ventilation, emergency call button and the access to the hospital from outside the accommodation is in good order.
- Routinely flush the toilets which are in spare cabins and other toilets which are not been used frequently. Try out the hot and cold-water systems, showers and ventilation systems frequently in these toilets as well.
- Ensure the floor tiles are in good condition without damages.
- Ensure the firefighting appliances, first aid boxes, emergency escape devices and the other equipment available to use in emergencies, are available and clear of obstructions.
- Ensure all notices and placards are posted in appropriate places in accordance with the company SMS and they are legible.

- Ensure the cabin muster cards (if available), muster lists and training manuals are available in appropriate places.
- Ensure all the safety, security and pollution prevention signs are in good order and legible.
- Make sure the emergency escapes are properly marked and clear of obstructions.
- Alleyways and staircases shall be clear of obstructions providing clear passages.
- In a ship's galley:
  - wash basins shall be clean
  - water drainage system shall be in good order
  - the range hoods, ventilation openings with wire mesh to be clean of oil
  - ensure the garbage bins are daily emptied to storage facilities outside the galley.
  - Ensure the firefighting appliances, first aid boxes, fire blankets and the other equipment available to use in emergencies are available and clear of obstructions.
  - The general appearance of the galley must be in good order.

- Routinely inspect the condition of the illumination in and around the accommodation.
- Routinely clean the bulk heads.
- Routinely clean the deck heads, especially in the common areas (such as ship's office, mess rooms etc.) as the cigarette smoke dust deposits on the deck head making it discolour.
- Ensure the mess rooms are daily cleaned, garbage bins and ash trays are daily emptied.
- Ensure the blind folders of port holes in common areas are in good condition.
- Ensure the objects and equipment which are not commonly used are kept secured/lashed against accidental shift during bad weather conditions.

5) Guidelines for periodic servicing and maintenance of lifeboats, launching appliances and on-load release gear

Authorized persons for *Annual thorough examinations and operational tests* AND *Five yearly thorough examination, overhaul and overload operational tests*[48]

Above two shall be conducted by **certified personnel** of either the manufacturer or an authorized service provider.

Weekly and monthly inspections, and routine maintenance which are required by the equipment manufacturer, should be conducted under the **direct supervision of a senior ship's officer**.

[48] Resolution MSC.402(96), IMO

Maintenance and service

Maintenance manuals issued by equipment manufacturer shall be available onboard and all the services and maintenance carried out shall be in accordance with such maintenance manuals only[49]. During the period of maintenance or test, all the unnecessary persons must be kept away from the area of risk[50].

Annual thorough examinations and operational tests[51]

a) Lifeboat, freefall lifeboat, rescue boats, fast rescue boats

Following will be examined

i. All items undergo weekly/monthly inspections form the first part of the annual inspection.
ii. Reviewing of maintenance records made by the ship staff.
iii. Visual inspection of the lifeboat structure, fender/skates and loose equipment.
iv. Engine & propulsion system.
v. Sprinkler and air supply system (if fitted).
vi. Manoeuvring system
vii. Power supply systems
viii. Bailing system
ix. Fender/skate arrangements;
x. Rescue boat righting system, where fitted and
xi. Release gear

b) Operational test of on-load release function (for davit-launched lifeboats and rescue boats)

i. Position the lifeboat for on-load release. Boat just touching the water with the weight on the falls. Never drop the boat from above the water surface;
ii. Operate the on-load release gear;
iii. Reset the on-load release gear; and
iv. Examine the release gear and hook fastening to ensure that the hook is completely reset, and no damage has occurred.

[49] Resolution MSC.402(96), IMO
[50] MGN 560 (M), MCA, UK
[51] Resolution MSC.402(96), IMO

c) **Operational test of off-load release function (for davit-launched lifeboats and rescue boats)**

i. Position the lifeboat for off-load release (waterborne);
ii. Operate off-load release gear;
iii. Reset the on-load release gear; and
iv. Recover the lifeboat to the stowed position and verified ready for launching in an emergency

d) **Operational test of free-fall lifeboat release function**

i. Engage the simulated launching arrangements as specified in the manufacturer's operating instructions;
ii. If required to be onboard, the operator should be properly seated and secured in the seat;
iii. Operate the release mechanism to release the lifeboat;
iv. Reset the lifeboat in the stowed configuration;
v. Repeat procedures (ii) to (iv) above, using the back-up release mechanism, when applicable;
vi. After ensuring that the boat is safely re-stowed remove the simulated launching arrangements; and
vii. Verify that the lifeboat is in the ready to launch stowed configuration.

e) **Davit-launched life raft automatic release function**

i. Manually release the hook with a load of 150 kg on the hook;
ii. Automatically release the hook with a dummy weight of 200 kg on the hook when it is lowered to the ground and
iii. Examine the release hook and hook fastening to ensure that the hook is completely reset and no damage has occurred.

f) **Launching appliances of lifeboats, freefall lifeboats, rescue boats, fast rescue boats & life rafts**

Following will be checked for satisfactory condition & operation;

i. Corrosion, misalignments, deformations and excessive free play of launching devices;
ii. Wires and sheaves, possible damage such as kinks and corrosion;
iii. Lubrication of the wires, sheaves and moving parts; and
iv. If applicable:

- Functioning of limit switches;
- Stored power systems;
- Hydraulic systems; and

v. For winches:
- Inspect the braking system in accordance with the winch manual;
- Replace brake pads, if necessary;
- Winch foundation; and
- If applicable;
  - ➢ Remote control system; and
  - ➢ Power supply system

g) Winches of launching appliances (Dynamic winch break test)

For winches of the launching appliances for lifeboats, freefall lifeboats, rescue boats, fast rescue boats & life rafts annual operational testing shall be done **by lowering the empty boat or equivalent weight**. When the boat has reached its maximum lowering speed and before the boat enters the water, the brake should be abruptly applied.

Following shall be checked for satisfactory operations after the annual winch break test[52]:
- Operation of devices for activation of release gear;
- Excessive free play of the release gear;
- If fitted, hydrostatic interlock system;
- Cables for control and release and
- Hook fastening; including link plate, keel shoe, bolts etc.

Five yearly thorough examination, overhaul and overload operational tests[53]

A) Operational tests and overhaul at five-year intervals of release gear for lifeboats, freefall lifeboats, rescue boats, fast rescue boats and life rafts shall include:
- Dismantling of hook release units;
- Examinations with regards to tolerances and design requirements;
- Adjustment of release gear system after assembly
- Operational tests as stated in (b), (c), (d) and (e) above, as applicable, but with a load equal to 1.1 times the weight of the survival craft or rescue boat and it's full complement of persons and equipment; and
- Examinations of vital parts with regard to defects and cracks.

[52] MGN 560 (M), MCA, UK
[53] Resolution MSC.402(96), IMO

B) Winches of launching appliances (Dynamic winch break test)

At least once every five years rescue boats and lifeboats shall be lowered when loaded with weights to simulate 1.1 times weight of the survival craft or rescue boat and its full complement of persons and equipment or with an equivalent load.

It is worth to note the following which are mentioned in MGN 560 (M) issued by MCA with regards to 5-year load tests

- On UK flagged vessels this test to be conducted by an authorized service provider with a ship's officer in charge (OIC) and witnessed by an MCA surveyor or other person appointed by the MCA. Check your vessel's flag state requirements for this effect.
- The OIC is in charge of the test at all times and should brief those carrying out the test on what is required.
- The surveyor or other person appointed by the MCA should take no part in the test and should not be the OIC. He will be only witnessing the operation.
- All such tests are to be planned in advance. All routine maintenance and records are to be updated before the test.
- Lifeboats must be weighed before testing to confirm that the weight remains as previously recorded and that it is no more than the certificated production test weight.
- The results of the test should be recorded on a test certificate produced by the competent persons and signed by the witnessing authorised person.
- This test can be done by means of two methods as explained below:

First method – testing boat and davit together

Boats should be loaded with weights amount to a load of 1.1 times the weight of the survival craft or rescue boat and its full complement of persons and equipment or with an equivalent load. The weights shall be distributed around the boat equally. This is to be done at the embarkation position of the boat. Usually, lifeboat will be filled with water bags to achieve the above weight.

Source - https://doowin.cc/load-testing-services/lifeboat-davit-testing/

If the embarkation position is not the stowed position, bring the boat alongside using bowsing tackle (this should be done from the ship, not from the boat as usually done), remove tricing pendants and do the loading as above.

Once ready, remove bowsing tackle and the boat is to be lowered lifting the brake fully to enable the boat to reach maximum speed. Once maximum speed achieved, the brake is then applied suddenly. The boat is then lowered until the keel of the boat is just **touching the water**. On-load release gear can be tried out now.

Once released the weights may be removed from the boat. **Under no circumstances should the ship's davits be used to lift the loaded boat.**

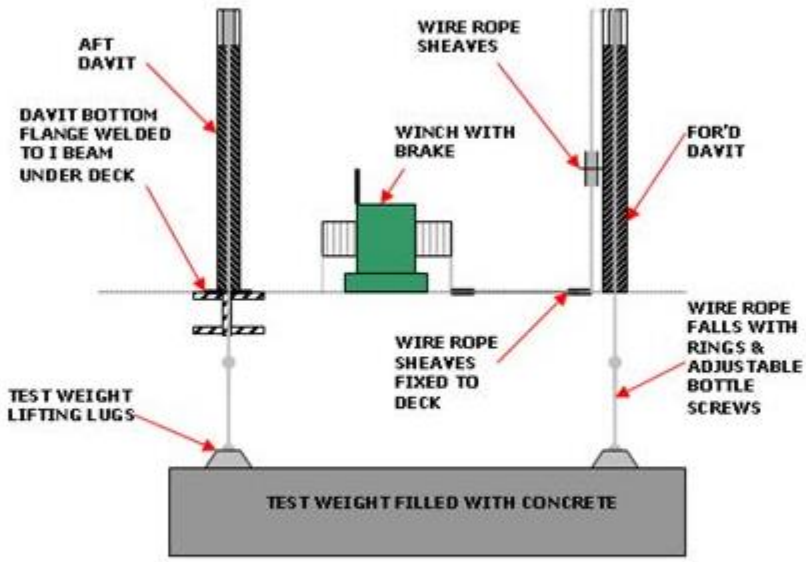
If the unloaded boat is to be raised on the falls, the hooks should be reset, and the falls attached. The boat should be raised just clear of the water and the hook and interlock mechanism double checked and the secure location of the falls confirmed prior to full recovery. No persons to be inside the boat during recovery.

Once the boat is stowed and secured on the vessel the boat and davit should be inspected by the authorised person for any signs of test damage or straining.

Second method – testing boat and davit separately

Tests are made of the davit and winch using weights, and a spreader bar suspended from the falls having the same weight as mentioned under the first method and test is carried out in the same manner. This could be done by using concrete weights or water bags as illustrated below, but no spreaders are used in the both the diagrams below:

Using concrete weights[54]



Using water bags[55]

The boat is tested by suspending it from a spreader bar and it is loaded to a weight equivalent to the peak load established during one dynamic test.

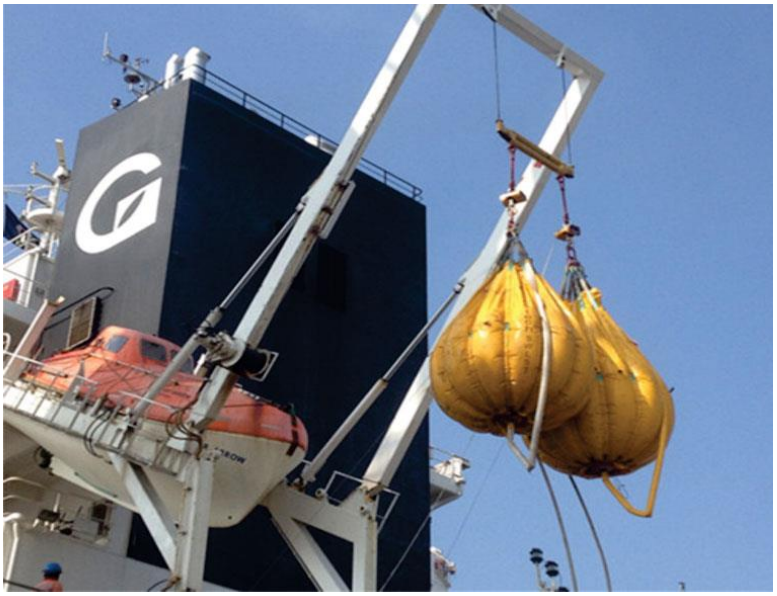
---

[54] https://www.brighthubengineering.com/marine-engines-machinery/63742-offshore-oil-and-gas-load-testing-of-lifeboat-davits/

[55] https://www.nauticexpo.com/prod/doowin-underwater-lift-bags-water-weight-bags/product-196283-550911.html

Five yearly load tests – freefall lifeboats

The dynamic winch brake test to be carried out on the secondary launching system with a proof load equal to 1.1 times weight of the survival craft or rescue boat and its full complement of persons and equipment or with an equivalent load;



Source - https://www.shmgroup.com/services-lifeboats.php

If the boat is launched unmanned without use of its own release system, the release system has to load- tested separately. In the case of freefall lifeboats, a hydrohalic system is used for releasing boat while launching. During this test, the hydraulic systems will be pressure tested by applying a pressure equivalent to a pressure which require to release the boat having a weight equal to 1.1 times weight of the survival craft or rescue boat and its full complement of persons and equipment or with an equivalent load.

Reports and Records[56]

All reports and checklists should be correctly completed out and signed by the person who carries out the inspection and maintenance work and should also be signed by the company's representative or the ship's master.

Records of inspections, servicing, repairs and maintenance should be updated and filed on board the ship.

[56] Resolution MSC.402(96), IMO

When repairs or servicing are completed, a statement confirming that the lifeboat arrangements remain fit for purpose should be issued by the authorised service provider.

Acceptable Equivalence to the 110% Dynamic Test[57]

If, for operational reasons, the dynamic test is not practicable, the MCA will accept the testing of lifeboats/rescue boats and davits separately but this must be agreed in consultation with the lead surveyor for the vessel, and in accordance with the policy described below. The alternative method acceptable to the MCA is where:

a) the hook release is tested under a 110% static load using a hydraulic ram (not required on single hook systems used in combination with a painter),
b) the lifeboat/rescue boat is statically load tested ashore by suspending the loaded boat momentarily from its hooks (using a static load representing the peak load that would have been experienced in a 110% dynamic test, see details below), and
c) the davit, fall wire, sheaves and winch are tested to 110% dynamically with the use of a spreader bar (only necessary on double head davits) and weights.

[57] MGN 560 (M), MCA, UK

SHIP'S STABILITY

1) How to check whether a vessel is complying with the stability criteria manually

A flag state may have stringent stability criteria than specified by the Intact Stability Code. Therefore, a chief officer needs to refer the ship's stability book to identify the stability criteria that the vessel to be complied with.

At the same time, it is a usual practice that the vessel's stability book provides self-explanatory notes showing how to calculate her stability and how to evaluate the seaworthiness of her.

Usually, follow the below mentioned procedure in evaluating the seaworthiness of a vessel manually:

- By means of sounding tables, calculate the weight of ballast water, fresh water and the fuel oil onboard. Take the LCG, VCG and the FSM of those liquids from stability book, tank arrangement plans etc.
- Take the light ship displacement, light ship KG and the light ship LCG from the stability book.
- Calculate the weight of cargo in each hold. Following formula to be used if the shipper has provided only the stowage factor of the cargo:
  - Weight = Volume / SF

- Ensure the load density is not exceeded.
- Enter the above details to "stability pro-forma" or the "loading sheet".
- Calculate the KG_s by taking moments about the keel and obtain the final KM_T from the stability book for the corresponding displacement.
- Calculate the KG_f by applying the FSC.
  - FSC = Total FSM / final displacement

- Calculate the final LCG by taking moment about the aft or midship perpendicular.
- Obtain the LCF, LCB and the MCTC for final displacement.
- Calculate the COT.
  - COT = W x (LCB – LCG) / MCTC
  - If the LCB >LCG, the vessel will be trimmed by stern and if the LCB<LCG, the vessel will be trimmed by head.

- Calculate T_a and T_f :

  T_a = COT x distance to LCF from aft perpendicular / LBP

  T_f = COT - T_a
- Calculate the departure draughts.

- Draw a GZ curve for the departure condition by the method provided in the stability book.
- Ensure she is complying with the stability criteria provided in the stability book.
- Some ship's are provided with:
  - A minimum GM curve against the draught or the displacement or
  - A maximum KG curve against the draught or the displacement or
  - A maximum deadweight moment curve

  When the above curves are provided, manual evaluation of the vessel's stability by means of GZ curve is not required. Make sure the final GM_f is above the GM_f provided in the curve for the respective draught/displacement or the final KG_f is below the KG_f provided in the curve for the respective draught/displacement or final deadweight moment (which includes the free surface moment of the vessel) is below the maximum deadweight moment provided in the curve for the respective displacement.

At the same time ensure;

- the vessel is not stiff or tender.
- the vessel will not be overloaded by referring to the summer displacement or winter displacement or tropical displacement as appropriate.

If the vessel is expected to cross load line zones;

- Take the applicable displacements (summer displacement, winter displacement, tropical displacement) from the stability book and
- Calculate the amount of fuel consumption and the change of freshwater amount when crossing the load line limit.
- Calculate the arrival displacement at the entrance to the new load line limit as below:
  - Arrival displacement at the new load line limit = departure displacement – fuel consumption + / - change of fresh water

- If the arrival displacement at the new load line zone is below or equal to the respective displacement provided in the stability book, she is complying with the load line regulations.

2) How to check whether the vessel is complying with the stability criteria when carrying grain cargoes

- Calculate the weight of the grain loaded in each compartment.
- Obtain the tabulated VHM for each compartment and the KG of the cargoes against the grain ullage.
- Calculate the actual VHM of each compartment by multiplying the tabulated VHM of each compartment by the correction factor. Correction factor to be used shall be decided as follows:

- Full compartments:
  - If the **actual KG of grain** is used – correction **factor is 1.06**
  - If the **KG of the hold space** (not the cargo space) is used – correction **factor is 1.00**
- Part full compartments (use **actual KG of the cargo**) – correction **factor is 1.12**

- Calculate the actual total VHM by adding the actual VHM of each hold.
- Calculate the final displacement and final KG_f.
- Calculate λ_0 and λ_{40}
  - $\lambda_0 = \Sigma$ VHM / (SF x W)
  - $\lambda_{40} = 0.8 \times \lambda_0$

- Draw the GZ curve by the method provided in the stability book.
- On the same curve, plot λ_0 at zero degree heal and λ_{40} at 40^0 heal and join the two points.
- Obtain the angle of heal due to shift of grain by referring to the interception between the GZ curve and the line joining λ_0 and λ_{40}.
- Manually evaluate the stability of the vessel by referring to the stability of the vessel against the criteria provided in the stability book.
- In some stability books, a table showing the 'maximum permissibly grain healing moments' will be provided against various displacement along with the respective KG_f. In that case, if the actual grain heeling moment (Σ VHM) is below or equal to the 'maximum permissibly grain healing moment' provided for the final displacement and the KG_f, the vessel is complying with the grain stability criteria.

3) Calculation of draft with the change of density of water

The following formula to be used to calculate the COT:

- $$\textbf{COT} = \frac{W \times (RD_1 - RD_2) \times (LCF - LCB)}{RD_1 \times MCTC_2} \quad \text{(cm)}$$

- Then need to calculate T_a and T_f
  - If **LCF > LCB – trim by stern**
  - If **LCF < LCB – trim by head**

- By means of a deadweight scale, calculate the hydraft for the new density of water **OR** by means of the following formula calculate FWA and if required DWA;
  - FWA = W / (40 x TPC)
  - DWA = FWA x change of density / 0.025

- Apply the T_a and T_f to hydraft obtained from deadweight scale **OR** apply T_a, T_f and FWA or the DWA to the initial draughts as appropriate.

4) Calculation of maximum amount of cargo to be loaded

The maximum amount of cargo that may be loaded can be calculated by using following methods (Method – A or Method – B or Method – C). Remember, this is only the tonnage of the cargoes than can be loaded. Therefore, you have to carry out separate calculations to make sure the load density is not exceeded and also the individual cargo spaces (volumes) are sufficient to accommodate the cargo. This is very important when loading heavy density cargoes and volumetric cargoes. Accordingly, you may have to reduce the weight of the cargo to be loaded. *At the same time, remember, maximum amount of cargo can be loaded with an even keel condition only.*

SOLAS Chapter II-1, Part B – 1 state that if the stability information shall show the influence of various trims in cases where the operational trim range exceeds +/- 0.5 of L_s.

You are not required to worry about the meaning of L_s, basically, what you need to understand is that, there may be occasions where that stability book may contain stability information for various trims. In such cases, the appropriate trims shall be used in calculating the required stability information.

Method – A

This method can be considered as the least accurate method.

- Obtain the light ship displacement from the stability book.
- Calculate the amount of fuel and fresh water onboard at present.
- Calculate the amount of ballast water which is un-pumpable.
- Obtain the ship's constant.
- Get the maximum displacement for the respective load line zone from the stability book. The maximum amount of cargo to be loaded can be calculated by:
  - Amount = maximum displacement for the respective load line zone – light ship displacement – fuel – fresh water – constant – un-pumpable ballast

Method – B

This method can be considered as more accurate than the Method – A above.

- Obtain the actual present draughts and calculate the arithmetic mean draught (AMD).
  AMD = (fwd draught + aft draught) / 2
- If the fwd and aft marks are not at the respective perpendiculars, by means of above fwd and aft draughts calculate the draughts at the fwd and aft perpendiculars.

- By means of draughts at perpendiculars, calculate the trim at perpendiculars.
- Obtain LCF from stability particulars for above AMD.
- Calculate the true mean draught (TMD) by using the LCF obtained. If the vessel is trimmed by stern;

  TMD = draft aft **–** (trim at perpendiculars x LCF_{foap}) / LBP

  If the vessel is trimmed by head;

  TMD = draft aft **+** (trim at perpendiculars x LCF_{foap}) / LBP

- Obtain the present displacement from stability particulars against the above TMD
- Get the maximum displacement for the respective load line zone from the stability book. The maximum amount of cargo to be loaded can be calculated by:
  - Amount = maximum displacement for the respective load line zone – present displacement + ballast water that can be pumped out + cargo to be discharged

Method – C

This method can be considered as more accurate than both the methods mentioned above.

- Calculate the present displacement with the aid of a draught survey.
- Get the maximum displacement for the respective load line zone from the stability book. The maximum amount of cargo to be loaded can be calculated by:
  - Amount = maximum displacement for the respective load line zone – present displacement + ballast water that can be pumped out + cargo to be discharged.

5) Calculation of maximum amount of cargo to load with a draught restriction at the port of loading

- Obtain the maximum displacement from the stability particulars for the maximum loadable draught (after allowing for sufficient UKC) at port of loading
- Amount to load = displacement obtained above – light ship displacement – fuel – fresh water – constant – unpumpable ballast.
- The vessel must complete loading with the respective even keel draught.

6) Calculation of maximum amount of cargo to load with draught restrictions at the port of arrival

- Obtain the maximum displacement from the stability particulars for the maximum loadable draught for the arrival port.

- Calculate the amount of fuel oil, fresh water and the un-pumpable ballast that will be available onboard at the port of discharge.
- Amount to load = displacement required at the port of discharge – (fuel oil + fresh water) at the port of discharge – constant – unpumpable ballast.
- When arriving at the discharge port, she must arrive at an even keel draught. Therefore, discussed with the chief engineer about the fuel oil tanks that he is going to use during the passage and calculate the COT that may experience due to fuel oil and freshwater consumption/production.
- Need to complete loading which a sufficient trim so that the vessel will arrive at the port of discharge with an even keel condition.
  - ➢ If the tanks which are at the COF are used, there will be only a bodily rise. Therefore, need to complete with an even keel condition.
  - ➢ If the tanks which are abaft the COF are used, it will create a head trim. Therefore, need to complete loading with appropriate stern trim.
  - ➢ If the tanks which are forward of COF are used, the fuel consumption will create a stern trim. Which means, need to complete loading with a head trim. Sailing with head trims are not common unless slight head trim for speed and fuel optimization. Therefore, you may have to request the chief engineer to transfer fuel oil that is going to be used to stern tanks and complete loading with an appropriate stern trim.

7) Calculation of maximum amount of cargo to load with draught restrictions at the port of arrival and with change of density of the water

As mentioned above, with or without draught restrictions, maximum amount of cargo can be loaded only when she is to be loaded with an even keel condition. Therefore, if the draught restriction is before the change of density, the procedure mentioned **above (6)** will ensure that she is loaded with the maximum amount of cargo. But, if the draught restriction is after the change of density of water, adhere to the following procedure to ensure she enters the draught restricted are with an even keel condition.

The following procedure is recommended assuming she is going from sea water to fresh water.

- From hydrostatic tables obtain the displacement for the allowed maximum permissible draught at discharge port [Eg. – if the maximum allowed draught in fresh water is 8 m, obtain the displacement for 8 m draught. Remember, this displacement is for a saltwater draught of 8 m. Therefore, we will name it as "W_{sea}"].
- Therefore, by means of interpolation, calculate the displacement at the fresh water for the same draught (W_{fresh}).

  $W_{fresh} = W_{sea} \times 1.000 / 1.025$

- W_{fresh} is the displacement that she needs to have at the time of change of density (to avoid complications we will assume that there is no much distance difference between change of density and the draught restricted area).
- Displacement does not change with the density of water.
- Now, again refer the hydrostatic particulars to obtain the sea water draught for the W_{fresh}.
- This is the draught she needs to have at the time of change of density
- Cargo to load = W_{fresh} – (fuel oil + fresh water) at the time of change of density – constant – unpumpable ballast
- Calculate the change of trim due to change of density.
- Calculate the change of trim due to change of fuel and fresh water.
- Total COT = COT due to change of density +/- COT due to fuel & freshwater consumption
- She needs to have a departure trim equal and opposite to counteract the total COT calculated above

8) GM by means of rolling period

The GM of a vessel in seaway may be calculated by means of couple of methods, but, only two methods are mentioned below. Refer the ship's stability book to find the exact method of GM by means of rolling period for your ship.

a) By the formula provided in the IS Code

Rolling period, $T = (2 \times C \times B) / \sqrt{GM}$ (seconds)

Where;

C = 0.373 + 0.023 (B/d) – 0.043 (L_{wl} / 100)
L_{wl} = length of the ship at waterline (m)
B = moulded breadth of the ship (m)
D = mean moulded draught of the ship (m)
GM = metacentric height corrected for free surface effect (m)

b) By means of Browns nautical almanac

TABLE FOR VESSEL'S GM (Fluid) BY ROLLING PERIOD AND THE BEAM IN METRIC UNITS

Compiled by G. P. CHOUDHARY, Chief Officer Barber Ship Management Ltd., Hong Kong

Period = Rolling period of a vessel in seconds Beam = Vessel's Beam in meters GM given in the table is in meters

$$GM = ((0.8 \bullet \text{Beam}) : \text{Period})^2$$

Beam / Period	14m	15m	16m	17m	18m	19m	20m	21m	22m	23m	24m	25m	26m	27m	28m	29m	30m	31m	32m	33m	34m	35m
6s	3.48	4	4.55	5.14	5.76	6.42	7.11	7.84	8.6	9.4	10.2	11.1	12	13	13.9	15	16	17.1	18.2	19.4	20.6	21.8
7s	2.56	2.94	3.34	3.77	4.23	4.72	5.22	5.76	6.32	6.91	7.52	8.16	8.83	9.52	10.2	11	11.8	12.6	13.4	14.2	15.1	16
8s	1.96	2.25	2.56	2.89	3.24	3.61	4	4.41	4.84	5.29	5.76	6.25	6.76	7.29	7.84	8.41	9	9.61	10.2	10.9	11.6	12.3
9s	1.55	1.78	2.02	2.28	2.56	2.85	3.16	3.48	3.82	4.18	4.55	4.94	5.34	5.76	6.19	6.64	7.11	7.59	8.09	8.6	9.13	9.68
10s	1.25	1.44	1.64	1.85	2.07	2.31	2.56	2.82	3.1	3.39	3.69	4	4.33	4.67	5.02	5.38	5.76	6.15	6.55	6.97	7.4	7.84
11s	1.04	1.19	1.35	1.53	1.71	1.91	2.12	2.33	2.56	2.8	3.05	3.31	3.58	3.86	4.15	4.45	4.76	5.08	5.42	5.76	6.11	6.48
12s	0.87	1	1.14	1.28	1.44	1.6	1.78	1.96	2.15	2.35	2.56	2.78	3	3.24	3.48	3.74	4	4.27	4.55	4.84	5.14	5.44
13s	0.74	0.85	0.97	1.09	1.23	1.37	1.51	1.67	1.83	2	2.18	2.37	2.56	2.76	2.97	3.18	3.41	3.64	3.88	4.12	4.38	4.64
14s	0.64	0.73	0.84	0.94	1.06	1.18	1.31	1.44	1.58	1.73	1.88	2.04	2.21	2.38	2.56	2.75	2.94	3.14	3.34	3.56	3.77	4
15s	0.56	0.64	0.73	0.82	0.92	1.03	1.14	1.25	1.38	1.5	1.64	1.78	1.92	2.07	2.23	2.39	2.56	2.73	2.91	3.1	3.29	3.48
16s	0.49	0.56	0.64	0.72	0.81	0.9	1	1.1	1.21	1.32	1.44	1.56	1.69	1.82	1.96	2.1	2.25	2.4	2.56	2.72	2.89	3.06
17s	0.43	0.5	0.57	0.64	0.72	0.8	0.89	0.98	1.07	1.17	1.28	1.38	1.5	1.61	1.74	1.86	1.99	2.13	2.27	2.41	2.56	2.71
18s	0.39	0.44	0.51	0.57	0.64	0.71	0.79	0.87	0.96	1.04	1.14	1.23	1.34	1.44	1.55	1.66	1.78	1.9	2.02	2.15	2.28	2.42
19s	0.35	0.4	0.45	0.51	0.57	0.64	0.71	0.78	0.86	0.94	1.02	1.11	1.2	1 29	1.39	1.49	1.6	1.7	1.82	1.93	2.05	2.17
20s	0.31	0.36	0.41	0.46	0.52	0.58	0.64	0.71	0.77	0.85	0.92	1	1.08	1.17	1.25	1.35	1.44	1.54	1.64	1.74	1.85	1.96
21s	0.28	0.33	0.37	0.42	0.47	0.52	0.58	0.64	0.7	0.77	0.84	0.91	0.98	1.06	1.14	1.22	1.31	1.39	1.49	1.58	1.68	1.78
22s	0.26	0.3	0.34	0.38	0.43	0.48	0.53	0.58	0.64	0.7	0.76	0.83	0.89	0.96	1.04	1.11	1.19	1.27	1.35	1.44	1.53	1.62
23s	0.24	0.27	0.31	0.35	0.39	0.44	0.48	0.53	0.59	0.64	0.7	0.76	0.82	0.88	0.95	1.02	1.09	1.16	1.24	1.32	1.4	1.48
24s	0.22	0.25	0.28	0.32	0.36	0.4	0.44	0.49	0.54	0.59	0.64	0.69	0.75	0.81	0.87	0.93	1	1.07	1.14	1.21	1.28	1.36
25s	0.2	0.23	0.26	0.3	0.33	0.37	0.41	0.45	0.5	0.54	0.59	0.64	0.69	0.75	0.8	0.86	0.92	0.98	1.05	1.12	1.18	1.25
26s	0.19	0.21	0.24	0.27	0.31	0.34	0.38	0.42	0.46	0.5	0.55	0.59	0.64	0.69	0.74	0.8	0.85	0.91	0.97	1.03	1.09	1.16
27s	0.17	0.2	0.22	0.25	0.28	0.32	0.35	0.39	0.42	0.46	0.51	0.55	0.59	0.64	0.69	0.74	0.79	0.84	0.9	0.96	1.01	1.08
28s	0.16	0.18	0.21	0.24	0.26	0.29	0.33	0.36	0.4	0.43	0.47	0.51	0.55	0.6	0.64	0.69	0.73	0.78	0.84	0.89	0.94	1
29s	0.15	0.17	0.19	0.22	0.25	0.27	0.3	0.34	0.37	0.4	0.44	0.48	0.51	0.55	0.6	0.64	0.68	0.73	0.78	0.83	0.88	0.93
30s	0.14	0.16	0.18	0.21	0.23	0.26	0.28	0.31	0.34	0.38	0.41	0.44	0.48	0.52	0.56	0.6	0.64	0.68	0.73	0.77	0.82	0.87
31s	0.13	0.15	0.17	0.19	0.22	0.24	0.27	0.29	0.32	0.35	0.38	0.42	0.45	0.49	0.52	0.56	0.6	0.64	0.68	0.73	0.77	0.82
32s	0.12	0.14	0.16	0.18	0 2	0.23	0.25	0.28	0.3	0.33	0.36	0.39	0.42	0.46	0.49	0.53	0.56	0.6	0.64	0.68	0.72	0.77
33s	0.12	0.13	0.15	0.17	0.19	0.21	0.24	0.26	0.28	0.31	0.34	0.37	0.4	0.43	0.46	0.49	0.53	0.56	0.6	0.64	0.68	0.72
34s	0.11	0.12	0.14	0.16	0.18	0.2	0.22	0.24	0.27	0.29	0.32	0.35	0.37	0.4	0.43	0.47	0.5	0.53	0.57	0.6	0.64	0.68
35s	0.1	0.12	0.13	0.15	0.17	0.19	0.21	0.23	0.25	0.28	0.3	0.33	0.35	0.38	0.41	0.44	0.47	0.5	0.53	0.57	0.6	0.64

Top horizontal column is the vessel's beam in metres, vertical column on the left hand side is the rolling period in seconds. Vessel's corrected GM is found by finding the corresponding figure for its beam against the rolling period. Rolling period is the one complete roll of the vessel from one side to the other and back to the same side in seconds.

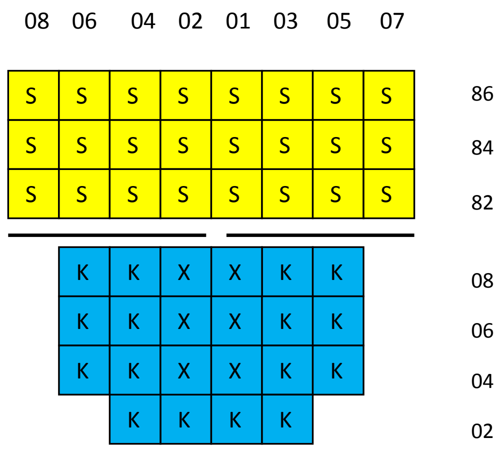
Example:—What is the GM of a vessel of 28 metres beam and the rolling period is 20 seconds?

Look at the table for 28 metres beam in the horizontal top column and the rolling period of time 20 seconds in the left vertical column enter the table, the corresponding GM is 1·25 Metres.

Note:—Rolling period is to be found only in calm weather, without any external disturbances. Hard over wheel to one side or shifting of weights will give a fairly accurate rolling period for a vessel in calm weather. This table may not be correct for Liquid carriers in bulk. GM for the rolling period in ballast condition will be more than in fully loaded condition, with very little bunkers or ballast in the tanks. This table is prepared on the mean value.

9) Manual stability calculation on a container ship

BAY 11 (10)



Calculation of KG_f for evaluating the vessel's stability

Add the weights of all the containers in each tier separately. Refer the above figure as an example;

Add the weights of all the containers (port to stbd and aft to fwd) in tier 02.

Add the weights of all the containers (port to stbd and aft to fwd) in tier 04.

Continue until all are added tier wise up to the tier 86. Now, to calculate the final KG_s, take moments of each tier about the keel.

Final KG_s = (light ship Δ x light KG + ballast weight x KG + fuel weight x KG + tier 02 weight x ½container height + tier 04 weight x 1½container height + tier 06 weight x 2½container height …………) / final Δ

Calculate the KG_f by applying the FSC to above KG_s. Now, the stability of the vessel can be evaluated.

To check whether the vessel is upright or not

Add the weights of all the containers in each row separately. Refer the above figure as an example;

Add the weights of all the containers (from bottom to top and fwd to aft) in row 01.

Add the weights of all the containers (from bottom to top and fwd to aft) in row 02.

Continue until all the weights are added row wise. Now, take moments of rows about the transverse centre line of the vessel.

Port side listing moments = row 02 weight x ½container width + row 04 weight x 1½container width + row 06 weight x 2½container width ………

Similarly,

Stbd side listing moments = row 01 weight x ½container width + row 03 weight x 1½container width + row 05 weight x 2½container width ………

Final listing moment = difference between port and stbd side listing moment
Tan (list) = Final listing moment / (W x GM_f)

If the port side listing moments are equal to the stbd side listing moments, the vessel is upright.

Calculation of final draughts

Add the weights of containers in each bay separately. As an example;
Add the weights of all the containers in bay number 01 separately.
Add the weights of all the containers in bay number 03 separately.
Remember, weights of 40-footer containers may be divided into two and add to the odd number bays. In this case, weights of 40-footer containers can be divided between bay number 1 and 3.

Continue until the weights of all the bays are calculated separately.
Now, to calculate the final LCG take moments of bays around aft perpendicular.
Since the final displacement is known, following can be obtained from hydrostatic particulars;

- Hydraft of the loaded vessel
- LCB
- MCTC

Now, by using the following formula, final trim can be calculated.
Trim = Δ x (LCB_{foap} ~ LCG_{foap}) / MCTC
Now calculate Ta and T_f and apply them to the hydraft to get the final draughts fwd and aft.

Even though these types of manual calculations are feasible on smaller container ships, it may not be that practicable on ultra large container ships.

10) Final trimming of a bulk carrier

Usually, it is a common practice to allocate two or three holds and sufficient amount of cargo (usually the amount of cargo shall be 2% to 5% of the DWT of the vessel or more than twice the MCTC) to get the required trim and the draughts at the completion of the loading operations. The allocation of the amount of cargo and the holds for final trimming depends upon:

- Vessel's TPC

- Vessel’s MCTC
- The distances between the holds

If three holds are allocated, advisable to allocate one hold which is at the COF. The vessel can achieve the required trim by loading the allocated holds which are fwd and aft and finally, load the hold, which is at the COF, but, remember to have sufficient cargo to sink body until the required draughts are achieved.

This final trimming calculation may be carried out by means of trimming tables or by taking trimming moments.

In case of taking trimming moments, take the moment about the COF instead of the aft perpendicular. No need to carry out any interpolations for hydrostatic particulars as there is no much time available. Use the hydrostatic particulars for the expected final draughts.

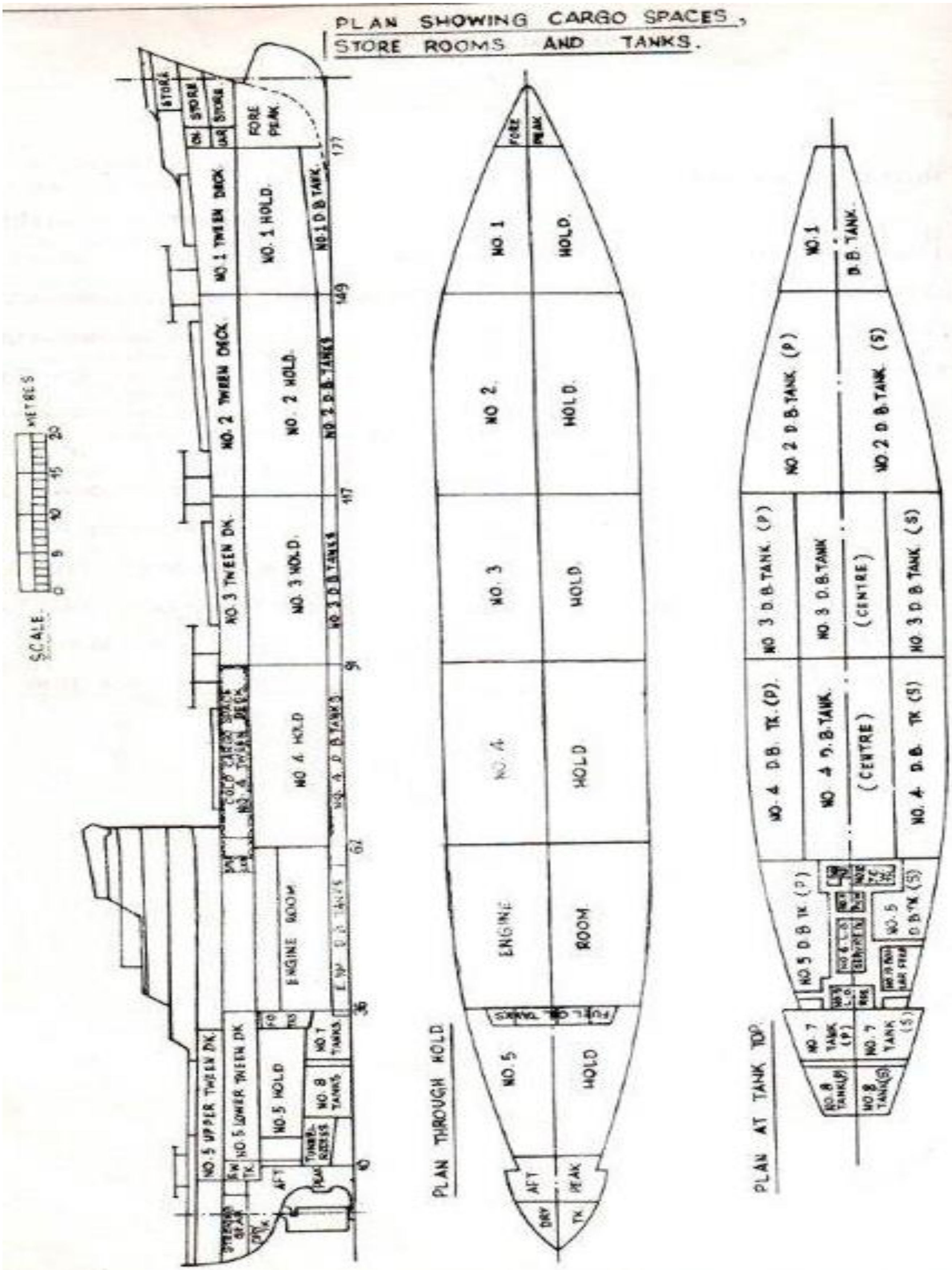
11) Use of trimming tables

Some trimming tables provide changes of draughts when a known amount of cargo (usually, 100 t of cargo) is loaded at the centre of each hatch. Some trimming tables provide changes of draughts when cargoes, again 100 t, are loaded at the different frame numbers. The latter types of trimming tables are more accurate than the former one.

For the purpose of getting use to the trimming tables refer the example provided below obtained from “stability, trim and cargo calculations on M.V. Hindship and oil tankers” (by Capt. T .K. Joseph & Capt. S. S. S. Rewari).

Example 1

M.V. Hindship floating at a draught of F 5.45 m, A 6.53 m, fills up No. 1 DB tank with water ballast, discharges 120 t of cargo from No. 2 TD, 99.5 m forward of aft perpendicular and shifts a 70 t parcel of cargo from No. 2 TD to No. 4 TD. With the aid of the below trim tables, determine the final draughts forward and aft.


PLAN SHOWING CARGO SPACES, STORE ROOMS AND TANKS.
SCALE.
METRES
0
5
10
15
20
NO.1 TWEEN DECK.
NO.1 HOLD.
NO.1 D.B.TANK.
FORE PEAK.
NO.2 TWEEN DECK.
NO.2 HOLD.
NO.2 D.B.TANKS.
NO.3 TWEEN DK.
NO.3 HOLD.
NO.3 D.B.TANKS.
COLD CARGO SPACE
NO.4 TWEEN DECK.
NO.4 HOLD.
NO.4 D.B.TANKS.
ENGINE ROOM.
NO.5 UPPER TWEEN DK.
NO.5 LOWER TWEEN DK.
NO.5 HOLD.
NO.7 TANKS.
NO.8 TANKS.
AFT
177
149
117
91
62
36
10
PLAN THROUGH HOLD.
NO.1
HOLD.
NO.2
HOLD.
NO.3
HOLD.
NO.4
HOLD.
ENGINE
ROOM.
FUEL OIL TANKS.
NO.5
HOLD.
AFT
PEAK
DRY
TK.
FORE
PEAK
PLAN AT TANK TOP.
NO.1
D.B.TANK.
NO.2 D.B.TANK (P)
NO.2 D.B.TANK (S)
NO.3 D.B.TANK (P)
NO.3 D.B.TANK
(CENTRE)
NO.3 D.B.TANK (S)
NO.4 D.B. TK.(P).
NO.4 D.B.TANK.
(CENTRE)
NO.4 D.B. TK (S)
NO.5 D.B TK (P)
NO.5 D.B.TK (S)
NO.7 TANK (P)
NO.7 TANK (S)
NO.8 TANK(P)
NO.8 TANK(S)

TANKS

TRIM TABLES

CHANGE IN DRAUGHTS IN CM. WHEN EACH TANK IS FILLED + IMMERSION — = EMERSION

TANKS	Con-tent.	Capa-city in Tonnes	DRAUGHTS					
			5.0 M.		7.0 M		9.0 M	
			Aft	Ford	Aft	Ford	Aft	Ford
Bulbous Bow (Void Space)	F.W.	182.0	—29.0	+43.7	—25.3	+40.8	—20.8	+37.0
Fore Peak Tank	W.B.	106.1	—15.1	+24.8	—14.4	+23.5	—12.1	+21.7
No. 1 D.B. Tank	W.B.	161.5	—18.3	+31.8	—16.4	+30.2	—13.8	+28.0
No 1 D.B. Tank	H.F.O.	149.7	—16.9	+29.5	—15.2	+28.0	—12.8	+26.0
No. 2 D.B. Tanks P & S	W.B.	415.0	—18.5	+54.4	—16.6	+52.5	—13.9	+49.6
No. 2 D.B. Tanks P & S.	H.F.O.	384.6	—17.1	+50.4	—15.4	+48.6	—12.9	+46.0
No. 3 D.B. Tank P & S.	W.B.	226.6	+ 4.8	+15.3	+ 4.3	+15.4	+ 3.7	+15.3
No. 3 D.B. Tank P & S.	H.F.O.	210.0	+ 4.5	+14.2	+ 4.0	+14.3	+ 3.4	+14.2
No. 3 D.B. Tank (C)	W.B.	216.0	+ 4.7	+14.7	+ 4.1	+14.7	+ 3.5	+14.6
No. 3 D.B. Tank (C)	H.F.O.	200.2	+ 4.3	+13.6	+ 3.8	+13.6	+ 3.3	+13.6
No. 4 D.B. Tank P & S.	W.B.	261.2	+23.6	+ 0.5	+21.0	+ 1.9	+17.8	+ 3.5
No. 4 D.B. Tank P & S.	H.F.O.	242.0	+22.0	+ 0.6	+19.4	+ 1.7	+16.5	+ 3.2
No. 4 D.B. Tank (C)	H.F.O.	244.5	+22.6	+ 0.1	+20.0	+ 1.4	+17.0	+ 2.9
No. 4 D.B. Tank (C)	W.B.	263.8	+24.3	+ 0.1	+21.6	+ 1.5	+18.3	+ 5.8
No. 5 D.B. Tank (P)	D.O.	73.5	+10.1	— 3.1	+ 8.9	— 2.5	+ 7.6	— 1.7
No. 5 D.B. Tank (S)	H.F.O.	46.4	+ 6.8	— 2.4	+ 6.0	— 2.0	+ 5.1	— 1.5
No. 6 D.B. Tank (C)	L.O.	17.5	+ 2.9	— 1.2	+ 2.6	— 1.0	+ 2.2	— 0.8
No. 7 D.B. Tank (P)	D.O.	100.8	+20.1	—10.1	+17.8	— 8.9	+15.1	— 7.2
No. 7 D.B. Tank (S)	D.O.	89.7	+17.8	— 9.0	+15.8	— 7.9	+13.4	— 6.4
No. 8 D.B. Tank (P)	F.W.	74.1	+16.3	— 8.9	+14.4	— 7.9	+12.3	— 6.4
No. 8 D.B. Tank (S)	F.W.	63.4	+14.0	— 7.6	+12.4	— 6.7	+10.4	— 5.6
No. 9 L.O. Reserve Tk. (C)	L.O.	19.2	+ 3.6	— 1.6	+ 3.1	— 1.5	+ 2.7	— 1.1
No. 10 Boiler Feed Tk. (S)	F.W.	14.1	+ 2.5	— 1.0	+ 2.2	— 1.0	+ 1.9	— 0.7
No. 11 Piston Cooling (C)	F.W.	6.3	+ 0.9	— 0.3	+ 0.2	— 0.2	+ 0.7	— 0.2
No. 12 Cooling Water Tk. (S)	F.W.	14.4	+ 2.0	— 0.5	— 1.7	— 0.5	+ 1.5	— 0.3
No. 13 Leakage Water Tk. (P)	F.W.	4.7	+ 0.6	— 0.2	+ 0.6	— 0.1	+ 0.5	— 0.1
Aft Peak	W.B.	120.7	+31.2	—19.0	+27.8	—16.9	+23.5	—14.2
Aft Peak	F.W.	117·8	+30.4	—18.6	+27.0	—16.6	+22.9	—13.9
Tween Deck Tank (P)	F.W.	49.7	+12.5	— 7.5	+11.3	— 6.8	+ 9.7	— 5.9
Tween Deck Tank (S)	F.W.	43.7	+11.0	— 6.6	+9.9	— 6.0	+ 8.5	— 5.2

TRIM TABLES AT VARIOUS FRAMES

CHANGE OF DRAUGHT AT A.P. & F.P. DUE TO AN ADDITIONAL LOAD OF 100 TONNES AT VARIOUS POINTS

Mean Draught = 5.0 M.: + = Immersion: – = Emersion.

Distance of CG of Load from ϕ in Mtrs.	Near Fr. No.	Sinkage in C.M. Aft.	Sinkage in C.M. Ford.	Sinkage in Inches Aft.	Sinkage in Inches Ford.	Distance of CG of load from ϕ in Mtrs.	Near Fr. No.	Sinkage in Cm. Aft.	Sinkage in Cm. Ford.	Sinkage in Inches Aft.	Sinkage in Inches Ford
Mid-ship	92	+ 5.0	+ 4.0	+1.97	+1.58						
3 A	88	+ 5.9	+ 3.1	+2.32	+1.22	3 F	96	+ 4.1	+ 4.9	+1.62	+1.93
6 A	85	+ 6.9	+ 2.3	+2.72	+0.91	6 F	100	+ 3.2	+ 5.8	+1.26	+2.29
9 A	81	+ 7.8	+ 1.4	+3.07	+0.55	9 F	104	+ 2.2	+ 6.6	+0.87	+2.60
12 A	77	+ 8.7	+ 0.5	+3.43	+0.20	12 F	107	+ 1.3	+ 7.5	+0.51	+2.96
15 A	73	+ 9.6	— 0.4	+3.78	—0.16	15 F	111	+ 0.4	+ 8.4	+0.16	+3.31
18 A	70	+10.5	— 1.3	+4.14	—0.51	18 F	115	— 0.5	+ 9.3	—0.20	+3.66
21 A	66	+11.5	— 2.1	+4.53	—0.83	21 F	119	— 1.4	+10.2	—0.55	+4.02
24 A	62	+12.4	— 3.0	+4.89	—1.18	24 F	122	— 2.4	+11.0	—0.95	+4.33
27 A	58	+13.3	— 3.9	+5.24	—1.54	27 F	126	— 3.3	+11.9	—1.30	+4.69
30 A	55	+14.2	— 4.8	+5.59	—1.89	30 F	130	— 4.2	+12.8	—1.65	+5.04
33 A	51	+15.1	— 5.7	+5.95	—2.25	33 F	134	— 5.1	+13.7	—2.01	+5.40
36 A	47	+16.1	— 6.5	+6.34	—2.56	36 F	137	— 6.0	+14.6	—2.36	+5.75
39 A	43	+17.0	— 7.4	+6.70	—2.92	39 F	141	— 7.0	+15.4	—2.76	+6.07
42 A	40	+17.9	— 8.3	+7.05	—3.27	42 F	145	— 7.9	+16.3	—3.11	+6.42
45 A	36	+18.8	— 9.2	+7.41	—3.62	45 F	149	— 8.8	+17.2	—3.47	+6.78
48 A	32	+19.7	—10.1	+7.76	—3.98	48 F	153	— 9.7	+18.1	—3.82	+7.13
51 A	28	+20.7	—10.9	+8.16	—4.29	51 F	158	—10.6	+19.0	—4.18	+7.49
54 A	25	+21.6	—11.8	+8.51	—4.65	54 F	162	—11.6	+19.8	—4.57	+7.80
57 A	21	+22.5	—12.7	+8.87	—5.00	57 F	167	—12.5	+20.7	—4.93	+8.16
60 A	17	+23.4	—13.6	+9.22	—5.36	60 F	171	—13.4	+21.6	—5.28	+8.51
63 A	13	+24.4	—14.4	+9.61	—5.67	63 F	176	—14.3	+22.5	—5.63	+8.87
66 A	8	+25.3	—15.3	+9.97	—6.03	66 F	181	—15.3	+23.3	—6.03	+9.18

TRIM TABLES AT VARIOUS FRAMES.

CHANGE OF DRAUGHT AT A.P. AND F.P. DUE TO AN ADDITIONAL LOAD OF 100 TONNES AT VARIOUS POINTS.

Mean Draught = 7.0M: + = Immersion: — = Emersion.

Distance of CG load from ϕ in Mtrs.	Near Fr. No.	Sinkage in Cm.		Sinkage in Inches		Distance of CG of Load from ϕ in Mtrs.	Near Fr. No.	Sinkage in Cm.		Sinkage in Inches	
		Aft.	Ford.	Aft.	Ford.			Aft.	Ford	Aft.	Ford
Mid-ship	92	+ 4.5	+ 4.3	+1.77	+1.69						
3 A	88	+ 5.3	+ 3.5	+2.09	+1.38	3 F	96	+ 3.7	+ 5.1	+1.46	+2.01
6 A	85	+ 6.2	+ 2.7	+2.44	+1.06	6 F	100	+ 2.8	+ 5.9	+1.10	+2.32
9 A	81	+ 7.0	+ 1.9	+2.76	+0.75	9 F	104	+ 2.0	+ 6.7	+0.79	+2.64
12 A	77	+ 7.8	+ 1.1	+3.07	+0.43	12 F	107	+ 1.2	+ 7.5	+0.47	+2.96
15 A	73	+ 8.6	+ 0.2	+3.39	+0.08	15 F	111	+ 0.4	+ 8.4	+0.16	+3.31
18 A	70	+ 9.4	— 0.6	+3.70	—0.24	18 F	115	— 0.4	+ 9.2	—0.16	+3.62
21 A	66	+10.2	— 1.4	+4.02	—0.55	21 F	119	— 1.2	+10.0	—0.47	+3.94
24 A	62	+11.1	— 2.2	+4.37	—0.87	24 F	122	— 2.1	+10.8	—0.83	+4.26
27 A	58	+11.9	— 3.0	+4.69	—1.18	27 F	126	— 2.9	+11.6	—1.14	+4.57
30 A	55	+12.7	— 3.8	+5.00	—1.50	30 F	130	— 3.7	+12.4	—1.46	+4.89
33 A	51	+13.5	— 4.6	+5.32	—1.81	33 F	134	— 4.5	+13.3	—1.77	+5.24
36 A	47	+14.3	— 5.5	+5.63	—2.17	36 F	137	— 5.3	+14.1	—2.09	+5.56
39 A	43	+15.2	— 6.2	+5.99	—2.44	39 F	141	— 6.2	+14.8	—2.44	+5.83
42 A	40	+16.0	— 7.0	+6.30	—2.76	42 F	145	— 7.0	+15.7	—2.76	+6.91
45 A	36	+16.8	— 7.9	+6.62	—3.11	45 F	149	— 7.8	+16.5	—3.07	+6.50
48 A	32	+17.8	— 8.7	+6.93	—3.43	48 F	153	— 8.6	+17.7	—3.38	+6.82
51 A	28	+18.4	— 9.5	+7.25	—3.74	51 F	158	— 9.5	+18.1	—3.74	+7.13
54 A	25	+19.3	—10.3	+7.60	—4.06	54 F	162	—10.3	+18.9	—4.06	+7.45
57 A	21	+20.1	—11.1	+7.92	—4.37	57 F	167	—11.1	+19.7	—4.37	+7.76
60 A	17	+20.9	—11.9	+8.23	—4.69	60 F	171	—11.9	+20.6	—4.69	+8.12
63 A	13	+21.7	—12.8	+8.55	—5.04	63 F	176	—12.7	+21.4	—5.00	+8.43
66 A	8	+22.5	—13.6	+8.87	—5.36	66 F	181	—13.5	+22.2	—5.32	+8.75
69 A	3	+23.3	—14.4	+9.18	—5.67	69 F	188	—14.3	+23.0	—5.63	+9.06

Answer – 1

	Fwd draft	Aft draft	Mean draft
Original drafts	5.45	6.53	5.99
Change in draft due to ballasting Interpolating for mean draft 5.99 m from tank's trim tables for 161.5 t WB in No. 1 DB tank (refer *TANK TRIM TABLES* above)	+ 0.310	- 0.174	
Change in draft due to cargo discharge Centre of gravity of no. 2 td is 99.5 m fwd of AP. Midships = 71.58 m fwd of AP. Therefore, cargo discharged from 27.92 m fwd of midships (refer *TRIM TABLES AT VARIOUS FRAMES for mean draught 5m & 7m* above)	- 0.144	+ 0.041	
Shift of cargo to be calculated in two stages (discharge 70 t from the original position and reload the same at the final position) Change in draft due to discharge of 70 t (from No. 2 TD, 32.33 m fwd of midships)	- 0.093	+ 0.032	
Change in draft due to loading of 70 t (in No. 4 TD, 14.14 m aft of midships) (refer *TRIM TABLES AT VARIOUS FRAMES for mean draught 5m & 7m* above)	+ 0.001	+ 0.062	
Final drafts	**5.524**	**6.491**	

Now, we will look at an actual trimming calculation by means of trim tables.

Example – 2

600 t of cargo is remaining to load when the vessel is floating at fwd draft 6.9 m and aft draft 7.1 m. The vessel is expected to complete loading with an even keel condition. Hold number one and number four are selected for final trimming. Calculate the amount of cargo to be loaded in each hold and the sailing draughts of the vessel. (use the same trimming tables provided above)

Answer – 2

As the trim tables provide change of drafts when 100 t loaded at different frame numbers, more accurate results can be obtained by referring to the frame numbers. But, remember this will not be problem for a tanker (where you can take the centre of the hold as loading point). To make the calculation easy we will take the centre of the hold as the loading point.

In accordance with the *PLAN SHOWING CARGO SPACES, STORE ROOMS AND TANKS* above:

- Centre of the hold 1 is at frame number 162
- Centre of the hold 4 is at frame number 77

Fwd draft = 6.9 m
Aft draft = 7.1 m
AMD = 7.0 m

From the *TRIM TABLES AT VARIOUS FRAMES* (Mean draft 7.0 m) above;

Hold number	**4**	**1**
Frame number	77	162
Change of draft Fwd (cm)	+ 1.1	+ 18.9
Change of draft Aft (cm)	+ 7.8	- 10.3
COT each hold (cm)	6.7 (aft)	29.2 (fwd)
Total COT of the vessel (cm)	6.7 + 29.2 = 35.9	

Initial trim = 7.1 – 6.9 = 0.2 m = 20 cm
COT required = 20 cm (by fwd)

Therefore, first we will calculate how much to load in hold number one to make her even keel. The rest of the cargo can be divided between the two holds to have a bodily sinkage.

By interpolation, cargo to be loaded in hold 1 = 100 x 20 / 29.2 = 68.5 t

Balance to spread between one and four holds = 600 – 68.5 = 531.5 t

Out of 531.5 t, cargo to load in hold one (interpolation) = 6.7 x 531.5 / 35.9 = 99.2 t
Out of 531.5 t, cargo to load in hold four (interpolation) = 29.2 x 531.5 / 35.9
= 432.3 t

Therefore,
cargo to load in hold 1 = 68.5 + 99.2 t = 167.7 t
cargo to load in hold four = 432.3 t

Calculation of final drafts:

	Fwd draft	Aft draft
Initial drafts	6.9	7.1
Change of draft due to loading in hold 1	+ 0.32	- 0.17
Change of draft due to loading in hold 4	+ 0.05	+0.34
Final drafts	**7.27**	**7.27**

12) Use of various loaded 'Conditions' provided in the stability book

The final GM, LCG, draughts, displacement etc. can be calculated and seaworthiness against the IMO stability criteria also can be evaluated manually without using a stability computer. But, the SF, BM and the torsional effects cannot be verified manually. In fact, the calculation of stresses is the main purpose of a stability computer. Therefore, if the stability computer is not working, we cannot load the vessel as the stresses cannot be calculated. In such a situation, select a 'Condition' from the stability book which is similar to the amount of cargo that you are going to receive and distribute the cargo, fuel oil and the ballast water as provided in selected 'Condition'. Calculate the GM, draught etc. and evaluate the seaworthiness manually, but no need to worry about the stresses as they will be more or less close to the stress levels given in the selected 'Condition'.

13) Damage stability

Damage control plan and damage control booklet

The SOLAS Chapter II-1, Regulation 19 states that:

- Plans showing all the:
  - openings,
  - means of closing them,
  - positions of any controls of them and
  - arrangements for the correction of any list due to flooding each deck and hold the boundaries of the watertight compartments shall be permanently displayed on the navigation bridge. This refers to a **damage control plan**.

- Books containing above information shall also be available. This refers to **damage calculation books**.
- Watertight doors that can be left open during navigation on passenger ships shall be clearly indicated in the stability book.

- The damage stability information which is to be provided to the master shall be in simple and easily understandable way to assess the ship's survivability in all damage cases involving a compartment or group of compartments.

In accordance with the requirements of the DNV-GL, The Damage Control Plan (DCP) should include inboard profile, plan views of each deck and transverse sections to the extent necessary to show the following[58]:

- The watertight boundaries of the ship.
- The locations and arrangements of all cross-flooding systems.
- Arrangements for any mechanical means to correct list due to flooding, together with the locations of their valves and remote controls, if any.
- The locations of all internal watertight closing appliances, including internal ramps or doors acting as extension of the collision bulkhead on 'Ro-Ro ships', their controls and the locations of their local and remote controls, position indicators and alarms.
- The locations of those watertight closing appliances which are not allowed to be opened during navigation, and of those watertight closing appliances which are allowed to be opened during navigation.
- Watertight doors in passenger ships that are allowed to remain open during navigation.
- The location of all doors in the shell of the ship, position indicators, leakage detection and surveillance devices.
- The locations of all weathertight closing appliances in local subdivision boundaries above the bulkhead deck and on the lowest exposed weather decks, together with locations of controls and position indicators, if applicable.
- The location of all bilge and ballast pumps, their control positions and associated valves.
- Any pipes, ducts or tunnels through which limited progressive flooding has been accepted by the Administration.
- Reference to where to find detailed information for each damage case. This information shall be given in the DCM. Each damage case should therefore refer to the corresponding page number in the DCM.

In accordance with the requirements of the DNV-GL, a damage control booklet shall include the following:

- Above information in the DCP should be repeated in detail.
- general instructions for controlling the effects of damage, such as:
  - Immediately closing all watertight and weathertight closing appliances
  - Establishing the locations and safety of persons on board, sounding tanks and compartments to ascertain the extent of damage and repeated soundings to determine rates of flooding

[58] Stability documentation for approval, DNV-GL, https://rules.dnvgl.com/docs/pdf/DNVGL/CG/2016-04/DNVGL-CG-0157.pdf

- Cautionary advice regarding the cause of any list and of liquid transfer operations to lessen list or trim, and the resulting effects of creating additional free surfaces and of initiating pumping operations to control the ingress of water.

The booklet should be supplemented with copies of the general arrangement plan, tank capacity plan and piping diagram as well as information about the used abbreviations and the definition of the co-ordinate system.

According to MSC/Circ. 434 for dry cargo vessels a limited number of damage cases is to be provided to inform the master about capabilities of his ship in the case of flooding. At least the flooding of the machinery space and each cargo compartment are to be shown. For the initial condition (before the damage) the ship should be assumed on even keel at least for two separate draughts (full load and partial load). The vertical centre of gravity (VCG) should be taken either from intact stability information or should correspond to the assumed load condition. The permeabilities should correspond to the applicable Regulations.

Additional guidance should be provided to ensure that the ship's officers referring to that information are aware that the results are included only to assist them in estimating the ship's relative survivability. The guidance should identify criteria on which the analyses were based and clearly indicate that the initial conditions of the ship's loading extents and locations of damage, permeabilities, assumed for the analyses may have no correlation with the actual damaged condition of the ship[59].

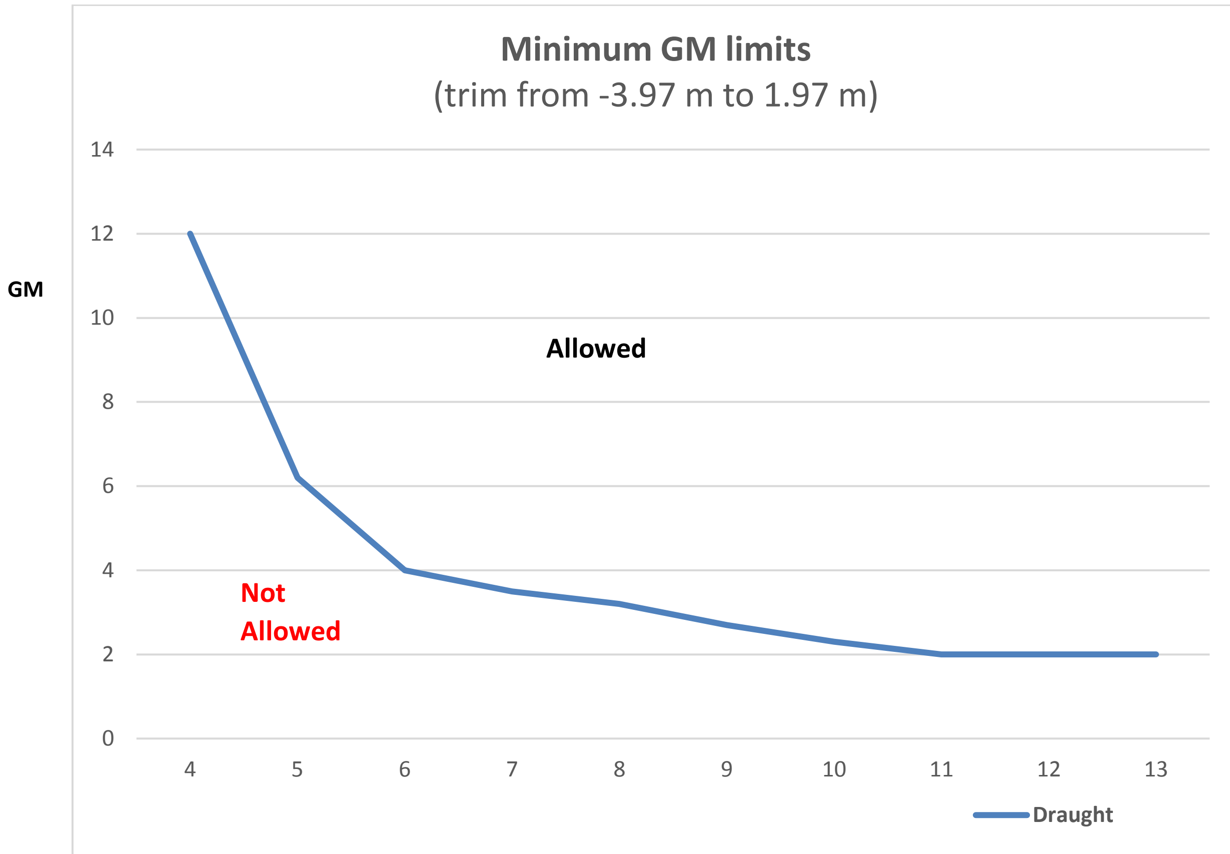
Damage stability criterion

IMO has established damage stability criteria through SOLAS chapter II-1, Part B-1 that need to be complied with and these criteria depends upon the type of the ship. Further it states:

- The master shall be supplied with such information necessary to enable him by rapid and simple process to obtain accurate guidance as to the stability of the ship under varying conditions of service. This information should include:
  - Curves or tables of minimum operational GM versus draught which assures compliance with relevant intact **and damage stability requirements**, alternatively corresponding curves or tables of the maximum allowable KG versus draught, or with the equivalent of either of these curves;
  - Instructions concerning the operation of cross-flooding arrangements; and
  - **All other data and aids** which might be necessary to maintain the required intact stability **and stability after damage.**

[59] Guidelines for the Preparation of Subdivision and Damage Stability Calculations, DNV-GL

Following graph shows damage stability verification by means of a “Minimum GM Limits” curve in case of damage to tanks or ER or cargo hold. If the vessel’s damaged fluid GM for the corresponding damage draught is higher than the minimum given in the below table, it can be assumed that the damage vessel is in a satisfactorily safe condition.



Remember, in the above case, the GM limit curve that is required to be complied, both in the case of intact (without damage) and damage conditions are the same.

With reference to the above minimum GM limit curve, for any draughts lesser than 4 m, the minimum GM limit at 4.0 m to be used and for any draughts of more than 13 m, the minimum GM at 13.0 draught shall be used.

Intact and damage stability instruments

From 1st of January 2016, but not later than 1st January 2021, tankers (oil, chemical and gas) are required to have approved intact and damage stability instruments onboard. Need to carry a Document of Approval issued by the administration or Class as an evidence for the approval received.

14) Evaluation of a ship against wind heeling criterion

Wind heeling criterions are applicable to certain types of ships only. If it is applicable to your ship, it will be given in the ship's stability book. Remember, the wind heeling criterion provided in the stability book may defer from the criterion provided in the IS Code depending upon the flag state requirements.

The calculation and the evaluation method also will be provided in the stability book. At the same time, a simplified version of verifying the compliance with the criterion may also be provided.

15) How to carry out a draught survey

The main purpose of carrying out a draught survey is to calculate the accurate displacement of a vessel at the time of carrying out the survey. The following can be calculated by using this displacement:

- Ship's constant can be calculated provided the weights on board (fuel, fresh water, ballast water etc.) are known.
- Amount of cargo to be loaded can be calculated by carrying out a draught survey before loading.
- Amount of cargo loaded can be calculated by carrying out a survey before and also after loading.

Comply with the following at the time of carrying out a draught survey:

- Should have calm weather (the draught readings will be accurate), but this may not be practicable;
- Should not have strong currents;
- The vessel to be upright;
- Shall have a trim within the limits of the tank calibration tables;
- Preferably, the trim should not be more than 1% of the vessel's length (the second trim correction may not be accurate if the trim exceeds this); and
- Shall have calculated the amount of ballast, fresh water, cargo and fuel oil on board.

Following information are required for the purpose of carrying out the calculation:

- The distances between the draught marks and respective perpendiculars.
- Density of sea water. Water density shall be taken from half the ship's draught. Depending upon the length of the vessel, you may take samples from fwd and also from aft.
- The draughts at fwd, amidship and aft on both (port & stbd) sides. When the weather is bad, a 'draught tube' could be used to take accurate draught readings.

The following proforma may be use full in carrying out draught survey calculations:

Draught survey calculation sheet

Information required	Formula to use	Answer
Fwd mean	Fwd (port + stbd) / 2	
Amidships mean	Mid (port + stbd) / 2	
Aft mean	Aft (port + stbd) / 2	
Apparent trim	Aft mean – fwd mean	
Length Between fwd & aft Draught Marks (LBDM)	Need to refer the ship's plans	
Correction to fwd draught	$\frac{\text{Apparent trim x distance between FP \& FDM}}{\text{LBDM}}$	
Correction to mid draught	$\frac{\text{Apparent trim x distance between MP \& MDM}}{\text{LBDM}}$	
Correction to aft draught	$\frac{\text{Apparent trim x distance between AP \& ADM}}{\text{LBDM}}$	
Draught at FP[1]	Fwd mean +/- correction to fwd draught	
Draught at MP[2]	Mid mean +/- correction to mid draught	
Draught at AP[3]	Aft mean +/- correction to aft draught	
Trim between perpendiculars (**TRIM**)	Draught at AP – Draught at FP	
Quarter mean draught (QMD)	$\frac{\text{6 x draught at MP + draught at FP + draught at AP}}{8}$	
Displacement for QMD	From tables	
TPC for QMD	From tables	
LCF for QMD	From tables	
MCTC for 50 cm + QMD	From tables ($MCTC_1$)	
MCTC for 50 cm – QMD	From tables ($MCTC_2$)	
Layer correction	$\frac{\textbf{TRIM}\text{ x Distance between amidships \& LCF}}{\text{LBP}}$	
First trim correction	Layer correction x 100 x TPC	
Second trim correction	$\frac{\textbf{TRIM} \times \textbf{TRIM} \times 50 \times (MCTC_1 - MCTC_2)}{\text{LBP}}$ [4]	
Heel correction	$6 \times (TPC_{port} - TPC_{stbd}) \times (Draught_{port} - Draught_{stbd})$	
Displacement in SW	Displacement for QMD +/- first trim correction[5] + Second trim correction + heel correction	
Displacement if the vessel is in DW	Displacement SW x DW density / 1.025	

NOTE

FP – Fwd Perpendicular
FDM – Fwd Draught Mark
MP – Midship Perpendicular
MDM – Midship Draught Mark
AP – Aft Perpendicular
ADM – Aft Draught Mark

1 For a stern trim ship, when the FDM is aft of FP : minus
2 For a stern trim ship, when the MDM is aft of MP : minus
3 For a stern trim ship, when the ADM is fwd of AP : plus
4 The difference between the MCTCs only
5 If LCF is aft of mid ship : plus

Remember, that the draught survey calculations may not be 100% accurate due to the following problems and errors:

- Inaccuracies in draught reading (especially in heavy weather).
- Draught reading may not be accurate if the vessel is experiencing a currant and if she is berthed in shallow water due to squat effect.
- Density of water may not be the same all around the vessel.
- The sag or hog calculations are made (the quarter mean draught formula) assuming the vessel is bend like a parabola, but, actually it may not be.
- The ballast amounts may not be that accurate especially when the vessel is trimmed. A sounding of zero centimetres does not necessarily mean that the tank is empty. At the same time, if the tank is ballasted until it is over flowed does not mean that is it full 100% due to air pockets inside.
- The densities of the ballast water inside the tanks may not be measured accurately.

IMPORTANT CASE STUDIES

Self-study the following case studies as they are important not only for the purpose of getting through the examinations but, for general knowledge as well:

a) Herald of free enterprises
b) Estonia
c) Exxon Valdez
d) Cougar Ace
e) Derbyshire
f) Erika
g) Prestige
h) Hoegh Osaka
i) Benita
j) Bulk Jupiter
k) Stellar Daisy
l) Costa Concordia
m) Sanchi
n) Wakashio

LIST OF INCIDENTS WHICH CAUSED TO MAKE NEW CONVENTIONS/CODES, AND AMENDMENTS TO EXISTING CONVENTIONS/CODES AND SUCH AMENDMENTS MADE

The amendments in certain conventions / codes were not exactly due to the named vessel or the incident but made due to a series of similar incidents.

Name of the vessel	Date of the Incident	Requirement/regulation/amendment/Code
Titanic	14th April 1912	Implementation of SOLAS Lifeboat & life raft capacities to comply with the ship's complement
Torrey Canyon	18th March 1967	MARPOL 1973 International Convention on Civil Liability for Oil Pollution Damage 1969
Argo Merchant	15th Dec 1976	Hazardous Material Response Division (HAZMAT team) was created to provide scientific expertise during a response incident - USA 1978, adopted a protocol to the 1973 MARPOL Convention, absorbing the parent Convention Pre-arrival navigation tests - USA
Amoco Cadiz	16th March 1978	Significant updates to both MARPOL and SOLAS Expansions and addition of safety and pollution prevention to the Paris MoU Established Port State Control (initiated with Paris MoU) International Salvage Convention 1989
Derbyshire	9th Sept 1980	Compulsory daily reporting of the position of all vessels Adopted amendments and new text to SOLAS chapter XII Adopted amendments to 1988 Load Lines Protocol
Herald of free enterprises	06th March 1987	This is the most near incident to ISM Code Indicators on the navigating bridge for all doors which, if left open, could lead to major flooding of a special category space or a ro-ro cargo space, as well as means such as monitoring to detect water leakage. Monitoring of special category and ro-ro spaces to detect undue movement of vehicles in adverse weather, fire, the presence of water or unauthorized access by passengers whilst the ship is underway. Supplementary emergency lighting for ro-ro passenger ships

		"SOLAS 90" standards Maximum angle of heel after flooding but before equalization shall not exceed 15^0 Masters to be supplied with data necessary to maintain sufficient intact stability, including information showing the influence of various trims, taking into account operational limits Cargo loading doors to be locked before the ship proceeds on any voyage and to remain closed until the ship is at its next berth Lightweight survey must be carried out to passenger ships to verify any changes in lightweight displacement and the longitudinal centre of gravity, at periods not exceeding five years From 1 February 1992 new ships have had to be equipped with power-operated sliding doors, except in specific cases, which must be capable of being closed from a console on the bridge in not more than 60 seconds. All watertight doors must be kept closed except in exceptional circumstances. "probabilistic" concept of survival on ships built after 1 February 1992 Revised SOLAS chapter VI Carriage - Code of Safe Practice for Cargo Stowage and Securing, which includes a number of annexes dealing with such "problem" cargoes as wheel-based cargoes and unit loads, both of which are carried on ro-ro ships. Large open spaces such as atriums on passenger ships built on or after 1 January 1994 were to be provided with two means of escape, one of which gives direct access to an enclosed vertical means of escape and be fitted with a smoke extraction system and with automatic sprinkler systems Modified SOLAS 90 - A/Amax (it is a simplified probabilistic approach attempting to assess the survivability standard of one ferry against another) Stockholm Agreement
Exxon Valdez	24th March 1989	Double hull requirements OPA 90 – US Regulations
Estonia	28th Sept 1994	A.792(19) Safety culture in and around passenger ships. A.793(19) Strength and securing and locking arrangements of shell

		doors on ro-ro passenger ships. A.794(19) Surveys and inspections of ro-ro passenger ships. A.795(19) Navigational guidance and information scheme for ro-ro ferry operations. A.796(19) Recommendations on a decision-support system for masters on passenger ships
Erika	12th Dec 1999	Acceleration of the schedule to phase out single-hulled tankers Amendments to CLC Convention Amendments to IOPC Fund Amendments to the guidelines on the enhanced programme of inspections during surveys of bulk carriers and oil tankers (resolution A.744(18)) with relation to the evaluation of the longitudinal strength of the hull girder of oil tankers
Attack on Twin towers - USA	11th Sep 2001	ISPS Code
Prestige	13th Nov 2002	extended application of the Condition Assessment Scheme (CAS) for tankers acceleration of the schedule to phase out single-hulled tankers banned the carriage of HGO in single-hull tankers of 5,000 dwt and above
Ythan	28th Feb 2004	Amendments to IMSBC Code – changes to the Code in relation to the carriage of DRI (A), (B) and (C)
Karen Danielsen	03rd March 2005	BNWAS
Star Princes	23rd March 2006	Amendments to SOLAS chapter II-2 and to the International Code for Fire Safety Systems (FSS Code) to strengthen the fire protection arrangements in relation to cabin balconies on passenger vessels
Costa Concordia	13th Jan 2012	Amendments require musters of newly embarked passengers prior to or immediately upon departure, instead of "within 24 hours of departure". For detailed information refer – MSC.1/Circ.1446/Rev.2 issued on 08th August 2013
MSC Napoli MOL Comfort	18th Jan 2007 17th Jun 2013	Shipper to verify the gross weight of the containers from 1st of July 2016
Bulk Jupiter	02nd Jan 2015	Bauxite which was classed as Group C (cargo may not liquefy) in the IMSBC Code. After the loss of Bulk Jupiter, some types of bauxite was re-classified as Group A (cargo which may liquefy) cargo

EMERGENCIES

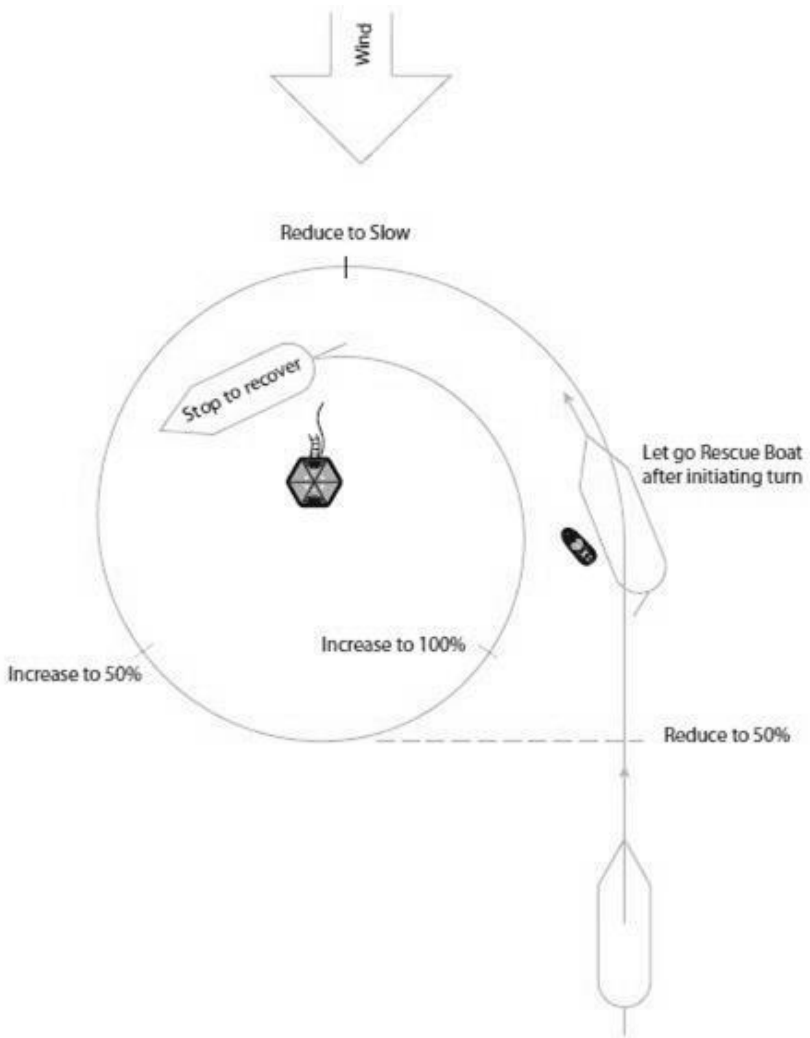
1) Actions to be taken during a man overboard situation

Actions by duty officer

a) Put the wheel hard over to the man overboard side.
b) Let go the MOB marker which is on the same side.
c) Press the MOB marker on the GPS.
d) Call up emergency stations, inform master, post lookouts and man the wheel.
e) In restricted visibility, the SART may be used to monitor the position of the MOB by dropping it along with the MOB marker, but, if the vessel's free board is very high, the SART may be damaged.
f) Put the engines standby.
g) Send a distress message.
h) Take the check list for man overboard and ensure all the actions are taken according to the check list.
i) When the heading is 60º - 80º off the initial course, put the wheel hard over to the opposite side. When the heading is coming close to the reciprocal course, steady the vessel (this is for the purpose of carrying out a Williamson turn). Any other methods recommended by the IAMSAR Volume III may be used depending upon the situation. You are required to have a good idea of the search patterns given in the IAMSAR Volume III.
j) Put the Oscar flag up.
k) Follow the guidelines provided in the '**Plans and procedures for recovery of persons from the water**'.
l) Prepare rescue boat for lowering.
m) First aid party must be ready with warm clothing and first aid kits.
n) If the rescue boat cannot be lowered due to weather conditions, keep ready cargo nets.
o) If the sea is rough and rescue boat cannot be lowered, take the victim on to the leeward side of the ship and let the vessel drifts towards the victim. If the sea condition is alright and expecting to lower the rescue boat, then take the victim on the windward side.
p) If the weather is bad, consider the use of **Loren turn**. Loren turn means circling around the datum point in order to make a relatively calm area at the datum point. Refer the IAMSAR Volume III. Loren turn will[60];
    - facilitates launch and recovery of a rescue boat
    - facilitates rescue work by other craft
    - circling calms the sea by interfering with wave patterns
    - the more turbulence created by the ship the better
    - additional ships circling to windward will calm the sea further

[60] IAMSAR Volume III

q) Loren Turn procedure;
   - Head into the wind at full speed.
   - Begin the circle and reduce to slow when the wind is abeam.
   - When the wind crosses the stern to the opposite quarter, increase to half speed.
   - Continue circling as long as calmer water is needed.
   - Slow down, or stop, to launch and recover rescue boat on the leeward side, inside the circle.



2) Actions to be taken in an oil pollution incident

a) Ring the general alarm and Call for "pollution emergency"
b) If the vessel is engaged in bunkering or loading/discharging (in case of a tanker), stop the operation immediately.
c) Take the pollution emergency check list and follow it.
d) Try to contain the pollution on board.

e) If it flows overboard, try to contain it in a limited area by using oil booms.
f) Never use any type of sea cleaning without the permission of the local authorities.
g) Inform the required parties as per the SOPEP.
h) Never give any information to media or any outside party without the permission of the master or the designated person.

In case of an oil spill during bunkering operations

If any oil spill occurs during bunkering operations, irrespective of the party who has made the mistake (bunker spill), both the vessels (the barge and the ship who was receiving bunkers) are required to take actions together to contain and stop the pollution. This is agreed while signing the bunkering contract.

The BIMCO standard bunker contract states "In the event of any spillage causing or likely to cause pollution occurring at any stage of the bunkering operation, the Buyers and the Sellers shall jointly, and regardless as to whether the Buyers or the Sellers are responsible, immediately take such actions as are reasonably necessary to effect clean up and which shall always be conducted in accordance with such local laws and regulations which may compulsorily apply".

3) Actions to be taken when the steering system is not working

a) Call for "emergency steering" stations.
b) While the people are proceeding to the emergency steering position, try out the non-follow up mode. The non-follow up mode bypasses certain functions in the normal steering system. Therefore, if the fault is in one of those units in the bypassed systems, the non-follow up mode may work.
c) Take the emergency steering check list and make sure all tasks are complied with.
d) Inform the anchor party to be standby in the forward.
e) Ensure the repeater in the steering flat synchronized with the master gyro.
f) The use of walkie-talkies in the steering gear flat is not advisable as the communication may break since the steering gear flat is a covered area. Therefore, always use the emergency communication system.
g) Continue steering from the steering gear flat.

4) **Actions to be taken when received a distress message saying that a passenger ship is on fire and 2000 passengers are on board and in distress.**

a) If distress alert through DSC is received, do not acknowledge as it is to be acknowledged by a coast station, but, it may acknowledge only if no other station has received the alert and if the alert keeps coming continuously. In that case it may be acknowledged through the DSC for the purpose of terminating and need to inform a coast station as soon as possible by most convenient method.
b) Acknowledge the distress message and relay the message if necessary (a DSC distress relay alert may be transmitted if the distress vessel himself is not in a position to send a distress message or if the master consider further assistance is required) and plot the position of the distress vessel.
c) Calculate the stability for the purpose of picking up 2000 passengers on board and make sure that vessel will have positive stability.
d) The master has to decide whether he can go for the distress assistance without putting own vessel in distress. If the distress vessel is in a reachable distance, but, cannot go for the assistance, the master has to make a log book entry with reasons for not providing assistance.
e) Establish communications and pass all the details including the ETA to the distress vessel. (Name, call sign, position, speed, ETA)
f) Keep watch on VHF channel 16 and other distress communication frequencies MF/HF frequencies.
g) While approaching, rig a GUEST WARP secure with the LIZARD LINES from bow to quarter on both side of the vessel at the water line. (For made fast the boats and rafts alongside)
h) Rigged the fire hoses and pressure up the fire mains. First aid party ready with all the equipment. Rescue boat and rafts to be prepared for immediate use.
i) Rig portable ladders scramble nets secure to the lowest point of the deck up to the water level. Line throwing apparatus, heaving lines and messenger lines kept ready for immediate use.
j) During dark hours, arrange searchlights and extra illumination to be prepared for night rescue.
k) Keep cranes or derricks ready for hoisting on both sides of the vessel with platforms or cargo nets to pick up the casualties.
l) Post extra lookout when approaching to the area
m) Pass all available information to the RCC and update the information as necessary.
n) Follow the guidelines provided in '**Plans and procedures for recovery of persons from the water**'.
o) Put the engines on standby and approach keeping the distress vessel on the windward side and also keep monitoring and plotting the other vessels position around the area.
p) David launching life rafts can be used as boarding stations on the water surface alongside the own ship.

q) If there are life rafts belongs to the distressed ship, they also can be used as boarding stations.
r) After picking up all crew and passengers take final count, if anybody is missing, make search and rescue operation again and deviate to a port of refugee as soon as possible, to disembark the rescued people.
s) All the entries must be logged with the time in the GMDSS logbook and OLB as well.
t) Remember, since you are on a cargo ship, your lifeboat capacity will not be sufficient. Therefore, you are required to report to the flag state as soon as possible and need to discharge them as soon as possible.
u) If possible, arrange;
    - first aid facilities
    - sanitary facilities
    - fresh water
    - meals
    - accommodation etc.
v) As you and your officers are not used to manage passengers, it is always advisable to use the helps of the rescued officers of the passenger ship in managing the rescued people.
w) Survivors to be sorted out according to medical condition and prioritize them for emergency care, treatment and evacuation. This is known as '**Triage**'. Refer the IAMSAR Volume – III.

Actions to be taken in the above situation if the own vessel is loaded up to maximum draught

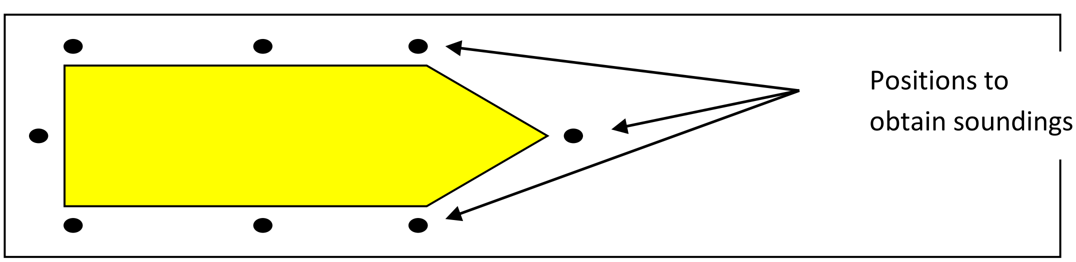
a) The assisting vessel must not become a casualty when going for assistance of a distress ships.
b) Consider the weight of one passenger is 80 Kg.
   Therefore, total weight of passengers = 2000 x 80 = 160000 Kg =160 t
   TPC (a possible value) = 40 t per cm
   The draft will be increased by = 160 / 40 cm = 4 cm

c) If the weather condition ahead is good, stability condition is alright (positive GM), and if this increase of draft (4 cm) is not going to put your ship in trouble under any circumstances you may take the passengers on board. If doing so inform the,
    - Owners
    - Flag state
    - Underwriters
    - Classification Society

d) If it is not safe to take all the passengers on board, you can assist them by taking injured people, old people, children, women etc. If it is about less than 100 people, it will not create much difference of draught (as per the calculation above).
e) Discharging of cargo is not an appropriate option as it takes a long time and also it will create more complications as well.
f) Even if you can't take the passengers on board, you can assist distressed people (in communications with shore and other ships, motivating them, by providing first aid etc) by being with them while they are in their survival crafts, until more help is received.
g) Whether you take them onboard or not, the reason must be justifiable.
h) Remember, even though the stability of the own vessel is alright after taking all the passengers, you have to discharge them as soon as possible from the nearest place as your lifeboat capacity is exceeded and it may put your own staff in danger.

5) Actions to be taken in case of grounding

a) Stop engine and change over to hand steering.
b) Sound the general emergency alarm followed by PA announcement.
c) Inform engine room to change over low suction to high suction.
d) Retract the log sensors if fitted.
e) Display aground signals.
f) Save the data in the VDR.
g) Plot the position on the chart.
h) Keep record of all events.
i) Send out urgency message and inform to relevant parties.
j) Render first aid to any persons onboard who suffers injuries.
k) Sound all tanks including fuel tanks and compare with last sounding records.
l) Check the external sounding and drafts of the vessel to determine the side and extent of grounding and nature of seabed. In checking the external soundings, make sure to take soundings as per the picture below. Depending upon the size of the vessel (length and breadth), the number of sounding positions may be increased.



m) Check the watertight integrity of the vessel.
n) If there is any water ingress, try to control it by means of pumping out.
o) Assess the extent of damage and calculate the damage stability.

p) Calculate the tides, currents and find out possibilities of re floating.
q) If requires call tug for assistance.
r) Obtain the latest weather reports from all available means.
s) If a fuel tank is damaged minimize the pollution by rigging oil booms & transfer fuel to empty fuel tank and standby the SOPEP team.
t) Report to appropriate authorities.

6) Master's obligations in case of a collision

Without endangering own ship, crew and passengers;

a) Render all practicable assistance to the other vessel
b) Standby until ascertain that she does not require further assistance
c) Take details of the other vessel (ship name, name of last port and next port)

7) Actions to be taken in case of a collision

a) Stop engines and obtain an assessment of the situation. (depending upon the angle of collision, it may be prudent to maintain a few revolutions on the engines to avoid the other vessel from total flooding and possible sinking when the two vessels are separated)
b) Make sure to follow the check list for collision.
c) Sound the emergency signal and carry out a head count (To check injuries onboard).
d) Shut all watertight doors (in fact these doors to be kept closed during sea passage, unless for maintenances) and fire doors.
e) Obtain weather report and plot position on the chart.
f) Save the data on the VDR.
g) If there is a water ingress start pumping out the water.
h) Switch on deck lights and not under command (NUC) lights if at night and NUC shapes.
i) Muster damage control parties and delegate duties.
j) Check the viability of containing the water ingress by referring to the damage control plan.
k) Prepare survival crafts and make ready for immediate launch if the situation demands.
l) Assess the damage to the vessel.
m) Check the damage stability condition of the vessel.
n) If there is a possibility of flooding and sinking, consider about passing mooring ropes between ships

Source : https://www.rivieramm.com/news-content-hub/news-content-hub/shipping-experts-discuss-reasons-behind-2018-ship-collisions-25989

o) Investigate the possibility of pollution and if there is any possibility, take measures for pollution prevention.
p) Consider the possibility of fire hazardous.
q) Contact chief engineer and check the condition of the engine room.
r) Consider about making following reporting and call for helps,
   - Distress/urgency message
   - Calling for salvage
   - Owners, charterers, agents
   - Flag state, Coast guards, AMVER, local authorities.
s) If required (specially, if the vessel is sinking) and if possible, consider about beaching the vessel.
t) For minor damages, consider about using collision pads.
u) Consider of listing the vessel to the opposite side to take the damage area above the water level.

8) Actions to be taken in case of hatch cover damage during heavy weather

a) Try to reduce the water ingress by rigging tarpaulins over it.
b) If the opening is not too large and if the weather permits, it can be cemented as well.
c) Consider about altering course to minimize the shipping seas to reduce the water ingress.
d) Check the sounding of the bilges and if it is increasing, pump it out by bilge pump.
e) Check the stability condition of the ship and assess the situation.
f) Consider about deviating to a port of refuge.
g) Inform classification society, administration, owners, charterers, P & I etc.

h) Since this affects the load line certificate, it should be inspected by a class surveyor. Therefore, arrange a class surveyor on arrival next port.
i) After repairs also the surveyor must approve it.
j) If surveying or repairing is not possible in that port, the master can take the vessel to another port where surveying or repairing is available, but he must ensure it is safe to do so.

9) Lashing failures during heavy weather

As long as possible to do so, lashings of the deck equipment, cargo and safety equipment shall be checked while experiencing heavy weather. That is the reason to rig safety wires fwd and aft so that people can go fwd and aft to check the condition of the vessel. If any lashing damage or loose lashing is found, need to take immediate actions to reduce further damage. In doing so, generally, follow the procedure below;

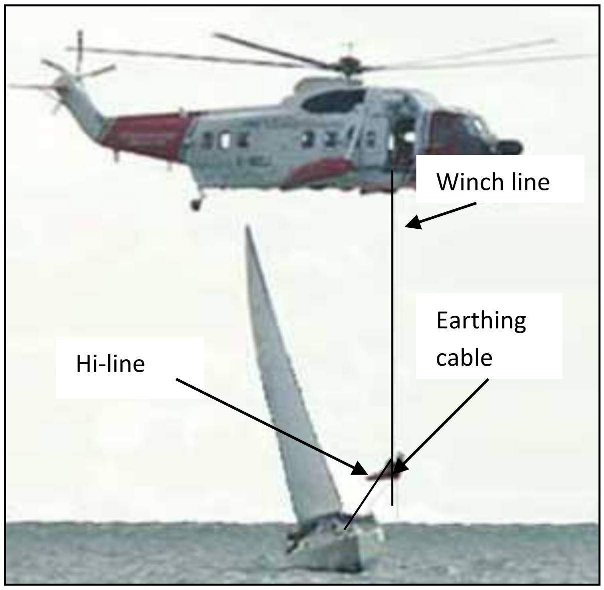
- Carryout a risk assessment and make sure it is safe to send people there.
- In consultation with the master reduce the rolling/pitching by altering the course or by reducing the speed.
- Discuss with master about how to arrange lashing and draft a plan. This may include re-arranging of the whole lashing (provided it is safe to do so and time permits) or use of temporary lashing etc.
- Cross check your plan with the cargo securing manual if it is related cargo lashing.
- Do not hesitate to call any number of crew as it is important, but, better to select minimum number of SUITABLE (experienced & competent) crew.
- Brief crew about the plan.
- Ensure that they are wearing appropriate PPE. If the work to be carried out on deck, wear life jackets.
- Keep a proper communication with the bridge throughout the operation.
- Once the operation is completed, time to time check the successfulness of the operation provided it is safe to do so.

If lashing of lifeboat is parted or loosed, follow the below guidelines in addition to those mentioned above;

- Always it is better to tight with the existing lashing and using wooden wedges to re-secure the lifeboat without using additional lashing. Because, in case of emergency, it shall be possible to use it.
- Master’s permission is required if you are going to put additional lashings and if additional lashings to be used:
  - ➢ Always better to use bottle screw/s, so that the lifeboat can be tightened properly. At the same time, wooden wedges could be used for tightening.
  - ➢ Inform all the persons onboard about the extra lashings used and how to release them.

- Delegate the duty of removing additional lashings to one or more crews (as required) on the muster list.
- Time to time check the successfulness of the lashings applied.

10) Hi-Line rescue[61]



"In certain weather conditions it may not be possible to winch a 'helicopter winchman' or the strop (rescue harness) from a position directly above a vessel to the vessels deck. Under such circumstances a rope with weight and extension to the winch wire may be lowered to the vessel. This extension is known as a Hi-Line or Heaving-in Line and is connected via a weak link to the aircrafts winch hook".

"When the Hi-Line technique is used, once the weighted line is placed on the deck, one crew member must handle the line. He should take up the slack on the Hi-Line and haul in ONLY when instructed to do so by the helicopter crew by radio message or hand signal. The Hi-Line must NOT be secured to any part of the vessel. A second crew member should coil the slack line into a bucket or similar container clear of obstructions. It is advisable for the handling crew to wear protective gloves to prevent from rope burns. If the helicopter has to break away during the operation the line must be paid out or, if necessary, released completely ensuring that the line passes clear outboard".

"As the Hi-Line is paid out, the helicopter will move to one side of the vessel and descend. Normally the winchman will be winched out, the ship's crew should continue to take in the slack. As the winchman or strop approach the vessel the earthing lead or hook must make contact with the vessel to discharge the static electricity before the vessels crew make

[61] MGN 161, MCA, UK

contact with the wire. Considerable effort may be needed when pulling the Winchman onboard".

11) Actions to be taken in case of dealing with emergencies arising with IMDG

- If there is spillage or fire involving IMDG, immediately need to refer the EmS Guide (emergency procedures for ships carrying dangerous goods). In fact, the chief officer must make a summary of the IMDG containers onboard along with their emergency schedules and it shall be kept in the bridge before sailing so that it can be used in an emergency.
- In case of fire:
  - ➢ Need to decide what type of extinguishing medium to be used after referring the EmS Guide.
  - ➢ Master may have to decide whether to abandon the vessel, assistance is required, or assistance is not required depending upon the type of the IMDG and the seriousness of the fire.
  - ➢ When fire is on deck:
    - ensure to wear fireman's outfit and the BA set when fighting fire at close range.
    - may have to turn the vessel such a way that the flames and the smoke are moving away from the firefighting team or to take the fire on to the leeside.

  - ➢ If the fire is under deck (in this case, it will be very difficult to identify whether the fire is caused by an IMDG cargo or some other cargo):
    - Most suitable action would be to release CO_2. Therefore, ensure to close all ventilators and openings to that hold.
    - Once it is confirmed that no one is inside the hold, flood the hold with CO_2.
    - Use of water is not advisable as it may affect the ship's stability and water is not a good extinguishing medium for some IMDGs and with some IMDGs, water may increase the fire.
    - Start boundary cooling.

  - ➢ Cooling of IMDG cargoes around the fire will be very helpful in avoiding further severe fires and expositions.
  - ➢ Refer the EmS Guide and be ready to deal with spillages beforehand.
  - ➢ Be prepared with the requirements of the MFAG
  - ➢ Ensure to comply with the other requirements such as preparing of lifeboats, keeping good contact with bridge, arrange sufficient spare bottles for BA sets and also refilling them, arrangement of first aid party, boundary cooling etc.

- In case of a spillage:
  - ➢ Do not touch it.

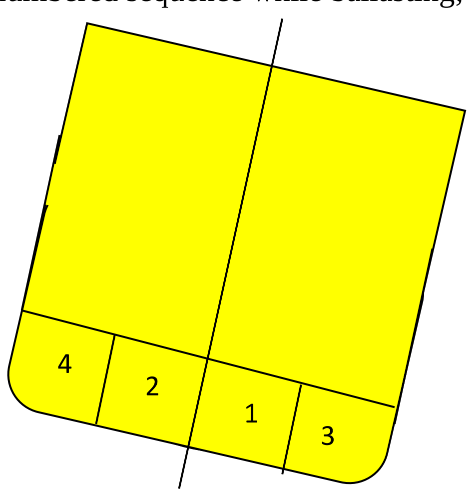
- ➢ Master may have to decide whether to take assistances from external services depending upon the type of the IMDG and the nature of the spillage.
- ➢ If the vessel is in a port, it would be advisable to remove all the cargo workers and outsiders who are onboard depending upon the type of IMDG.
- ➢ Consider of discharging the cargo in consultation with the master if the vessel is in a port.
- ➢ Use chemical suits which are supposed to carry on board in accordance with the Document of Compliance for carrying IMDG cargoes while handling dangerous goods.
- ➢ Consider of diluting the spilled material by means of water if it is not reactive with water.
- ➢ If it is possible, try to contain the spillage on deck without letting it fall overboard.

12) Actions to be taken when the vessel is in an angle of loll

If the vessel is in an 'angle of loll', actions should be taken to move the 'G' towards the keel (to create a positive GM). **Remember, angle of loll is a dangerous situation and must be corrected immediately**. The position of 'G' can be moved down,

- by adding weights below 'G' (in lower holds, double bottom tanks)
- by removing weights which are already above 'G' (deck cargo)
- by lowering the weights which are already onboard.
- by reducing free surfaces effect

In discharging deck cargoes or while shifting cargoes, ship's cargo gears shall not be used since it will increase the negative GM once the weight is taken by a ship derrick or crane. The best practice is to ballast double bottom tanks. Ballasting should be started from the heeled side. Follow the below numbered sequence while ballasting;



This should not be started from the higher side because the up-righting momentum created whilst correcting the situation could cause the ship to swing to the opposite side which may cause the vessel to capsize.

At the same, there may not be double bottom tanks onboard as illustrated in the above figure, therefore, start ballasting with the tanks having lesser inertia, below the COG of the vessel and on the heeled side of the vessel.

13) Dry docking with a damage condition

If the water tight integrity of the hull is not breached and if the vessel is need to be dry docked just to make the repairs of the dented and buckled areas due to grounding or collision, no need to take the actions and precautions mentioned below, since the hull is intact and no stability is affected due to the incident. But the chief officer has to identify the exact areas of the damage and inform the dock master for the purpose of positioning the keel blocks and if required the shores. At the same time, if the damage is at the stern, you may require having an even keel condition. This will be informed by the dock master.

If area of the damage is under water and if it cannot be seen from above water, the class surveyor may use divers to identify the damage area for the purpose of identifying whether docking is required, if the watertight integrity is not breached.

There are no internationally accepted safety procedures, practices and guidelines for dry docking a damaged vessel. This completely depends upon the extent of the damage and the vessel's stability condition. Therefore, extensive thinking is required and probably, the vessel may require taking advices from external sources such as from the classification society, salvors etc.

Following to be considered in **addition to the normal dry-docking procedures mentioned above**:

- There shall not be any sort of pollution because any dock will not accept a vessel with leaking any marine pollutants, specially, oil, noxious illiquid substances and IMDG. In that case the vessel is required to transfer the cargo or the marine pollutant before docking.
- A set of exact draughts, soundings, cargo distribution arrangement, condition of the vessel's list, extent of the damage, area of the damage to be informed to the dock.
- If the vessel is listed, consider of up righting her without making the stability condition worse.
- If the list cannot be corrected, it will be advisable to dock the vessel with an even keel condition (arrange the keel blocks to touch the whole bottom at once, by adjusting the heights of the keel blocks) so that the full length of the parallel rounded bottom will touch the keel blocks at once. In that case:
  - The P force will be acting through the ship's rounded bottom on the side.
  - The critical period is the time between the first touch and the finally touching of the breadth overall and the maximum P force will occur at the time of touching the full breadth overall.

- The P force which occurs at the critical instant can be reduced by reducing the list if possible.
- Remember, if the initial GM is insufficient, unlike with a trimmed vessel, the vessel may capsize very easily when she is listed.
- Shoring would be very helpful in positioning the vessel in the dock. But, it may be possible to rig the shores only on the listed side.
- Once the emptying of the dock is commenced, need to slack the mooring ropes on the listed side and heave up the mooring lines on the other side.

- Consider about the ship's stability and may have to consider of discharging the cargo and / or transfer ballast water, ballast or de-ballast to improve stability so that the vessel will be stable during the critical period.
- To reduce the critical period and loss of GM at the critical instant, consider of making the vessel even keel while maintaining stability.
- If the vessel is sagged or hogged, consider of ballasting or de-ballasting or transferring of ballast to reduce the sag or hog effect.
- If the vessel is trimmed by head and if it cannot be reduced, a dock master may consider to, adjust the heights of the keel blocks, in such a way that the whole vessel will touch the bottom at once.
- Consider of;
    - taking the vessel to a floating dock. The trim and list of a floating dock can be adjusted to suit the condition of your vessel.
    - carrying out repairs while the vessel is waterborne by changing the trim or list.
    - doing the repair while the dock is partly empty, so that part of the weight of the vessel will be taken by the blocks and part will be supported by buoyancy force.

14) Making a collision mat

A collision mat will not completely stop the water ingress. To stop the water ingress, the best option is to list or trim the vessel to bring the damage area above the water level. The main purpose of a collision mat is to reduce the water ingress so that the pumps can take the control over the leaking water and carrying out temporary repairs would be easy.

Collision mats are convenient only for small openings on the hull and if the damaged hull plates are turned out wards, it may not be viable to use a collision mat.

A collision mat may be made by sewing few layers of tarpaulin or canvas together to give it a little rigidity and framed by means of wooden battens or a wire rope. If a wire rope is used, higher the diameter of the rope, stronger the mat would be.

If the hole is on the vertical hull, a collision mat can be positioned on it by hanging it by means of ropes. To sink the mat below the water level, need to add a weight at the bottom of the collision mat such as a steal rod.

If the hole is on the bottom of the hull, a great difficulty may arise in placing the collision mat over the hole. But, when there is a severe threat to life, anything would be possible! The only way possible is by attaching four wire ropes (two on either side of the mat), lower the mat over the forecastle and drag it towards the hole. Wire ropes are required because otherwise the mat will not go under the hull, it will keep floating. At the same time all the ropes shall have lengths almost equal to the breadth plus the height of the vertical hull (breadth + draught + freeboard).

If the hole is small, hole may be plugged from inside the vessel. critical thinking is required depending upon the situation before deciding what to do and how to do.

DRILLS ONBOARD

1) Summary of drills and safety trainings to be conducted on board

Name of the drill or safety training	Period
Fire drill & **abandon ship drill** for crew members	Once every month
Abandon ship drill and **fire drill** for crew members	If more than 25% of the crew have not participated in abandon ship and fire drills on board within 24 hrs of the ship leaving a port
Abandon ship drill and **fire drill** for crew members	Enters service for the first time or after major modification, before sailing
Passenger safety briefing	Newly embarked passengers shall be given safety briefing immediately before sailing or immediately after sailing
Abandon ship drill and **fire drill** for passengers	Newly embarked passengers prior to or immediately upon departure
Abandon ship drill and **fire drill** for passengers	Shall take place weekly.
Launching of Gravity launched lifeboats	Once every 3 months Ships on short international voyages may not launch the lifeboats on one side if their berthing arrangements in port and their trading patterns do not permit launching of lifeboats on that side. However, all such lifeboats shall be lowered **at least once every three months and launched at least annually**.
Launching of Dedicated rescue boats (other than those which are also lifeboats)	Monthly, if not possible, at least once every 3 months
Launching of Free fall lifeboats	Once every 6 months if not possible, Flag Sate may extend to 12 months provided suitable simulated launching practices are carried out every 06 months
Onboard training in the use of Davit-launched Life rafts	Once every 4 months. If possible, it shall include the inflation and lowering of the life raft.
Fast rescue boats (ro-ro passenger ships)	At least two crews of each fast rescue boat shall be trained & drilled regularly.
Operating of watertight Doors, Side Scuttles and Other Openings (passenger ships)	Once every week
All watertight doors, both hinged and	Shall be operated daily

power operated, in main transverse bulkheads, in use at sea	
Marine evacuation system drills	Training on procedures of deploying the system – regularly Actual deployment (onboard or ashore) – at intervals of 2 years but in no case longer than 03 years
Enclosed-space entry and rescue drill	Once every 2 months
Steering gear	Within 12 hours before departure, the ship's steering gear shall be checked and tested. Ships regularly engage on voyages of short duration shall carry out these checks and tests at least once every week.
Steering gear drill	Once every 03 months
Onboard training in the use of the ship's: • life-saving appliances, • fire extinguishing appliances	As soon as possible but not later than two weeks after a crew member joins the ship. Thereafter, instructions shall be given at the same interval as the drills. Individual instruction may cover different parts of the ship's life-saving and fire extinguishing appliances, but all the ship's life-saving and fire-extinguishing appliances shall be covered within any period of two months.
Security drill	At least once every three months. If more than 25 % of the ship's personnel have been changed, at any one time, a drill should be conducted within one week of the change.
Drills & emergency exercises on ships which applies the IGF Code.	The IGF Code states that the drills and emergency exercises to be conducted at regular intervals

2) Important points to remember when preparing muster lists

- Ensure that the people who are responsible for the maintenance of LSA and FFA are named.
- In case of carrying passengers, crews shall be appointed to assist passengers.
- Make sure the muster list is in compliance with the latest crew list and the Minimum Safe Manning Document.
- Need to nominate person in charge (deck officer or certified person) for **each survival craft** and also nominate a second in command for **lifeboats**. In this case, a certified person means a person having a Certificate of Proficiency in survival crafts and rescue boats other than fast rescue boats.
- Nominate a second in charge for the duties of the key persons.
- Crew members shall be familiarized, and prior training shall be given prior assigning any duties on the muster list.
- When assigning more than one duty to a single person, make sure it is viable in any circumstances. Otherwise, more than one duty shall not be assigned to one person.

- Each lifeboat shall be appointed with a person who can carry out minor engine repairs.
- Check the operational viability of staff before assigning any duties. Example – a person with a beard may not be suitable to wear BA set. People with large BMI (Body Mass Index) may not be suitable to make enclosed space entries.
- Be aware of the competency and the experience of seafarers before assigning complicated duties, such as lowering of lifeboats, fighting fires with BA set and fireman's outfit etc.
- Active roles (operation or preparing or keeping standby any equipment or accessories) shall not be assigned to anybody who are working or onboard as supernumeraries, riding gangs etc.
- It is better to assigned duties of individual departments to respective staff in the department. Examples – fighting engine room fires to be carried out by engine staff. This is because, staff members are familiar with their own environments.
- After completing the muster list, double check it, to make sure the ship's full complement is covered and make sure all the safety duties are covered.
- Change of the duties of the people already onboard is not a wise idea unless it is extremely necessary. This may not be avoidable if the new joiners are not experienced enough.

3) How to plan and conduct drills onboard

Points to remember when planning drills

- Need to have a knowledge of the types of the drills to be conducted and frequencies required by the vessel's flag state and by international standards (refer the drill matrix onboard vessel).
- Need to be aware of instructions, precautions provided in the SMS with regards to drills.
- Need to have a good idea of the manufacturer's instructions with regards to the operation and maintenance of safety related equipment. Make sure equipment are maintained in accordance with such instructions before operating them.
- Refer the past drill records and see whether there were any lessons to be learned. If so, plan the drill in such a way to avoid the repetition of such errors.
- **SOLAS requires that drills shall, as far as practicable, be conducted as if there was an actual emergency. This means that the entire drill should, as far as possible, be carried out, while ensuring that the drill can be performed in such a way that it is safe in every respect. Consequently, elements of the drill that may involve unnecessary risks need special attention or may be excluded from the drill.**
- Need to carry out a risk assessment.
- Check the viability of carrying out combined drills, as this may save time and it will be closer to an actual situation. Example – carrying out fire and abandon ship drill together, carrying out the emergency steering drill and a collision drill together etc.
- Make sure to conduct the drills safely, with minimum disturbances to rest periods and without inducing fatigue.

- Drills to be conducted with maximum number of participants. Therefore, need to conduct drills when minimum number of operations are being carried out onboard as far as practicable.
- Check the past drill records and see what equipment are used to demonstrate the operational procedures and try to select different equipment each time. All the safety equipment used during drills shall be ready to use again in an emergency and shall be kept in the correct places.
- Ensure the persons who operate or demonstrate the operation of the safety equipment are familiar with such operations.
- Discuss the plan with the master.

Points to remember during and at the end of a drill

- Make sure all are familiar with the duties and the use of equipment relevant to the type of the drill.
- When giving training in the use of certain equipment, may require giving priorities to certain staff members. Example – more training shall be given to deck staff on emergency steering.
- The instructions to be given to crew includes;
    - Information with regards to personal safety,
    - Areas where special attentions are required,
    - Operation & use of safety equipment,
    - Importance of familiarization with LSA & FFA training manual,
    - Importance of following the instructions given by officers,
    - Correct use of PPE even during drills,
- Among other timings, check the time taken from the activation of the alarm to muster at the muster station and also the time taken from the time of mustering to the completion of the drill. This is one method of monitoring the efficiency and awareness of the staff.
- At the end of each drill need to carry out a debriefing and discuss the mistakes happened during the drill, the efficiency of the drill and ideas to improve the efficiencies in future.
- Make appropriate logbook entries and records, which includes the lessons learned.

4) Abandon ship drills

Each abandon ship drill shall include[62];

- summoning of passengers and crew to muster stations with the alarm required and followed by drill announcement on the public address or other communication system;
- reporting to stations and preparing for the duties described in the muster list;

[62] Resolution MSC.47(66), IMO

- checking that passengers and crew are suitably dressed;
- checking that lifejackets are correctly donned;
- lowering of at least one lifeboat after taking necessary preparation for launching;
- starting and operating the lifeboat engine;
- operation of davits used for launching life rafts;
- a mock search and rescue of passengers trapped in their staterooms;
- instruction in the use of radio life-saving appliances;
- different lifeboats shall, as far as practicable, be lowered.

5) Launching of lifeboats[63]

Free fall launch

- The monthly drills with free-fall lifeboats should be carried out according to the manufacturer's instructions, so that the persons who are to enter the boat in an emergency are trained to;
  - ➢ embark the boat;
  - ➢ take their seats in a correct way;
  - ➢ use the safety belts; and
  - ➢ being instructed on how to act during launching into the sea.

- When the lifeboat is free-fall launched as part of a drill, this should be carried out with the minimum personnel required to manoeuvre the boat in the water and to recover it. The recovery operation should be carried out with special attention, bearing in mind the high-risk level of this operation. Where permitted, simulated launching should be carried out in accordance with the manufacturer's instructions, taking due note of the Guidelines for simulated launching of free-fall lifeboats.

Simulated launching

Simulated launching is the procedure for demonstrating the operation of free-fall lifeboats without the physical activation of the free-fall release system.

Simulated launching should only be carried out with lifeboats and launching appliances designed to accommodate it, and for which the manufacturer has provided instructions. The procedure of simulated launching depends upon the lifeboat manufacturer but, in general simulated launching sequence includes the following:

[63] MSC.1/Circ.1578, IMO

a) Check equipment and documentation and make sure everything is in good working order.
b) Ensure that all personnel involved in the drill are familiar with the operating manuals, posters and signs.
c) Ensure that the restraining device(s) (The system of restraints should allow movement of the lifeboat along the launching ramp for a sufficient distance to prove freedom of movement without disengaging from the ramp) provided by the manufacturer for simulated launching are installed and secure and that the free-fall release mechanism is fully and correctly engaged.
d) Establish and maintain good communication between the assigned operating crew and the responsible person.
e) Disengage lashings, gripes, etc. installed to secure the lifeboat for sea or for maintenance, except those required for simulated free-fall.
f) Participating crew board the lifeboat and fasten their seatbelts under the supervision of the responsible person.
g) All crew disembark the lifeboat.
h) Return the lifeboat to the condition it was in prior to step provided in paragraph (d).
i) Ensure that the lifeboat is returned to its normal stowed condition. Remove any restraining and/or recovery devices used only for the simulated launch procedure.

Lifeboats lowered by means of falls

a) During drills, everyone participating should be alert for potentially dangerous conditions or situations and should bring them to the attention of the responsible person for appropriate action. Feedback and recommendations to the shipowner, the Administration and the system manufacturer are important elements of the marine safety system.

b) When drills are to be performed with persons on board the lifeboat, it is recommended that the boat be lowered and recovered without any persons on board first to ascertain that the arrangement functions correctly. In this case, the boat should then be lowered into the water with only the number of persons on board necessary to operate the boat.

c) To prevent lashings or gripes from getting entangled, proper release should be checked before swinging out the davit.

6) Fire drills

- Refer the former drill records and select a different place each time. Example – galley fire, engine room fire, cargo hold fire, accommodation fire etc.
- Watertight doors shall not be closed remotely, since there is a possibility of persons inside un-noticed.

- If there are fire doors with remote release devices, as far as possible, make a public announcement before releasing the doors.
- Instead of using smoke to generate reduced visibility environment inside the compartment, consider of using darken visors with the head protection of the fireman's outfit.

In addition to above, fire drills should be planned in such a way that due consideration is given to regular practice in the various emergencies that may occur depending on the type of ships and the cargo. Each fire drill shall include[64]:

- reporting to stations and preparing for the duties described in the muster list required;
- 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;
- checking 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; and
- checking the necessary arrangements for subsequent abandoning of the ship.

The equipment used during drills shall immediately be brought back to its fully operational condition and any faults and defects discovered during the drills shall be remedied as soon as possible.

7) Enclosed space entry and rescue drill

- Never hoist stretcher with people in it, use a weight having a weight similar to a person.
- The SOLAS states that each enclosed space entry and recue drill to include:
  - ➢ checking and use of personal protective equipment required for entry;
  - ➢ checking and use of communication equipment and procedures;
  - ➢ checking and use of instruments for measuring the atmosphere in enclosed spaces;
  - ➢ checking and use of rescue equipment and procedures;
  - ➢ instructions in first aid and resuscitation techniques;
  - ➢ providing instructions to crew with regards to the risks associated with enclosed spaces and onboard procedures for safe entry into such spaces.

[64] Resolution MSC.47(66), IMO

HEALTH SAFETY ON BOARD

The chief officer must be well aware of the general safety practices and safety procedures onboard his/her ship. The following safety precautions, practices and procedures were obtained from the relevant sections of reputed documents such as COSWP, MGN (MCA), MSN (MCA) etc. The chief officer must refer the company SMS and flag state regulations to learn about company specific safety precautions, practices and procedures. Remember, some companies and flag states may have higher regulations than mentioned below.

1) Legionella bacteria

Most dangerous waterborne bacteria affecting humans are ingested in drinking water, however Legionella bacteria can gain entry to the respiratory system from water suspended in air in the form of a fine mist such as created by showers or tap sprays.

Legionnaires' disease is a type of pneumonia that is caused by Legionella, a bacterium found primarily in warm water environments. Legionnaires' disease develops within 2 to 10 days after exposure to legionellae. Initial symptoms may include loss of energy, headache, nausea, aching muscles, high fever (often exceeding 104°F), and chest pains. Later, many bodily systems as well as the mind may be affected. The disease eventually will cause death if the body's high fever and antibodies cannot defeat it. Victims who survive may suffer permanent physical or mental impairment.

Precautions to avoid the formation of Legionella bacteria include:

- Hoses used for taking fresh water should be,
  - suitably marked and used only for handling fresh water
  - stow in contamination free places after draining completely and keep the both ends closed.
  - flush the hose thoroughly before taking fresh water**.**
  - Recommended to charge the hoses for a period of 1 hour with a chlorine solution of 50 ppm at least every 6 months.

- When producing fresh water,
  - the inlet (on the hull) for the freshwater generator should be clear of all other inlets and discharge positions. Generally, it is forward and on the opposite side to the discharge positions.
  - Recommended to take sea water when at least 20 nm away from land.

- Fresh water tanks,
  - Chlorinate the tanks to a concentration of 0.2 ppm (refer the ship master's medical guide for further information).

- Freshwater tanks should be coated with cement wash or compatible paints.
- Recommended to do a pressure test of all freshwater tank boundaries at least every 5 years.
- Recommended to inspect the tanks every 12 months and clean them. The cleaning should be done with fresh water having a chlorine concentration of 50 ppm.
- Recommended to super chlorinated at a concentration of 50 ppm for a period of not less than 4 hours after each dry docking. Then empty it completely and refill it with a chlorine concentration of 0.2 ppm.
- Recommended to empty the tanks completely and refill at least 6 months intervals.
- Those who are working in freshwater tanks must wear clean clothes and must not have any skin infection or communicable disorder.

- Distribution systems,
  - Recommended to charge the whole delivery system with super chlorinated (50 ppm) fresh water for a period of 12 hours at each dry docking.
  - Shower heads and their flexible pipes where fitted, should be routinely thoroughly cleaned in a 50 ppm chlorine solution every three months.

2) **Working in ship's galleys, pantries and other food handling areas**[65] [You are also encourage to refer MLC 2006 for further details]

a) Refrigeration chambers

- Doors to be fitted with a device strong enough to hold them open in a seaway;
- Doors to be fitted with a means of opening them from the inside;
- Rooms should have a means of sounding the alarm both from inside and outside;
- The exit area from the chamber should have a slip-resistant surface;
- If found any leaking of refrigerants or suspected, no body shall enter the chamber and a warning sign to be posted with regards to this effect;
- If the chamber is padlocked, the person entering the chamber shall keep the padlock with him; and
- People who are entering the chamber shall be trained in above, they shall be familiar with the alarm bells and door opening systems from inside.

b) Preparation of food

- When meat is being chopped:
  - the chopping block should be firm;

[65] Accident prevention onboard ship at sea and in port, ILO

- ➢ the cutting area of the meat should be well on the block;
- ➢ make sure the fingers, arms and legs are clear of the line of strike;
- ➢ protective gloves shall be worn; and
- ➢ a protective apron should be worn.

- When foodstuffs are being chopped or cut with a knife, fingers should be bent inwards towards the palm of the hand with the thumb overlapped by the forefinger.
- All cuts (injuries), skin exposures to heat or concentrated cleaning liquids however small, should be reported immediately and treated for infection.
- Above cuts should be covered by a waterproof dressing when food is being handled.
- Care should be taken never to leave pans with fat unattended in an oven or on a heating stove, nor to allow water to come into contact with hot fat.
- All seafarers working in the galley should be trained in the use of appropriate fire-fighting equipment, including the use of a smothering blanket and appropriate type of fire extinguisher.
- Seafarers working in catering operations should wear clean clothing, particularly when handling food and preparing meals, and should wash hands and clean fingernails before handling food and after using the toilet.
- Particularly when purchased in a hot climate, vegetables to be used in salads should always be thoroughly washed in clean running fresh water before being served. Fruits should preferably be washed and peeled before being eaten.
- Seafarers should not be permitted to handle food or cooking utensils, etc., when suffering from dysentery, diarrhoea or stomach disorders of an infectious nature.
- They should report any such complaints, spots or rashes to a competent officer onboard.
- All accommodation areas and particularly places where food is stored or prepared should be inspected regularly to ensure cleanliness and freedom from insects, mice and rats.
- Cracked or chipped crockery and glassware should be discarded.
- Any food which has been in contact with broken glass or crockery should be thrown out.
- Smoking should be prohibited in kitchens, galleys, pantries, storerooms or other places where food is stored, handled or prepared and notices to this effect should be displayed.
- Concentrated cleaning liquids to be used only for the intended use recommended by the manufacturer and protective gloves to be worn.

c) Work in galleys, pantries and serving food

- Cleaned cloths to be worn.
- Suitable protective footwear of a type that fully covers the foot, with slip resistant soles, should be worn at all times.

- Decks should be mopped clear and surplus water removed after washing.
- Any defects in equipment or utensils should be reported to the responsible officer, who should arrange for their repair or replacement as soon as possible.
- The defective item should be taken out of service.
- The users should be trained and properly instructed:
  - in the use of any mechanical or electrical equipment which they may be required to use or operate; and
  - in the dangers of cutting instruments and slicing, mincing and chopping machines.

- Sharp knives, saws and choppers should be safely stowed in a proper rack and they should not be left lying around or in washing-up water.

3) General duties and responsibilities of the shipboard safety and health committee, safety officer and safety representatives[66]

a) Shipboard safety and health committee

- A safety and health committee should assist in the implementation of the shipowner's safety and health policy and programme and provide seafarers with a forum to influence safety and health matters.
- The safety and health committee should as a minimum consist of officers and ratings who should be appointed or elected as appropriate, bearing in mind the importance of balanced representation by shipboard departments and functions.
- All members of the safety and health committee should be given adequate information on safety and health matters.
- The duties and responsibilities of the safety and health committee include but are not limited to:
  - ensuring that the competent authority's and the shipowner's safety and health requirements are complied with;
  - making representations and recommendations on behalf of the crew through the master to the shipowner;
  - discussing and taking appropriate action in respect of any safety and health matters affecting the crew and the evaluation of adequate protective and safety equipment, including lifesaving equipment; and
  - studying accident reports.

- A record should be kept of all committee meetings and copies be posted for viewing by the entire crew as also be sent to the designated person as responsible for ship safety.

[66] ILO, MLC and ITF guidance about the health and safety on board ships

- Committee members should not be subject to dismissal or other prejudicial measures for carrying out functions assigned to this role.
- The safety and health committee should be consulted during the planning or alteration of shipboard work processes which may affect safety and health.
- The safety and health committee should have access to information on hazards or potential hazards on board which are known to the shipowner and master. The committee members should have access to the International Maritime Dangerous Goods Code and other relevant IMO publications.
- Committee members should be given reasonable time within working hours to exercise their safety functions, including attendance at safety and health committee meetings.

b) Safety officer (refer Code of Safe Working Practices for Merchant Seafarers, MCA for further details)

- The safety officer should implement the shipowner's safety and health policy and programme and carry out the instructions of the master to:
  - improve the crew's safety awareness;
  - investigate any safety complaints brought to his or her attention and report the same to the safety and health committee and to the individuals, where necessary;
  - investigate accidents and make the appropriate recommendations to prevent the recurrence of such accidents;
  - carry out safety and health inspections; and
  - monitor and carry out the on-board safety training of seafarers.

- The safety officer should seek the cooperation of the safety and health committee and the safety representative(s) and others in carrying out his duties.
- Appointment of Safety Officers:
  - On every sea-going ship on which more than five workers are employed, the Company should be required to appoint a safety officer.
  - The safety officer is the safety adviser aboard the ship and can provide valuable assistance to the Company and to seafarers in meeting the statutory responsibilities for health and safety. He should have attended a suitable Safety Officer's training course and should be familiar with the principles and practice of risk assessment.
  - The appointment of the master as the safety officer is not generally advisable. If possible, the Company should also avoid appointing as safety officer anyone to whom the master has delegated the task of giving medical treatment. This is because one of the duties of the safety officer is to investigate incidents, and he would not be able to give proper attention to this function while providing medical treatment for any casualties.

c) **Safety representatives** (refer COSWP for further details)

- The safety representative(s) should represent the crew on matters affecting their safety and health.
- The shipowner should make appropriate arrangements for the election of safety representatives and shall not have the rights to disqualify any particular seafarer.
- The number of safety representatives who should be elected will vary according to the number of the crew on board. The following ratios are recommended:
  - If, 6 – 15 crew - 1 elected by officers and ratings together;
  - If 16 or more crew - 1 elected by the officers and one by ratings
  - If more than 30 - 1 elected by the officers and 3 by the ratings (on cruise ships in addition appropriate number of representatives of the hotel catering crew should be elected)

- In carrying out the role of safety representative, access to information, assistance and advice should be provided by the safety committee, the shipowner and seafarers' organization.
- The safety representative(s):
  - should be elected or appointed by, in consultation with the seafarer's organization, from the crew and should participate in meetings of the safety and health committee;
  - should be allowed sufficient time off their main shipboard duties without loss of pay to enable them to fulfil their functions of receive training.
  - should not be subject to dismissal or other prejudicial measures for carrying out functions assigned to this role.

- The safety representative(s) should:
  - have access to all parts of the ship;
  - participate in the investigation of accidents and near-accidents;
  - have access to all the necessary documentation, including investigation reports;
  - have unrestricted rights to communicate directly with the relevant competent authorities and seafarer's organizations; and
  - receive appropriate training.

4) Work at height[67]

Anyone working in a location where there is a risk of falling may be regarded as working at height. This includes undertaking work inside a tank, near an opening such as a hatch, or on a fixed stairway.

[67] Code of Safe Working Practices for Merchant Seafarers

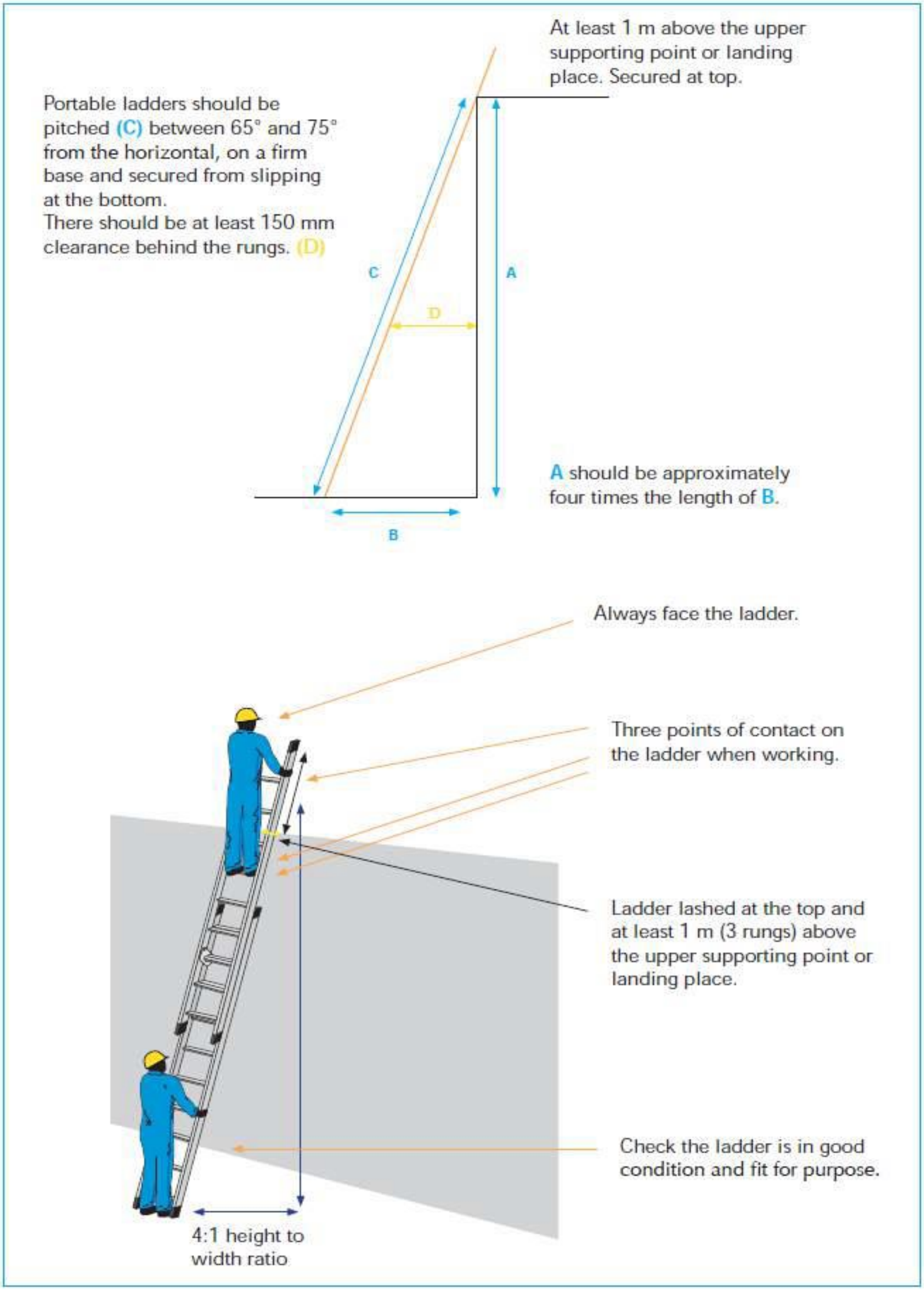
a) Work at height should be subject to risk assessment, and suitable control measures should be taken to protect those who may be put at risk. Depending on the severity of the risk, a permit to work may be required (e.g. for working aloft).
b) Only competent persons should engage in any activity relating to work at height, or use of equipment for work at height.
c) Where a seafarer is being trained to undertake such work, they must be supervised by another seafarer who is competent to supervise and undertake that activity.
d) Personnel under 18 years of age, or with less than 12 months' experience at sea, should not work aloft unless it forms part of their planned training, and unless they are accompanied by a competent person or otherwise adequately supervised.
e) A stage, ladder, scaffolding, bosun's chair or scaffold tower should be used when work is to be done beyond normal reach. Any equipment being used should be in a good state of repair.
f) Personnel working aloft should wear a safety harness with a lifeline or other arresting device at all times. A safety net should be rigged where necessary and appropriate. Additionally, where work is done over side, a working lifejacket (personal flotation device) or buoyancy garments should be worn and a lifebuoy with sufficient line attached should be kept ready for immediate use. Personnel should be under observation from a person on deck.
g) When a stage is rigged over side, the two gantlines used in its rigging should be at least long enough to trail into the water to provide additional lifelines should a person fall. A lifebuoy and line should be kept ready nearby.
h) Other than in emergency situations, personnel should not work over side whilst the vessel is under way. If such work has to be undertaken, lifeboats or rescue boats should be ready for immediate use. Any such work should be closely monitored/watched by a responsible person.
i) Before undertaking work near the ship's whistle, the officer responsible should ensure that it is isolated and that warning notices are posted on the bridge and in the machinery spaces.
j) Before undertaking work on the funnel, the officer responsible should inform the duty engineer to ensure that steps are taken to reduce as far as practicable the emission of steam, harmful gases and fumes.
k) Before undertaking work in the vicinity of radio aerials, the officer responsible should inform the radio room or person in charge of radio equipment so that no transmissions are made whilst there is a risk to personnel. A warning notice should be placed on the communications equipment or the equipment isolated.
l) Where work is to be done near the radar scanner, the officer responsible should inform the officer on watch so that the radar and scanner are isolated. A warning notice should be put on the radar equipment until the necessary work has been completed.
m) Work aloft should not be carried out in the vicinity of cargo working unless it is absolutely essential. Care must always be taken to avoid risks to anyone working or moving below. Suitable barriers should be erected, and warning notices displayed.

n) Tools and stores should be sent up and lowered by line in suitable containers, which should be secured in place for stowage of tools or materials not presently being used.
o) Tools should be secured by a lanyard, e.g. to the seafarer's wrist or harness, when in use no tools should be carried in pockets from which they may easily fall.

5) Use of portable ladders[68]

a) Working from ladders should be avoided as far as possible but, where necessary, personnel must use a safety harness with a lifeline secured above the work position, where practicable.
b) A portable ladder should only be used where no safer means of access is reasonably practicable. It is very important that the ladder is checked regularly by a competent person.
c) Portable ladders should be pitched between 60° and 75° from the horizontal, on a firm base, properly secured against slipping or shifting sideways and be so placed as to afford a clearance of at least 150 mm behind the rungs. Where practicable, the ladder should extend to at least 1 m above any upper landing place, unless there are other suitable handholds. Refer the illustration below.
d) Personnel negotiating a ladder should use both hands, and not attempt to carry tools or equipment in their hands. When working, three points of contact with the ladder should be maintained (both feet and a handhold).
e) Planks should not be supported on rungs of ladders to be used as staging, nor should ladders be used horizontally for such purposes.

[68] Code of Safe Working Practices for Merchant Seafarers


At least 1 m above the upper supporting point or landing place. Secured at top.
Portable ladders should be pitched (C) between 65° and 75° from the horizontal, on a firm base and secured from slipping at the bottom.
There should be at least 150 mm clearance behind the rungs. (D)
C
D
A
B
A should be approximately four times the length of B.
Always face the ladder.
Three points of contact on the ladder when working.
Ladder lashed at the top and at least 1 m (3 rungs) above the upper supporting point or landing place.
Check the ladder is in good condition and fit for purpose.
4:1 height to width ratio

6) Cradles, stages and bosun's chairs[69]

a) Cradles should be at least 430 mm (17 inches) wide and fitted with guardrails or stanchions with taut ropes to a height of 1 m (39 inches) from the floor. Toe-boards add safety.
b) Wooden components of staging should be stowed in a dry, ventilated space and not subjected to heat.
c) Ancillary equipment, lizards, blocks and gantlines should be thoroughly examined before use.
d) When used with a gantline, the chair should be secured to it with a double-sheet bend and the end seized to the standing part with adequate tail.
e) Hooks should not be used to secure bosun's chairs unless they are of the type, because of their special construction, cannot be accidentally dislodged, and have marked safe working load that is adequate for the purpose.
f) When a bosun's chair is to be used for riding topping lifts or stays, it is essential that the bow of the shackle, and not the pin, rides on the wire. The pin in any case should be seized.
g) When it is necessary to haul a person aloft in a bosun's chair, it should be done only by hand; a winch should not be used.

7) Biological agents[70]

a) Biological agents are classified in groups 1 to 4 as mentioned below:

Group 1	Unlikely to cause human disease.
Group 2	Can cause human disease and may be a hazard to employees; it is unlikely to spread to the community and there is usually effective prophylaxis or treatment available.
Group 3	Can cause severe human disease and may be a serious hazard to employees; it may spread to the community, but there is usually effective prophylaxis or treatment available.
Group 4	Causes severe human disease and is a serious hazard to employees; it is likely to spread to the community and there is usually no effective prophylaxis or treatment available.

b) Any worker involved with the handling of, or being exposed to, biological agents should be given appropriate training and advice.
c) Before any work is carried out, a risk assessment should be carried out and procedures put in place for any potential accident to minimise its effects.

---

[69] Code of Safe Working Practices for Merchant Seafarers
[70] ibid

d) The most likely areas for contamination by biological agents are from the following:
   - food preparation;
   - contact with animals and/or products of animal origin;
   - health care;
   - work with air-conditioning and water-supply systems; and
   - work involving waste disposal and the sewage plant.

8) Guarding of openings[71]

a) Guardrails or fencing should consist of an upper rail at a height of 1 m and an intermediate rail at a height of 0.5 m. The rails may consist of taut wire or taut chain.

[71] Code of Safe Working Practices for Merchant Seafarers

POLLUTION PREVENTION

1) MARPOL

a) **Annex – I** (Regulations for the prevention of pollution by oil)

- **Application**

  These regulations are applied on oil tankers of 150 GT or more and other vessels of 400 GT or more.

- **List of special areas**

  - Mediterranean Sea
  - Baltic Sea
  - Black Sea
  - Red Sea
  - Gulf areas
  - Gulf of Aden
  - Antarctic area
  - NW European Waters
  - Oman area of the Arabian Sea
  - Southern South African waters

- **Cargo pump room bilges may be pumped out under following conditions, but, except in Arctic waters:**

  - Not in special area
  - More than 50 nm from nearest land
  - En route
  - Instantaneous rate of discharge of oil does not exceed 30 litres per nm
  - Total quantity of the particular cargo of which the residue formed a part shall not exceed
    - 1/15000 (ships delivered on or before 31 Dec 1979
    - 1/30000 (ships delivered after 31 Dec 1979)

  - Equipped with Oil Discharge Monitoring and Control System (ODMCS) and a slop tank arrangement

- **Machinery space bilges may be pumped out in outside special areas under the following conditions (except in Arctic waters):**

  - En route

- Processed through an oil filtering equipment
- Oil content without dilution does not exceed 15 ppm
- Not originated from cargo pump room bilges on oil tankers
- Not mixed with oil cargo residues on tankers

- **Machinery space bilges may be pumped out within the special areas under the following conditions:**

  - En route
  - Processed through an oil filtering equipment which has an alarm & auto stopping device if exceeds 15 ppm
  - Oil content without dilution does not exceed 15 ppm
  - Not originated from pump room bilges on oil tankers
  - Not mixed with oil cargo residues on tankers
  - *ANY DISCHARGE OF OIL OR OILY MIXTURES INTO THE SEA OF ANTARCTIC AREA FROM ANY SHIP SHALL BE PROHIBITED.*

- **For ships of less than 400 GT in all areas except the Antarctic area and Arctic waters**

  - En route
  - Approved filtering equipment by the Administration to ensure the oil content of the effluent without dilution does not exceed 15 ppm
  - Not originated from pump room bilges on oil tankers
  - Not mixed with oil cargo residues on tankers

- **Use or carriage of oils in the Antarctic area**

  Carriage as bulk cargo, use as ballast, or carriage and use as fuel of the following is prohibited except in the case of vessels engage in securing the safety of ships or in a search and rescue operation:
  - Crude oils having a density at 15^0 C higher than 900 kg/m^3;
  - Oils, other than crude oils, having a density at 15^0 C higher than 900 kg/m^3or a kinematic viscosity at 50^0 C higher than 180 mm^2/s; or
  - Bitumen, tar and their emulsions.

  If above types of oils were carried in the previous voyage, the cleaning or flushing of tanks or pipelines is not required.

- **Regulations concerning STS operations**

  STS regulations will not be applied for the following;
  - for bunkering operations;

- when vessels are engaged with securing the safety of a vessel or saving life or pollution prevention operations; and
- if either of the ships involved is a warship or a vessel used for non-commercial service by a government.

Vessels engage in STS operations at sea shall comply with the following requirements:

These regulations are applicable to oil tankers of 150 GT & above engage in the transfer of oil cargo between oil tankers at sea:

- shall have an approved STS operation Plan onboard and shall comply with the plan;
- STS operations Plan may be incorporated into the SMS;
- The person in overall advisory control of STS operations shall be qualified to perform all relevant duties;
- Records of STS operations shall be retained onboard for three years; and
- Shall be readily available for inspection by a state party to the Convention.

Notifications by vessels expecting to carryout STS operations

Both oil tankers expecting carryout STS operations within the territorial sea, or the EEZ of a Party to the present Convention are required to inform the coastal state 48 hrs before starting the STS operation with the following data.

In an exceptional case, if all the below data cannot be provided 48 hrs before the STS operation, the discharging tanker shall notify the coastal state, 48 hrs before the operation that an STS operation will occur and the below information shall be provided to the coastal state at the earliest opportunity. The information to be reported includes:

- Name, flag, call sign, IMO Number and estimated time of arrival;
- Date, time and position of the location of the STS operation;
- Whether the STS operations are to be conducted while underway or at anchor;
- Type of oil and quantity;
- Planned duration of the STS operation;
- Identification of STS operations service provider or person in overall advisory control and contact information; and
- Confirmation that the oil tanker has on board approved STS operations Plan.

If the ETA of an oil tanker changes by more than 06 hours, the master, owner or agent of that tanker shall provide a revised ETA to the coastal state.

b) Annex – II (Regulations for the control of pollution by noxious liquid substances in bulk)

- **Application**

  Applies to all the vessels certified to carry noxious liquid substances in bulk.

- **List of special areas**

  - Antarctic area

- **Discharge regulations for Category – X cargoes:**

  - Pre-washed
    Once pre-washed, residues shall be discharged to a reception facility until the concentration is 0.1% or below by weight. Then continue to discharge until the tank is empty. Any water introduced after that can be discharged under following conditions;
  - En route at least at 7 knots
  - Discharge below water line not exceeding the maximum rate for which the underwater discharge outlet is designed
  - At least 12 nm from the nearest land
  - In depths of not less than 25 m
  - Refer the discharging procedure manual for further details

- **Discharge regulations for Category – Y and Z cargoes:**

  - Pre-washed
    If unloading is not carried out according to the Manual (discharge procedure manual), a pre-wash shall be carried out and any water introduced after that can be discharged under following conditions;
  - En route at least at 7 knots
  - Discharge below water line not exceeding the maximum rate for which the underwater discharge outlet is designed
  - At least 12 nm from the nearest land
  - In depths of not less than 25 m
  - Refer the discharging procedure manual for further details

- **Exemption for pre-wash**

  No ships are allowed to sail from the port of discharge, unless one of the following situations:
  - Unloaded tank is to be loaded with same cargo without washing/ballasting, or

- The tank is not to be washed/ballasted at sea. It is to be prewashed in another port provided that it is confirmed in writing that a reception facility is available at that port, or
- The residues will be removed by ventilation.

c) **Annex – III** (Regulations for the prevention of pollution by harmful substances carried by sea in packaged form)

- Designates no "special areas" and contains no provisions relating to discharges or disposal at sea.
- Harmful substances are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code). Need to comply with the requirements of the IMDG Code.
- IMDG Code applies to all ships carrying harmful substances carried by sea in packaged form
- The requirements of this Annex do not apply to ship's stores and equipment.

d) **Annex – IV** (Regulations for the prevention of pollution by sewage from ships)

- **Application**

  Applies to following ships engage in international waters:
  - New ships (refer the Annex VI for the definition of new ship) of 400 GT & above; and
  - New ships of less than 400 GT which are certified to carry more than 15 persons; and
  - Existing ships of 400 GT and above, five years after the date of entry into force of Annex VI; and
  - Existing ships of less than 400 GT which are certified to carry more than 15 persons, five years after the date of entry into force of Annex IV.
  - Passenger ship is a ship carrying more than 12 passengers
  - New passenger ship means
    - Building contract is placed, or the keel of which is laid on or after 1 June 2019; or
    - Delivery of which is on or after 1 June 2021

- **List of special areas**

  - Baltic sea

- **Discharge regulations**

Type of ships	Inside special area	Out side special area
New passenger ship	Prohibited[1] from 1st June 2019	1) comminuted and disinfected sewage (approved by Administration) 3' from land 2) not comminuted or disinfected 12' away from land 3) Sewage in holding tanks or sewage from living animals, shall not be discharged instantaneously 4) *en route at least at* 4 knts 5) rate of discharge to be approved by the Administration based upon IMO standards **OR** The ship has an approved sewage treatment plant which has been certified by the Administration & the effluent shall not produce visible floating solids or discoloration of the water.
Existing passenger ship	Prohibited[1] from 1st June 2021 or 1st June 2023 as provided by Resolution MEPC.275(69)	Same as above
Other vessels	Same as outside special areas	Same as above

[1] Except when the ship has in operation an approved sewage treatment plant which has been certified by the Administration to meet the operational requirements, and the effluent shall not produce visible floating solids nor cause discoloration of the surrounding water.

e) Annex – V[72]

- **List of special areas**

  - Mediterranean Sea
  - Baltic Sea
  - Black Sea
  - Red Sea
  - "Gulfs" area
  - North Sea

[72] Resolutions MEPC 201(62) & MEPC 219(63) and Resolution MEPC.277(70), IMO

- ➢ Antarctic area (south of latitude 60 degrees south)
- ➢ Wider Caribbean region including the Gulf of Mexico and the Caribbean Sea

- **Definitions**

  Dishwater means the residue from the manual or automatic washing of dishes and cooking utensils which have been pre-cleaned to the extent that any food particles adhering to them would not normally interfere with the operation of automatic dishwashers.

  Grey water means drainage from dishwater, shower, laundry, bath and washbasin drains. It does not include drainage from toilets, urinals, hospitals, and animal spaces, as defined in regulation 1.3 of MARPOL Annex IV (sewage), and it does not include drainage from cargo spaces. Grey water is not considered garbage in the context of Annex V.

  Garbage means all kinds of **food wastes**, **domestic wastes** and **operational wastes**, all **plastics**, **cargo residues**, **incinerator ashes**, **cooking oil**, **fishing gear**, and **animal carcasses** generated during the normal operation of the ship and liable to be disposed of continuously or periodically except those substances which are defined or listed in other Annexes to the present Convention. Garbage does not include fresh fish and parts thereof generated as a result of fishing activities undertaken during the voyage, or as a result of aquaculture activities which involve the transport of fish including shellfish for placement in the aquaculture facility and the transport of harvested fish including shellfish from such facilities to shore for processing.

- **Categorization of garbage**

  According to revised MARPOL Annex V shipboard generated garbage is to be grouped into the following categories:

  A) Plastics – Garbage that consists of or includes plastic in any form, including synthetic ropes, synthetic fishing nets, plastic garbage bags and incinerator ashes from plastic products.

  B) Food wastes – Spoiled or unspoiled food substances and includes fruits, vegetables, dairy products, poultry, meat products and food scraps generated aboard ship.

  C) Domestic Wastes – Garbage generated mainly in the accommodation spaces on board the ship (e.g. drinking bottles, papers, cardboard etc). Domestic wastes does **not include grey water**.

D) **Cooking Oil** – Edible oil or animal fat used for the preparation or cooking of food, but does not include the food itself that is prepared using these oils.

E) **Incinerator ashes** – Ash and clinkers resulting from shipboard incinerators used for the incineration of garbage.

F) **Operational wastes** – Solid wastes (including slurries) that are collected on board during normal maintenance or operations of a ship, or used for cargo stowage and handling. Operational wastes also includes cleaning agents and additives contained in cargo hold and external wash water that may be harmful to the aquatic environment. Operational wastes does not include grey water, bilge water, or other similar discharges essential to the operation of a ship.

Examples of operational wastes:

Following are considered as operational wastes and therefore categorized as garbage

- Ash and clinkers from shipboard incinerators and coal-burning boilers
- cleaning agents and additives contained in hold washwater, and deck and external surface washwater

Following are not considered as operational wastes and not considered as garbage:

- grey water,
- bilge water
- boiler/economizer blowdown;
- boat engine wet exhaust;
- chain locker effluent;
- controllable pitch propeller and thruster hydraulic fluid and other oil to sea interfaces (e.g. thruster bearings, stabilizers, rudder bearings, etc.);
- distillation/reverse osmosis brine;
- elevator pit effluent;
- firemain systems water;
- freshwater layup;
- gas turbine washwater;
- motor gasoline and compensating discharge;
- machinery wastewater;
- pool, spa water and recreational waters;
- sonar dome discharge; and
- welldeck discharges.

G) **Animal Carcasses** – Bodies of any animals that are carried on board as cargo and that die or are euthanized during the voyage.

H) **Fishing Gear** – Physical device that may be placed on or in the water or on the sea-bed with the intended purpose of capturing marine or fresh water organisms.

I) **E-Waste** – Any electronic equipment, including its components, sub-assemblies and consumables, when disposed of as a waste (e.g. electronic cards, gadgets, instruments, equipment, computers, printer cartridges, etc.)

J) Cargo residues not harmful for the marine environment (non-HME)

K) Cargo residues harmful for the marine environment (HME)

Solid bulk cargoes, other than grain, shall be declared by the shipper as to whether or not they are harmful to the marine environment.

- **Summary of garbage disposal at sea**

Type of garbage	Ships outside special areas	Ships within special areas
Food waste comminuted or ground (25 mm or less)	≥ 3 nm from the nearest land, en route[3]	≥12 nm from the nearest land or ice shelf, en route[3]. **Antarctic** area **avian** products are **not permitted** except when **sterile.**
Food waste not comminuted or ground	≥12 nm from the nearest land, en route[3]	**Discharge prohibited**
Cargo residues[1] not contained in wash water	≥12 nm from the nearest land, en route	**Discharge prohibited**
Cargo residues[1] contained in wash water	≥12 nm from the nearest land or the nearest ice shelf, en route	≥12 nm from the nearest land or the nearest ice shelf, en route & subject to 2 additional conditions[2]
Cargo residues harmful to the marine environment	Discharge prohibited	Discharge prohibited
Cleaning agents and additives[1] contained in cargo hold wash water	Discharge permitted	≥12 nm from the nearest land, en route & subject to 2 additional conditions[2]
Cleaning agents and additives[1] in deck and external surfaces wash water	Discharge permitted	Discharge permitted
Carcasses of animals carried on board as cargo and which died during the voyage	Discharge permitted while en route, as far as possible	Discharge prohibited
All other garbage including plastics, synthetic ropes, fishing gear, plastic garbage bags, incinerator ashes, clinkers, cooking oil, floating dunnage, lining and packing materials, paper, rags, glass, metal, bottles, crockery, e-waste and similar refuse	Discharge prohibited	Discharge prohibited
Mixed garbage	When garbage is mixed with or contaminated by other substances prohibited from discharge or having different discharge requirements, the more stringent requirements shall apply	

[1] These substances must not be harmful to the marine environment.

[2] Discharge shall only be allowed if:

a) both the port of departure and the next port of destination **are within the special area and the ship will not transit outside the special area between these ports** and
b) if **no adequate reception facilities** are available at those ports.

[3] The ***en route*** *requirements shall not apply* where it is clear the retention on board of these food wastes presents an imminent health risk to the people on board.

- **Garbage record book**

The Garbage record book has two Parts and the garbage is categorized for the purpose of recording in Part I & Part II of the Garbage Record Book **OR** in the case of ships of less than 400 GT, ship's official logbook as follows:

Part I

A Plastic
B Food wastes
C Domestic wastes
D Cooking oil
E Incinerator ashes
F Operational wastes
G Animal carcasses
H Fishing gear
I E – waste

Part II

J Cargo residues which are NOT HARMFUL to the marine environment
K Cargo residues which are HARMFUL to the marine environment

Entries in a garbage record book

Occasion	**Date & time of;**	**Name or place by;**	**Categories of cargo**	**Amount (m^3);**	**Signature**	**Remarks**
Delivered to reception facility	Delivery[73]	Name of port or facility or vessel	Yes	For each category	Yes	No
When incinerated	Starting & stopping of incinerator	Lat & Long at starting & stopping incinerator	Yes	For each category	Yes	No
Discharged Accidentally or complying with regulations	Discharge	Lat & Long In case of cargo residues, positions of discharge start & stop	Yes	For each category	Yes	No
Accidental or other exceptional discharges	Occurrence	Port or Lat/Long & water depth (if possible)	Yes	For each category	No	Reasons for discharge/loss Reasonable precautions taken to minimize/prevent & Other remarks

[73] Need to keep evidences or proof of delivery stating the amount of garbage delivered & such receipts must be kept with the garbage record book

Sample of a garbage record book (Part I & Part II)[74]

"RECORD OF GARBAGE DISCHARGES

PART I

For all garbage other than cargo residues as defined in regulation 1.2 (Definitions)

(All ships)

Ship's name	Distinctive number or letters	IMO number

Garbage categories

A-Plastics	B-Food waste	C-Domestic wastes	D-Cooking oil	
E-Incinerator ashes	F-Operational wastes	G-Animal carcasses	H-Fishing gear	I-E-waste

Discharges under MARPOL Annex V regulations 4 (Discharge of garbage outside special areas), 5 (Special requirements for discharge of garbage from fixed or floating platforms) or 6 (Discharge of garbage within special areas) or chapter 5 of part II-A of the Polar Code

Date/ Time	Position of the ship (latitude/longitude) or port if discharged ashore or name of ship if discharged to another ship	Category	Estimated amount discharged		Estimated amount incinerated (m^3)	Remarks: (e.g. start/stop time and position of incineration; general remarks)	Certification/ Signature
			Into sea (m^3)	To reception facilities or to another ship (m^3)			
/ :							

Exceptional discharge or loss of garbage under regulation 7 (Exceptions)

Date/ Time	Port or position of the ship (latitude/ longitude and water depth if known)	Category	Estimated amount lost or discharged (m^3)	Remarks on the reason for the discharge or loss and general remarks (e.g. reasonable precautions taken to prevent or minimize such discharge or accidental loss and general remarks)	Certification/ Signature
/ :					
/ :					

Master's signature:_________________________ Date: ___________________

[74] Resolution MEPC.277(70), IMO

PART II

For all cargo residues as defined in regulation 1.2 (Definitions)

(Ships that carry solid bulk cargoes)

Ship's name	Distinctive number or letters	IMO number

Garbage categories

J- Cargo residues (non-HME)	K- Cargo residues (HME)

Discharges under regulations 4 (Discharge of garbage outside special areas) and 6 (Discharge of garbage within special areas)

Date/ Time	Position of the ship (latitude/ longitude) or port if discharged ashore	Category	Estimated amount discharged		Start and stop positions of the ship for discharges into the sea	Certification/ Signature
			Into sea (m^3)	To reception facilities or to another ship (m^3)		

Master's signature:_______________________ Date: ____________________"

These records are required to be retained onboard for a period of 2 years from the date of last entry.

How to measure distance away from land in disposing Annex I, Annex II, Annex IV & Annex V at sea

MARPOL states that the garbage or other material may be discharged so many miles away "from the nearest land". The term "from the nearest land" means from the **baseline** from which the **territorial sea** of the territory in question is established in accordance with international law except in the case of north-east coasts of Australia which is measured from a line drawn from a point on the coast of Australia as provided in Annex V.

Remember, it says nearest land is measured from the **baseline.** Baselines are calculated by referring to following methodology[75]:

Normal baseline

This is the low-water line along the coast as marked on large-scale charts officially recognized by the coastal State.

[75] http://www.un.org/depts/los/convention_agreements/texts/unclos/part2.htm

Straight baseline

In localities where the coastline is deeply indented and cut into, or if there is a fringe of islands along the coast in its immediate vicinity, the method of straight baselines joining appropriate points may be employed in drawing the baseline.

Mouths of rivers

If a river flows directly into the sea, the baseline shall be a straight line across the mouth of the river between points on the low-water line of its banks.

Bays

If the distance between the low-water marks of the natural entrance points of a bay does not exceed 24 nautical miles, a closing line may be drawn between these two low-water marks, and the waters enclosed thereby shall be considered as internal waters.

Where the distance between the low-water marks of the natural entrance points of a bay exceeds 24 nautical miles, a straight baseline of 24 nautical miles shall be drawn within the bay in such a manner as to enclose the maximum area of water that is possible with a line of that length.

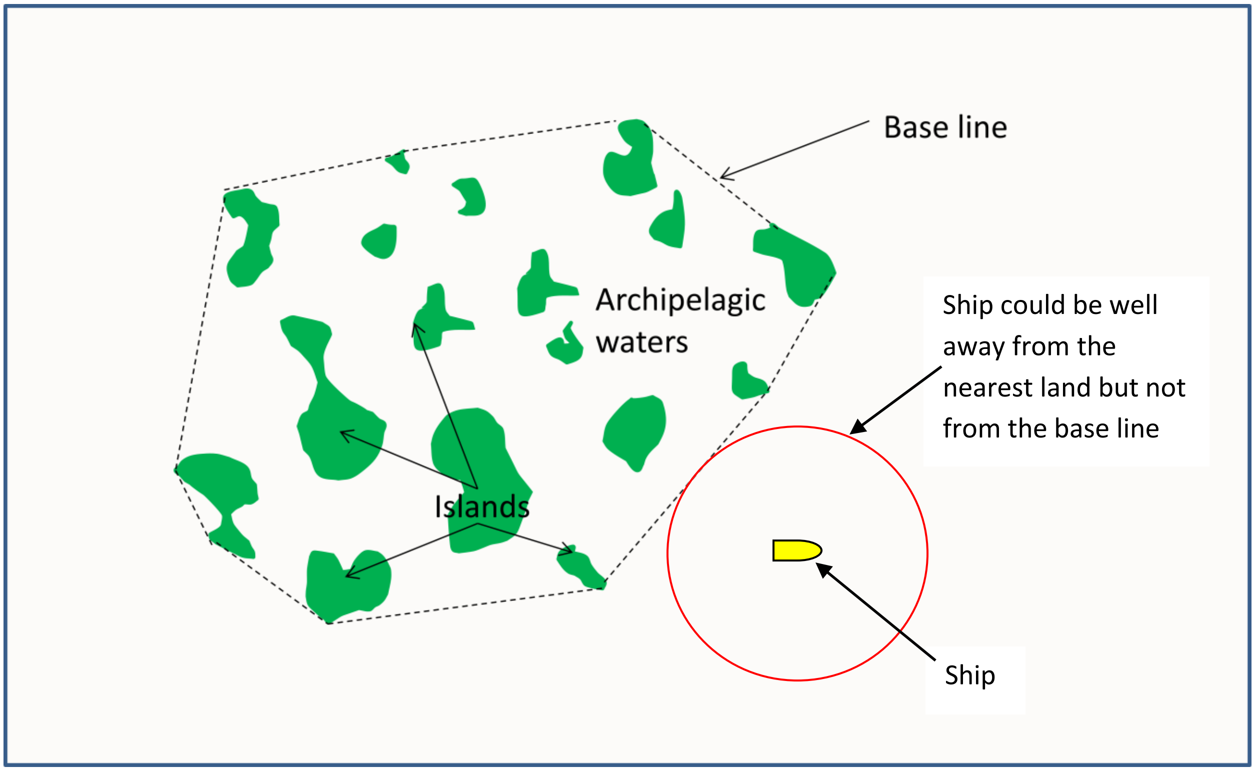
Archipelagic baselines[76]

An archipelagic State may draw straight archipelagic baselines joining the outermost points of the outermost islands and drying reefs of the archipelago provided that within such baselines are included the main islands and an area in which the ratio of the area of the water to the area of the land, including atolls.

Refer the below examples for a better knowledge:

Your vessel is closer (not inside) to an archipelagic water, you may be well away from the charted coast, but may not be away from the "baseline". Because, in case of archipelagic waters, the baseline is measured joining the outermost islands in the archipelagic state. Refer the figure below:

[76] http://www.un.org/depts/los/convention_agreements/texts/unclos/part4.htm



Therefore, in case of measuring the distance off from the nearest land, need to use the baseline instead of the land.

A similar situation may exist if your vessel is close to a bay as well. In case of a bay, a straight base line is drawn joining the low-water marks of the natural entrance points to the bay. Refer the figure below[77]:

77 http://www.gard.no/web/updates/content/20894781/gard-alert-bohai-sea-china-fines-for-discharge-of-pollutants

Bohai Sea is considered as inland waters of China, since the straight base line is drawn between Longkou and Lushun. A vessel may be well away from the land but, not from the baseline. All the distances are to be measured from the 'baseline'.

Identification of baselines is little completed by referring to the nautical charts alone. This can be clarified by referring to the Admiralty Annual Summary of Notices to Mariners Part I.

f) Implementation of garbage management onboard

In most of the companies, the chief officer is the garbage management officer onboard. Therefore, it is your responsibility to implement the garbage management onboard. First of all, you are required to have a good knowledge of the contents of the vessel's garbage management plan and make sure;

- the following documents are onboard:
  - ➢ garbage management plan
  - ➢ garbage record book
  - ➢ company placards
  - ➢ documentary evidences for the garbage delivered ashore
  - ➢ operational manuals of the garbage handling equipment such as incinerators, compactors etc.
  - ➢ type approval certificates of the incinerator.
- company placards and notices are displayed in correct places.

- the chief officer's instructions are clearly given to crew.
- the duties of garbage handling which includes incinerations, disposal properly etc. are delegated in accordance with the garbage management plan and they are properly trained.
- the crew is given appropriate training in reduction, re-cycling, segregation, storage of garbage.
- the garbage bins are colour coded as per the plan.
- the segregation and the storage are done in accordance with the garbage management plan.
- the navigating officers are having a good knowledge of the special areas and the areas where the garbage can be disposed at sea.
- proper record keeping is maintained.

Time to time, randomly check the garbage bins to make sure the segregation is done in accordance with the instructions provided.

g) Annex – VI (Regulations for the prevention of air pollution from ships)

- **List of pollutants**
  - NOx
  - SOx
  - Ozone – depleting substances
  - Volatile Organic Compounds (VOC)
  - Particulate matter
  - CO_2

- **SOx regulations**
  - SOx emissions are a function of the sulphur content of fuel. Reducing sulphur content will also result in lower particulate matter emissions.
  - Sulphur content of any fuel oil used on board ships (outside ECA) shall not exceed **0.5% m/m**
  - Sulphur content of fuel oil used on board ships in Emission Control Area (ECA) does not exceed **0.1% m/m**.
  - Emission Control Areas (ECA) include;
    - Baltic sea
    - North sea
    - North American ECA, includes most of US & Canadian coast
    - US Caribbean ECA, including Puerto Rico and the US Virgin Islands
  - Ships may also meet the SOx requirements by using:

- gas as a fuel or
- an approved equivalent method (example, exhaust gas cleaning systems or “scrubbers”)

- **Regulations on ozone depleting substances**

  - **Deliberate emissions** of ozone depleting substances shall be **prohibited**. Deliberate emissions include emissions occur during maintenance, servicing, repairing or disposing etc.
  - Equipment containing HCFC are prohibited on ships constructed after 01/01/2020.
  - Annex VI does not apply to ozone-depleting substances which contain in **permanently sealed equipment** where there are **no refrigerant charging connections** or **potentially removable components** containing ozone-depleting substances.
  - Each ship with an IAPP certificate shall have a list of equipment containing ozone depleting substances.
  - Each ship having an IAPP certificate which **has a rechargeable system that contains ozone-depleting substances** shall have an ozone-depleting substances record book. Entries in the record book shall be completed without delay on each occasion in respect of the following:
    - **Recharging full or partial**, of equipment containing ozone-depleting substances
    - **Repair or maintenance** of equipment containing ozone-depleting substances
    - **Discharge** of ozone-depleting substances to the **atmosphere** both deliberate and non-deliberate
    - **Discharge** of ozone-depleting substances to land based **reception facilities**
    - **Supply** of ozone-depleting substances **to the ship**

- **VOC regulations**

  - Applies only to tankers
  - Applies only when entering VOC emission-controlled areas
  - If a port is expecting to control VOC emissions, IMO shall be informed 6 months before the expected date of implementation
  - Such ports may accept existing tankers which are not fitted with vapour collection systems for a period of 3 years after the effective date
  - Tankers entering such ports shall have a vapour collection system in operation during loading
  - Every tanker carrying crude oil is required to have on board and implement a **VOC Management Plan**, approved by the Administration.

- **Regulations regarding incineration onboard**

  Following incinerations are prohibited on board;

  - Annex I, II & III cargo residues and related contaminated packing materials;
  - PCB (polychlorinated biphenyls);
  - Garbage containing more than traces of heavy metals;
  - Refined petroleum products containing halogen compounds;
  - Sewage sludge & sludge oil either of which is not generated onboard the ship;
  - Sewage sludge & sludge oil generated during normal operation of a ship may be incinerated in the main or auxiliary power plant or boilers, but shall not take place inside ports, harbours and estuaries;
  - Exhaust gas cleaning system residues; and
  - PVCs (polyvinyl chlorides) shall be prohibited, unless the incinerators is having an IMO type approval certificate

- **Regulations on CO_2 emissions**

  - **EEDI (Energy Efficiency Design Index)**

    - EEDI is a measure of CO_2 emissions per ton per nautical mile. Lower the EEDI, higher the efficiency of the vessel.
    - This is mandatory on new ships of 400 GT or more
    - Actual EEDI of a vessel is called the "**attained EEDI**" and it is calculated by using IMO guidelines
    - The "**required EEDI**" is the EEDI that a vessel to be designed at the time of construction and it is provided by the IMO for various ship types and their tonnages.
    - The "**Attained EEDI**" shall be **below** the "**required EEDI**"
    - A **technical file** shall be maintained;
      - It shall include calculation method of the "attained EEDI"
      - The technical file is subjected to the **verification by the flag state**

    - EEDI may be reduced by various methods such as advanced technologies, alternative fuels, deadweight increase, economical speed etc.

  - **EEOI (Energy Efficiency Operational Indicator)**

    - This is also a measure of CO_2 emissions per ton per nautical mile. Lower the EEOI, higher the efficiency of the vessel.
    - This is voluntary and applicable for all the vessels of 400 GT or more

- This a mechanism to measure energy-efficiency of each voyage
- An evaluation of operational performances will be carried out by owners, operators or charterers depending upon the data provided by the individual ships
- Individual ships will be continuously monitored by the owners / operator to ensure the CO_2 is reduced and the efficiency is increased.
- If any changes are made to a vessel, it will be evaluated again to ensure the efficiency is maintained.

➢ **SEEMP (Ship Energy Efficiency Management Plan)**

SEEMP is **not required to be approved** and it has two parts. The purpose of part I of the SEEMP is to establish a mechanism for a company and/or a ship to improve the energy efficiency of a ship's operation[78] and it is mandatory on ships of 400 GT and above. At the same time, air emissions to the marine environment can be reduced by improving the energy efficiency onboard.

IMO is carrying out a research on the CO_2 emissions from ships of 5,000 GT and above. For the purpose of this research, all the ships are required collect certain data and forward to their flag states. Part II provides the methodologies of collecting such data.

Therefore, Part II is applicable only for the ships of 5,000 GT and above.

Guidance on best practices for fuel efficient operations

IMO Resolution MEPC.282(70) also addresses various methods of fuel-efficient operations as well. Few such methods are listed and described below generally, which are important for a chief officer. Remember, refer the SEEMP onboard for ship specific measures of fuel-efficient operations.

- Optimum trim
  Loaded or unloaded, trim has a significant influence on the resistance of the ship through the water and optimizing trim can deliver significant fuel savings. For any given draft there is a trim condition that gives minimum resistance. Therefore, make sure the vessel is maintaining optimum trim for the draught applicable.

- Optimum ballast
  Ballast should be adjusted taking into consideration the requirements to meet optimum trim and steering conditions and optimum ballast conditions achieved through good cargo planning.

[78] Annex 10, Resolution MEPC.282(70), IMO

- Hull maintenance
  Generally, the smoother the hull, the better the fuel efficiency. Hull resistance can be optimized by new technology-coating systems, possibly in combination with cleaning intervals. Regular in-water inspection of the condition of the hull is recommended.

  Consideration may be given to the possibility of timely full removal and replacement of underwater paint systems to avoid the increased hull roughness caused by repeated spot blasting and repairs over multiple dockings.

- Improved cargo handling
  Now a days, the cargo handling is mainly controlled by the ports, but, if the cargo is handled to obtain the optimum draughts and trim, energy waste due to ballast operations can be eliminated.

Apart from the methods listed above in the said Resolution and requirements of the ship specific SEEMP, as a chief officer you may consider of the following in making the vessel fuel-efficient.

- Training and guidance for junior officers and ratings;
  - To switch off unnecessary lights
  - Avoid unnecessary uses of cargo gears, mooring winches, windless and other deck machinery.
  - When there are delays (as an example – when the cargo operations are ceased for shift change or tea or lunch) switch to standby mode or switch off the relevant machinery provided it is safe to do so.
  - Proper use of auto pilot to reduce unnecessary rudder movements

- If possible, keep the use of deck machinery at a minimum at any given time to avoid starting additional generators.
- Ensure the deck machineries are maintained in accordance with the vessel's PMS which will increase not only the safety but the efficiency as well by reducing resistances or frictions.
- Reduce the use of ballast pumps by ballasting or de-ballasting by gravity provided it is safe to do so.

- **Certification with regards to Annex – VI**

IEEC (International Energy Efficiency Certificate)

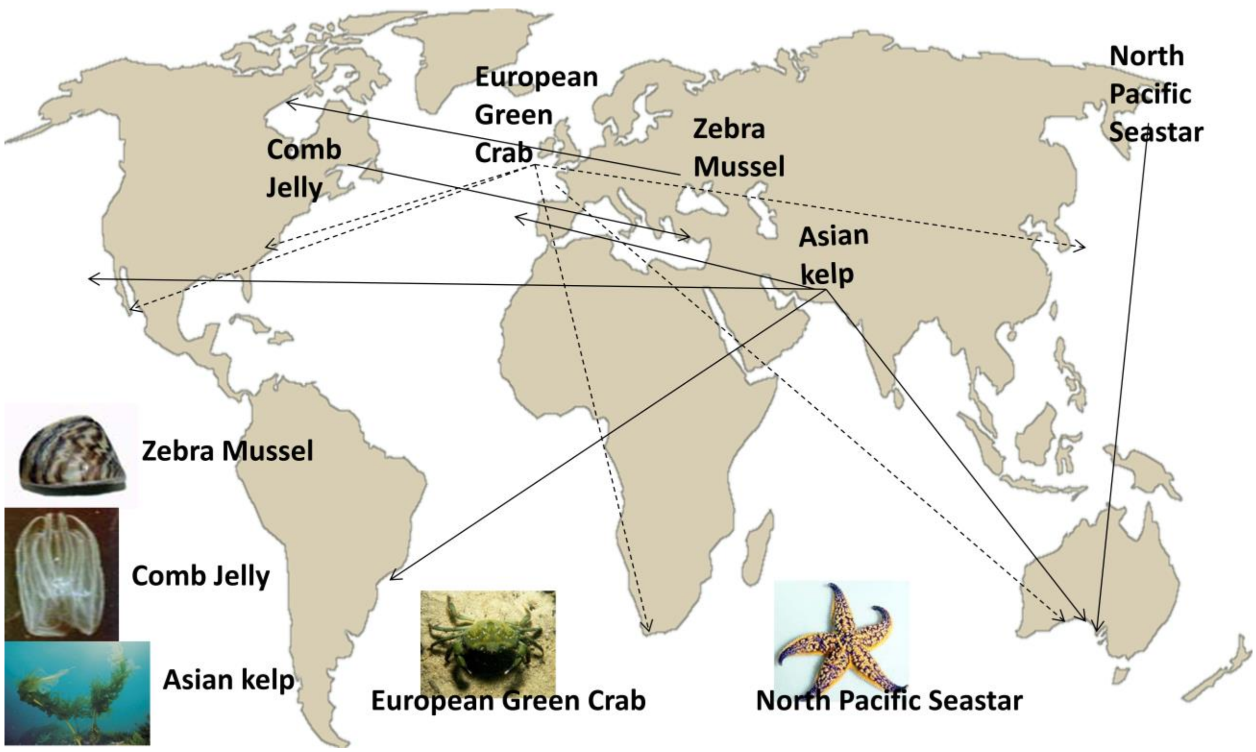
- This is mandatory for all vessels of 400 GT or more

- The certificate is valid for the lifetime of a vessel
- No surveys are required for the purpose of maintain the certificate unless for the issuance of the certificate.
- The "attained EEDI" and the "required EEDI" will be stated on IEEC on new ships
- **New ships -** IEEC is to be issued at the vessel's initial survey provided the EEDI has been verified (for applicable vessels) and the SEEMP is on board.
- **Existing vessels -** IEEC is to be issued on the first intermediate or renewal survey for the IAPP certificate (whichever comes first) on or after 1 January 2013 provided the SEEMP is on board.

2) International convention for the control and management of ships' ballast water and sediments

a) Few common invasive species

The following diagram shows the origins and the invaded areas of few invasive species due to the effect of ships ballast water.



b) Effects of invasive species

- Spreads very fast as there are no predators
- Displaces native species

- Alters local eco systems
- Alters food chains
- Health and safety issues when unknown species eaten by people in invaded areas
- Effects local fish & shellfish stocks
- Financial losses incurred by those who are engage in fishing and related industries
- Expenses incurred in cleaning and removal of invaded species

c) Enforcement and implementation of the convention

- Adopted on 13 February 2004
- Entered into force on 8th September 2017
- Sri Lanka is not a party (as of 10/11/2020)
- Applies to all ships with little exclusion such as war ships, vessels not going out of a party's waters etc.

d) Ballast water controlling methods

- Avoid or reduce taking BW
- Exchange methods
- Treatment methods
- Reception facilities for ballast water & sediments

e) Warning concerning up taking of ballast water

A party may prohibit the uptake of BW if;

- known to contain outbreaks, infestations, or populations of Harmful Aquatic Organisms and Pathogens
- near sewage outfalls
- where tidal flushing is poor or times during which a tidal stream is known to be more turbid.

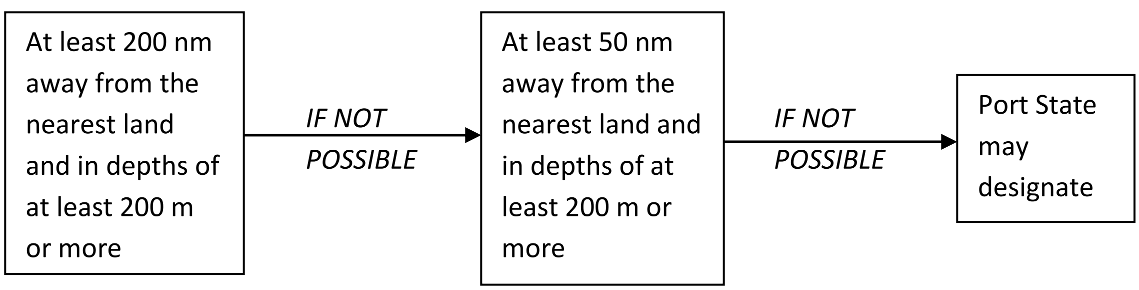
f) Exchange methods (Regulation-D1)

There are three internationally accepted ballast water exchange methods. The applicable exchange methods for the vessel will be given in the ship's ballast water management plan (manual). Any other methods shall not be used to exchange ballast water.

On tankers and bulk carriers, the ballast water management plan (manual) may contain ballast water exchange sequence plans which are to be used while exchanging ballast water. The responsible officer shall adhere to the stated sequence plans to ensure the stresses are within the limits, the vessel maintains sufficient stability and the navigational visibility ranges are maintained. Ballast water convention describes following methods of ballast water exchange:

Methods	Procedures	Remarks
Sequential method	Tank is first emptied and then refilled with replacement ballast water to achieve at least a 95% volumetric exchange	
Flow-through method	Ballast water is pumped into a ballast tank, allowing water to flow through overflow	The flow-through method and the dilution method are considered as "pump through" methods. Pumping through to be continued until three times the volume of the tank is overflown
Dilution method	Ballast water is filled through the top of the ballast tank with simultaneous discharge from the bottom at the same flow rate and maintaining a constant level in the tank throughout the ballast exchange operation	

g) Areas where the ballast water exchange may be carried out



h) Treatment methods

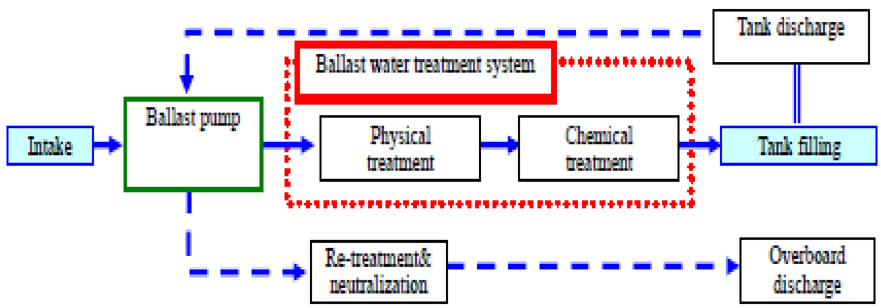
Ballast water treatment equipment may base any one of the bellow mentioned treatment methods or combination of these methods or other methods as approved by the flag administration of the vessel.

- Filtration/Physical Separation
- Chemical Biocides
- Ultraviolet Light
- Heat Treatment
- Ultrasound
- Ozone
- Deoxygenation using nitrogen gas

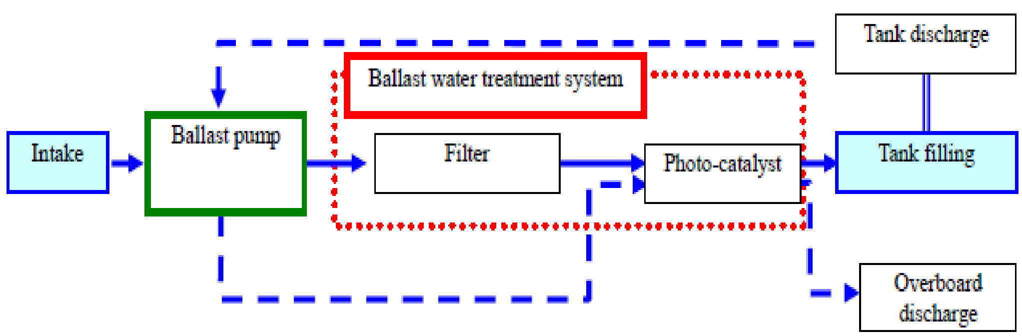
i) Examples of treatment methods used in ballast water treatment plants

Refer the above shown two treatment plants, they are using more than one treatment system when taking ballast water onboard and also again the ballast water is treated while discharging at least by one system to control the species that may be transferable through the ballast water.

- Example one



- Example two



j) Management of sediments contain in ballast water

All ships shall remove and dispose of Sediments from spaces designated to carry Ballast Water in accordance with the provisions of the ship's Ballast Water Management plan.

k) Exemptions granted by Administrations

Administrations are allowed to grant exemptions for certain regulations of the Convention and if so granted, shall be recorded in the ballast water record book.

l) Exceptions from these regulations

Vessels are exempted from complying with these regulations in below cases;

- The uptake or discharge of Ballast Water and Sediments necessary for the purpose of ensuring the safety of a ship in emergency situations or saving life at sea; or

- The accidental discharge or ingress of Ballast Water and Sediments resulting from damage to a ship or its equipment:
  - provided that all reasonable precautions have been taken before and after the occurrence of the damage or discovery of the damage or discharge for the purpose of preventing or minimizing the discharge; and
  - unless the owner, Company or officer in charge wilfully or recklessly caused damage; or

- The uptake and discharge of Ballast Water and Sediments when being used for the purpose of avoiding or minimizing pollution incidents from the ship; or
- The uptake and subsequent discharge on the high seas of the same Ballast Water and Sediments; or
- The discharge of Ballast Water and Sediments from a ship at the same location where the whole of that Ballast Water and those Sediments originated and provided that no mixing with unmanaged Ballast Water and Sediments from other areas has occurred.

m) Documents required relevant to the convention

- With regards to treatment facilities;
  - **Copy of the type Approval certification for treatment plant –** a certificate to be issued by the flag administration or a recognised organisation indicating the compliance with IMO standards.
  - **Operation, maintenance and safety manual**
  - Installation specifications (installation drawings, piping diagrams)
  - Installation commissioning procedures
- **Approved Ballast Water Management Plan (BWMP) -** approved by the flag administration or a recognised organisation (sometimes this is also called as ‘ballast water manual’)
- **Ballast Water Record Book -** in paper format or an electronic format approved by the administration
- **Ballast water reporting form**
- **International Ballast Water Management Certificate (IBWMC)** – every ship over 400 GT will be required to undergo an initial survey and be issued with an International Ballast Water Management Certificate (IBWMC)
- **Document of Compliance** – vessels flying the flag of non-ratified countries are required to have this without the IBWMC

n) Approved Ballast Water Management Plan (BWMP)

An approved BWMP may contain;

- Regulations concerning the handling of ballast water

- Name and the responsibilities of the person who is responsible for ballast water handling
- Methods available for ballast water exchange
- When and where to exchange ballast
- Handling of ballast sediments
- Training of crew
- Format of a ballast water reporting form
- Format of a ballast water handling log (recording form)
- Format for sediment removal log
- General arrangement plan
- Ballast tank arrangement plans
- Ballast line diagrams
- Ballast water sampling points
- Safety precautions and limitations applicable for ballast water handling
- Ballast water exchange sequence plans (applicable for tankers and bulk carriers)

o) Responsibilities of the officer in charge of ballast water handling

- Need to have a good knowledge of:
  - Port state and international regulations concerning the handling of ship's ballast water;
  - ballast water handling procedure;
  - ballast water handling equipment

- He/she shall obtain local regulations which are to be complied with from port authorities or other relevant parties when going to ports
- Decide when and where to undertake ballast water exchanges by consulting the master.
- Ensure to comply with the ship's ballast water management plans when ballasting, de-ballasting and exchanging ballast water.
- Ensure to make available the ballast water reporting form to local authorities when required.
- Provide required assistances to official from local authorities with regards to ballast water handling.
- Maintain ballast water and sedimentation handling records
- Training of crew with regards to handling of ballast water and sediments

p) Ballast water reporting form[79]

Some countries may require the vessels coming into their ports to complete a ballast water reporting form. A general reporting form and the guidelines to complete is provided by the IMO (which is provided below) but, individual countries may have different formats.

[79] Model Ballast Water Management Plan – INTERTANKO

Appendix 1 - **BALLAST WATER REPORTING FORM** (TO BE PROVIDED TO PORT STATE AUTHORITY UPON REQUEST)

1. VESSEL INFORMATION / **2. BALLAST WATER**

Vessel Name:	Type:	IMO Number:	Specify Units: m³, MT, LT, ST
Owner:	GT:	Call Sign:	Total Ballast Water on Board:
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 ON BOARD? YES____ NO____ HAS THIS BEEN IMPLEMENTED? YES____ NO____

TOTAL NO. OF TANKS ON BOARD______ 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)	**BW SOURCE**				**BW EXCHANGE** : circle one: Empty/Refill or Flow Through					**BW DISCHARGE**			
	DATE ddmmyy	PORT or LAT. LONG	VOLUME (units)	TEMP (units)	DATE ddmmyy	ENDPOINT LAT. LONG.	VOLUME (units)	% Exch.	SEA Hgt. (m)	DATE ddmmyy	PORT or LAT. LONG.	VOLUME (units)	SALINITY (units)

Ballast Water Tank Codes: Forepeak=FP, Aftpeak=AP, Double Bottom=DB, Wing=WT, Topside=TS, Cargo Hold=CH, O=Other

IF EXCHANGES WERE NOT CONDUCTED, STATE OTHER CONTROL ACTION(S) TAKEN:____________________

IF NONE, STATE REASON WHY NOT: ____________________

5. IMO BALLAST WATER GUIDELINES ON BOARD (RES. 868(20))? YES____ NO____

RESPONSIBLE OFFICER'S NAME AND TITLE (PRINTED) AND SIGNATURE: ____________________

q) Ballast water handling log

Ships are also needed to keep onboard the records of ballasting, de-ballasting ballast water exchanges etc. Usually, ballast water record books will be provided by the company, but, general format of such a logbook is provided below:

BALLAST WATER HANDLING LOG

Record of ballast water management on board

Ship .... Port of Registry ....…......... IMO number ....

TANK LOCATION	DATE	INITIAL CONTENT (tonnes)	FINAL CONTENT (tonnes)	GEOGRAPHIC LOCATION OF SHIP (Port or Lat. & Long.)	PUMPS USED, or GRAVITATE	DURATION OF OPERATION	SALINITY	SIGNATURE OF OFFICER IN CHARGE	RANK

Source : Model Ballast Water Management Plan – INTERTANKO

BALLAST WATER HANDLING LOG

Narrative record of events related to ballast water management on board

Ship .... Port of Registry .... IMO number ....

Record here events which are relevant to ballast management, and which will be of interest to quarantine officers, such as sediment removal during drydock, or tank flushing at sea. Each entry should be completed with the signature and rank of the officer making the entry.

Date	Activity	Comments

Source : Model Ballast Water Management Plan – INTERTANKO

r) **Surveys required by the convention**

The initial survey will confirm that an approved Ballast Water Management Plan and Ballast Water Record Book are on board, and that the arrangements for ballast water management are as shown in the BWMP. The survey will also verify that the ballast water treatment system is operational. Following surveys are also required:

- An annual survey within +/- 03 months of the Anniversary date
- An intermediate survey within +/- 03 months of the 2nd Anniversary date or within +/- 03 months of the 3rd Anniversary date
- A renewal survey at intervals not exceeding 05 years

The annual, intermediate and renewal surveys are conducted to ensure that:

- there have been no changes to the ballast water management arrangement since the last survey;
- an approved BWMP is on board;
- the ballast water record book has been maintained and has up to date entries;
- the treatment system is in good condition and has been operated and maintained in accordance with the manufacturer's instructions;
- there are sufficient consumables and spares on board as recommended by the manufacturer;

3) Anti-fouling Convention[80]

The compounds contain in antifouling paints slowly "leach" into the sea water, killing barnacles and other marine life that have attached to the ship. But the studies have shown that these compounds persist in the water, killing sea life, harming the environment and possibly entering the food chain. One of the most effective anti-fouling paints, developed in the 1960s, contains the organotin tributylin (TBT), which has been proven to cause deformations in oysters and sex changes in whelks.

Annex I attached to the Convention states that by an effective date of 1 January 2003, all ships shall not apply or re-apply organotin compounds which act as biocides in anti-fouling systems, and by 1 January 2008 (effective date), ships either:

a) shall not bear such compounds on their hulls or external parts or surfaces; or
b) shall bear a coating that forms a barrier to such compounds leaching from the underlying non-compliant anti-fouling systems.

[80] http://www.imo.org/en/OurWork/Environment/Anti-foulingSystems/Pages/Default.aspx

This applies to all ships except:

- fixed and floating platforms,
- floating storage units (FSUs),
- floating production storage and off-loading units (FPSOs) that have been constructed prior to 1 January 2003 and that have not been in dry-dock on or after 1 January 2003.

Ships of above 400 gross tonnage and above engaged in international voyages will be required to undergo an initial survey before the ship is put into service or before the International Anti-fouling System Certificate is issued for the first time; and a survey when the anti-fouling systems are changed or replaced.

Ships of 24 m or more in length but less than 400 gross tonnage engaged in international voyages will have to carry a Declaration on Anti-fouling Systems signed by the owner or authorized agent. The Declaration will have to be accompanied by appropriate documentation such as a paint receipt or contractor invoice.

4) Biofouling

Biofouling means the accumulation of aquatic organisms such as micro-organisms, plants, and animals on surfaces and structures immersed in or exposed to the aquatic environment. Biofouling can include microfouling and macrofouling[81]. Biofouling may also be known as hull fouling. Macrofouling means fouling is visible to naked eye, refer the figure below:

Microfouling is not visible to naked eye, but, still possible for the invasive specifies to transfer from one place to another.

[81] IMO, Resolution MEPC. 207(62), 15 July 2011

Invasive species could be transferred to a new environment through biofouling as well like transferring of invasive species through ship's ballast water.

Through the above resolution, IMO encourages all the ships to have biofouling management plan and a biofouling record book to ensure biofouling is eliminated or reduced from ships.

Biofouling management plan is a ship specific document, **no approvals** required and can be updated when required. It should contain at least;

a) details of the anti-fouling systems used in various areas of the vessel
b) typical operating speeds, trading routes, planned dry docking periods
c) description of hull locations susceptible to biofouling including;
    - schedule of planned inspections,
    - repairs, maintenance and
    - renewal of anti-fouling systems
d) details of the recommended operating conditions suitable for the chosen anti-fouling systems and operational practices (which includes in water cleaning & maintenance procedures, schedule of planned inspections, repairs etc.)
e) details relevant for the safety of the crew,
f) details of the documentation required to verify any treatments recorded in the Biofouling Record Book

The record book should contain details of all inspections and biofouling management measures carried out on the vessel. the record book shall be retained onboard for the entire life of the vessel. it should contain at least;

a) details of the anti-fouling systems and operational practices used (where appropriate as recorded in the Anti-fouling System Certificate), where and when installed, areas of the ship coated, its maintenance and, where applicable, its operation;
b) dates & location of dry-dockings (including the date of re-floated);
c) measures taken to remove biofouling or repair the antifouling system;
d) the date and location of in-water inspections, the results of that inspection and any corrective action taken to deal with observed biofouling;
e) the dates and details of inspection and maintenance of internal seawater cooling systems, the results of these inspections, and any corrective action taken to deal with observed biofouling and any reported blockages; and
f) details of when the ship has been operating outside its normal operating profile including any details of when the ship was laid-up or inactive for extended periods of time.

Such management practices can also improve a ship's hydrodynamic performance, as hull fouling leads to significant increases in ship resistance, which in turn has a severe impact both on fuel costs and on emissions of air pollutants and greenhouse gases. Therefore, biofouling management can be an effective tool in enhancing energy efficiency and reducing air emissions from ships[82].

Ship maintenance procedures to eliminate biofouling

a) Ship owners to select proper anti fouling system depending upon the planned periods of dry docking, ship speed, trade route etc.
b) When installing, or repairing anti-fouling systems make sure proper surface preparation is done, especially in niche areas (area that are more suspectable for bio fouling) such as sea chests, bow / stern thruster areas, edges & weld joints etc.
c) During dry docking;
    - ensure that areas under blocks are painted with anti-fouling, at least at alternate dry-dockings;
    - Inspections & proper maintenance of bow / stern thruster areas to be done;
    - Recesses within rudder hinges and behind stabilizer fins need to be carefully and effectively cleaned and re-coated;
    - If anodes are flush-fitted to the hull, a rubber backing pad should be inserted between the anode and the hull or the gap should be caulked.

d) Periodical in water inspections, cleaning and maintenance recommended.

[82] http://www.imo.org/en/OurWork/Environment/Biofouling/Pages/default.aspx

ISM Code

ISM Code was implemented to avoid ship losses, injuries, damages & pollutions due to human error. The closest reason for implementing the ISM Code was the loss of RO-RO vessel Herald of Free Enterprise. After a ISM audit onboard, an auditors may give their recommendations as 'Observations' or 'Non-conformities' or 'Major non-conformities'. Therefore, chief officers are required to have a good idea about the meaning of observation, non-conformity and major non-conformity, they are explained below with the actions to be taken if they are raised.

a) Observation

Observation is a statement or fact made during a safety management audit and substantiated by objective evidence.

In practice, an observation is not as severe or vital as a non-conformity and it does not require immediate actions. More specifically, an observation is an item for improvement so as not to result in a non-conformity[83].

b) Non-conformity

This is an observed situation where objective evidence indicates NON-FULFILMENT of specified requirement of the ISM code or the company SMS or situation of failure which resulted or could result in an accident or hazardous occurrence or failure to meet the SMS standards.

Actions to be taken when NCR are received

- Inform relevant parties
- It has to be closed within the time frame given to close it by the auditor or maximum within three months.
- Look into other areas where similar NC may be available
- Carryout a root cause analysis
- Take appropriate corrective action for the prevention of reoccurrence

No specific onboard audits required, as evidence once it is rectified, but, it will be checked during the next audit.

The actions to be taken when a NCR is received is also provided in the ship's SMS, therefore, refer your ship's SMS for further details.

[83] https://safety4sea.com/cm-ism-code-how-to-handle-non-conformities/

An NCR may consist of the following:

- NC found with the date (completed by auditor)
- Evidences for those NC (completed by auditor)
- References to the ISM Code for those NC (completed by auditor)
- Date to complete NC (completed by auditor)
- Report of the root cause analysis (completed by master)
- Auditor's recommendation for corrective action (completed by auditor)
- Corrective actions taken (completed by master)
- Confirmation of corrective actions taken with date (completed by master)

A DOC or SMC may be issued, endorsed or renewed before all identified non-conformities have been closed out provided that a schedule has been agreed between the Company and the auditor(s) for the implementation of the necessary corrective actions.

Additional audit(s) may be necessary to confirm the validity of a DOC and/or SMC depending on the nature of any non-conformities identified. The Company is responsible for applying for any follow-up audit required by the auditor.

c) Major non-conformity

Major NC means identifiable deviation which create a serious threat to safety of the people or ship or serious risk to the environment & required immediate corrective action.

Eg; Expired certificates
Un-qualified seafarers working onboard

Need to rectify it or down grade to a NCR before sailing. No ships are allowed to sail with a major NC. Onboard verification is required once it is rectified it.

d) Chief officer's duties in implementing the ISM Code onboard

Master is responsible to implement ISM Code onboard in accordance with the ISM Code. But, in accordance with the chief officer's 'job description' provided in the SMS, the chief officer also has to play certain parts in implementing ISM Code onboard. Chief officer shall ensure that;

- Chief officer shall be well aware of the SMS requirements;

- Ensure all the deck officers and ratings are well aware of their duties and responsibilities in accordance with the ship's SMS;
- Make sure the placards, posters and notices are posted in accordance with the SMS;
- company policies are understood by crew & officers;
- Ensure the muster lists are prepared;
- Make sure that all are well aware of their duties in emergencies;
- Make sure to implement risk assessment onboard;
- Proper training is given to all the staff onboard on the safe operation of LSA & FFA;
- One fire drill and an abandon ship drill are conducted within 24 hrs after leaving the 1st port, in case of a new ship;
- Deck filling system is arranged in accordance with the SMS;
- The safety checklists and the safe procedures described in the SMS are compatible with the actual jobs to be done;
- Watch schedules are posted, and work and rest hour are complied with;
- Safety, security and pollution prevention trainings are given;
- Relevant records are maintained; and
- In case of a new ship, as the vessel is having an Interim Safety Management Certificate, need to prepare the vessel for an audit within three months to get a full term ISM Certificate

e) How to assist the master in the periodical reviewing of the SMS onboard

Master is required to review the SMS periodically to ensure the objectives of the ISM Code are achieved. The company to be notified, if any deficiencies are found along with proposals to rectify the matters and recommendations to improve the system. The chief officer can assist the master with his periodical review by addressing the below, but, in fact, a chief officer is responsible to give suggestions to improve the SMS. Remember, the important and urgent matters to be rectified as soon as possible, rather than waiting till the periodical review.

- With regards to training onboard (in fact, the urgent areas to be addressed as soon as possible and rectified);
  - Efficiency and sufficiency of training;
  - New trainings to be added;
  - Adequacy of posters, CD's, videos and computer-based training programmes; and
  - Problems involved with cadet training programme of the company.

- Adequacy of risk matrix and any suggestions to improve the risk management system onboard.
- Raise any practical problems encountered with safety checklists and procedures provided in the SMS.

- The efficiency and the problems encountered with the PMS.
- Any unidentified potential ship hazards associated with the deck operations to be addressed.
- Sufficiency of available manpower onboard.
- Adequacy of pollution prevention measures.
- Comments on food and freshwater safety plans.
- Anything to be addressed in hand over procedures.
- Finally, the chief officer can propose any changes with respect to the ship's SMS to the master.

ISPS Code

The ISPS Code was implemented due to the attack on the Twin Towers, USA in the month of September 2009. The Code implemented by incorporating it in to SOLAS chapter XI part 2 and it is applicable to all ships of 500 GT or more engage on international voyages. The Code states that the applicable vessels to have SSO onboard. Some companies have appointed the chief officer as the SSO, some companies have appointed the master as SSO and some companies have appointed the chief engineer as the SSO. The SSO is responsible for the following:

- To carryout regular security related inspections and checks on board the vessel.
- Maintenance and updating of security measures and SSP (Ship Security Plan).
- Co-ordination between the ship and ports.
- Proposing modifications to SSP.
- Co-ordination between the ship and the company security officer.
- Reporting of security related incidents.
- Training of onboard personnel.
- Maintenance of security equipment.

The SSO shall ensure that the following documents which are related to ISPS Code are maintained:

- Records of training and drills.
- Records of security threats and incidents.
- Records of breaches of security.
- Records of changes of security levels.
- Reports of communications related to security.
- Reports of audits and reviews of security activities.
- Records of periodical reviews of ship security assessment and ship security plan.
- Records of implementation of amendments to the plan.
- Records of maintenance, testing and calibration of security equipment.

a) Declaration of Security (DoS)

This is s document completed to ensure both the parties (ship/port or ship/ship interfaces) are following their security plans to reach the objectives of the ISPS Code. Refer the below sample of a DoS to see the contents of a DoS.

Form of a Declaration of Security between a ship and a port facility[8]

DECLARATION OF SECURITY

Name of Ship:	
Port of Registry:	
IMO Number:	
Name of Port Facility:	

This Declaration of Security is valid from ……………………. until ……………………… for the following activities

………………………………………………………………………

(list the activities with relevant details)

under the following security levels

Security level(s) for the ship:	
Security level(s) for the port facility:	

The port facility and ship agree to the following security measures and responsibilities to ensure compliance with the requirements of Part A of the International Code for the Security of Ships and of Port Facilities.

	The affixing of the initials of the SSO or PFSO under these columns indicates that the activity will be done, in accordance with relevant approved plan, by	
Activity	The port facility:	The ship:
Ensuring the performance of all security duties		
Monitoring restricted areas to ensure that only authorized personnel have access		
Controlling access to the port facility		
Controlling access to the ship		
Monitoring of the port facility, including berthing areas and areas surrounding the ship		
Monitoring of the ship, including berthing areas and areas surrounding the ship		
Handling of cargo		
Delivery of ship's stores		

[8] This form of Declaration of Security is for use between a ship and a port facility. If the Declaration of Security is to cover two ships this model should be appropriately modified.

Handling unaccompanied baggage		
Controlling the embarkation of persons and their effects		
Ensuring that security communication is readily available between the ship and port facility		

The signatories to this agreement certify that security measures and arrangements for both the port facility and the ship during the specified activities meet the provisions of chapter XI-2 and Part A of Code that will be implemented in accordance with the provisions already stipulated in their approved plan or the specific arrangements agreed to and set out in the attached annex.

Date at ....on the..

Signed for and on behalf of	
the port facility:	the ship:
(Signature of Port Facility Security Officer)	*(Signature of Master or Ship Security Officer)*

Name and title of person who signed	
Name:	Name:
Title :	Title :

Contact Details *(to be completed as appropriate)* *(indicate the telephone numbers or the radio channels or frequencies to be used)*	
for the port facility:	for the ship:
Port Facility	Master
Port Facility Security Officer	Ship Security Officer
	Company
	Company Security Officer

DoS must be completed when,

- a vessel has a security level higher than a port.
- a port requires it as per their security plan.
- a port facility security officer requires depending upon the occasion.
- a ship requires it as per their security plan.
- an Administration requires (may not be required as per the plan).

When vessels are entering into ports, most of the contracting port states require the previous port's DoS. Therefore, even though the above mentioned conditions are not met, it is advisable to complete a DoS in each and every port.

If there are any changes to the relevant security levels as mentioned on DoS, a new DoS must be completed, or the existing DoS to be revised.

b) Can a vessel maintain a different security level than a port?

A vessel can maintain a higher security level than a port. In such cases, a DoS must be completed. A vessel cannot maintain a lower security level than a port. In such cases, the vessel has to increase the security level up to the security level of that port.

When the ship's security level is lower than the arrival port's security level

- SSO has to report the matter to the CSO and take necessary actions to increase the security level up to the level maintained in the port.
- Inform the flag state, if the flag state regulations require to inform the same to them.
- Inform all the ship staff that the security level is increased.
- Refer the SSP and take necessary actions to comply with the new security level (such as new watch schedules, closing of entry restricted areas, restrictions on entering people onboard etc.).

c) Access to the SSP

Section 9.8.1 of the ISPS Code states "If the officers duly authorized by a Contracting Government have clear grounds to believe that the ship is not in compliance with the requirements of chapter XI-2 or part A of this Code, and the only means to verify or rectify the non-compliance is to review the relevant requirements of the ship security plan, limited access to the specific sections of the plan relating to the noncompliance is exceptionally allowed, but only with the consent of the Contracting Government of, or the master of, the ship concerned. Nevertheless, the provisions in the plan relating to section 9.4 subsections

.2, .4, .5, .7, .15, .17 and .18 of this Part of the Code are considered as confidential information, and cannot be subject to inspection unless otherwise agreed by the Contracting Governments concerned".

Section 9.4 of the ISPS Code contains following:

9.4 Such a plan shall be developed**,** taking into account the guidance given in part B of this Code and shall be written in the working language or languages of the ship. If the language or languages used is not English, French or Spanish, a translation into one of these languages shall be included. The plan shall address, at least, the following:

.1 measures designed to prevent weapons, dangerous substances and devices intended for use against persons, ships or ports and the carriage of which is not authorized from being taken on board the ship;

.2 identification of the restricted areas and measures for the prevention of unauthorized access to them;

.3 measures for the prevention of unauthorized access to the ship;

.4 procedures for responding to security threats or breaches of security, including provisions for maintaining critical operations of the ship or ship/port interface;

.5 procedures for responding to any security instructions Contracting Governments may give at security level 3;

.6 procedures for evacuation in case of security threats or breaches of security;

.7 duties of shipboard personnel assigned security responsibilities and of other shipboard personnel on security aspects;

.8 procedures for auditing the security activities;

.9 procedures for training, drills and exercises associated with the plan;

.10 procedures for interfacing with port facility security activities;

.11 procedures for the periodic review of the plan and for updating;

.12 procedures for reporting security incidents;

.13 identification of the ship security officer;

.14 identification of the company security officer including 24-hour contact details;

.15 procedures to ensure the inspection, testing, calibration, and maintenance of any security equipment provided on board;

.16 frequency for testing or calibration of any security equipment provided on board;

.17 identification of the locations where the ship security alert system activation points are provided; and

.18 procedures, instructions and guidance on the use of the ship security alert system, including the testing, activation, deactivation and resetting and to limit false alerts[84].

Following note was obtained from a vessel's SSP for your further knowledge:

IMPORTANT NOTES:

01)

The Ship Security Plan is not subject to detailed inspection (other than confirming its existence on the ship) by duly authorised officials of a Port State unless there are "clear grounds" to believe that the ship is not in compliance with the requirements of SOLAS or the ISPS Code. The only means to verify or rectify the non-compliance is to review the relevant requirements of the Ship Security Plan. In such a case, limited access to the plan relating to the non-compliance is exceptionally allowed, but only with the consent of the Flag State, or the Master. **Any such request or demand must be immediately be reported by the ship to the Company Security Officer for guidance and reference to the Flag State before any details are revealed to Non-Flag State officials**.

02)

English is the official working language in all departments

d) Continuous synopsis record

After a collision or any other incident, if the ship owner wants to hide from the legal problems, he can change the flag state of the vessel very easily. If he changes the flag few times continuously, vessel may not be traceable at all.

Similarly, substandard ship owners very often change flag to hide from legal actions for not complying with international Conventions & Codes.

To avoid this, a “Continuous Synopsis Record” must be carried on board as per SOLAS chapter XI – 1/5.3. This applies to ships of 500 GT and above engage on international voyages. This is a record issued by the Administration. When the registration is changed, a new record will be issued by the new flag state. The following data are included in the record:

- IMO number
- CSR number
- Date and the port of the existing record.
- Name of the owners.
- Name of the charterers (if bare boat chartered).
- Name of the operators/managers.
- Name of the classification society.
- Names of issuing authorities of the following certificates,
  - DOC
  - SMC
  - ISSC

MISCELLANIOUS AREAS

1) Taking over duties as chief officer

a) As you walk on the pier to join the vessel, have a general inspection of the ship's hull, draught marks etc.
b) While walking on the gangway, see the general condition of the gangway; see whether the life buoy, fire plan, shore leave board, security logbook etc. are available.
c) See whether the gangway watchman is available with safety gear and he is following the security related duties.
d) While walking in alleyway see the general condition of the interior of the vessel.
e) Hand over the documents to the master.
f) Meet the outgoing chief officer and take the following information from him.
    - Present loading condition, loading/discharging plans, ballast/deballasting plans, cargo securing plans, DG declarations, shipper's documents related to present cargo and other cargo information.
    - Draught restrictions in the passage, if any.
    - Calculated departure draughts, trim and GM.
    - Special requirements on cargo segregation, stowage, trimming and lashing at present.
    - Special requirements related to present passage and cargo.
    - Information about stores, fresh water etc. expecting from this port.
    - Information about the next port and the cargo details, if available.
    - Master's special orders regarding cargo work.
    - Charterers requirements regarding cargo & cargo handling.
    - Pending work which are related to statutory surveys and information related to surveys expected.
    - Urgent equipment, spare parts, materials etc. ordered.
    - Urgent equipment, spare parts, materials etc. yet to be ordered.
    - Information about pending NCRs.
    - Information related to pending work according to the PMS.
    - Information about company SMS, manuals & roles/responsibilities of chief officer including the duties during emergency situations (if you are new to the company).
    - The arrangement of the chief officer's files and records.
    - The arrangement of the watch schedule of officers and crew.
    - An idea about the navigational equipment.
    - Any special defects or areas need special consideration related to cargo work, navigation, deck maintenance, windlass, mooring winches, provision crane, gangways, stability calculating equipment etc. (eg – malfunctioning of equipment, lack of securing materials etc).
    - On tankers, the incoming chief officer must be familiar with the COW operation. Therefore, the incoming chief officer must carry out at least one COW with the

outgoing chief officer. This is not required if you are on rotational basis on the same vessel.

- Familiarization with the operation of cargo handling pumps, valves controlling panel on tankers.
- Keys of the stores and the lockers under the custody of the chief officer.
- Positions of manuals, plans, publications, stability books, lashing manuals, list of inventories etc. which are under the chief officer's custody.
- Familiarization with the stability computer.
- Familiarization with the operation of ballasting / de-ballasting panels.
- Familiarization with the company record keeping systems, document management system on the computer.
- Amounts of fresh water available and production rates (if applicable).
- General over view of the staff.
- Finally, the handing over notes.

g) If the chief officer is also the SSO onboard:
- Position of the SSP and locker's key.
- Position of the ship security alarm activating point.
- list of inventories of security related equipment

h) If the chief officer is also the Safety Officer Onboard:
- Immediate actions to be taken in accordance with the safety committee minutes
- Safety officer's duties in accordance with the company SMS.
- Documents to be maintained by the Safety Officer.

i) Ensure to follow the safety familiarization practices as required by the SMS.
j) Ensure the handing over is carried out as per the company instructions.

2) Joining a brand-new ship as a chief officer

If you are familiar with the company, you will be already familiar with the company policies, roles/responsibilities of a chief officer. The new amendments and changes for the SMS can be obtained from the master and the company superintendent, as the superintendent will be onboard during this time period.

If it is a new company, chief officer's roles/responsibilities can be obtained from the company manuals. If required any clarification, the master and the superintendent can be consulted. Remember, in most of the standard companies, if you are joining for the first time as a chief officer, you will be briefed on the company regulations before joining the vessel.

Usually, in most of the standard companies, the staff will be briefed by the manning agents or by the mother company. Masters are mostly briefed by the mother company. Therefore, the master can be consulted to clarify any problem related to the chief officer's duties.

When joining a brand new ship, the dock yard personal will provide training on the operation of the:

- Windless and mooring equipment
- Cargo handling gears such as cranes and derricks
- Hatch opening closing
- Stability software
- Ballasting / de-ballasting operations
- Cargo handling gears such as pump operations, valve operations, COW systems on tankers
- Inert gas systems on tankers
- Lifeboat lowering
- Life raft lowering (in case of rigid life rafts)
- Fire/smoke detectors
- Fixed fire fighting systems
- Ship's ramps and bow visors
- Critical navigational equipment
- Emergency generators
- Emergency steering systems

Therefore, you and the master has a responsibility to have a thorough knowledge of all these operations and also you have to ensure that the junior officers and also the crew members are well familiar with all the safety systems and the areas in accordance with their job descriptions.

Make sure the safety familiarization is provided to the officers and the crew in accordance with the SMS.

Make sure to assign safety duties to the appropriate personal and the muster lists are completed and readily available.

Make sure to conduct one abandon ship drill and one fire drill before departure or within 24 hrs after departure.

You are also required to help the master;

- in implementing the ISM Code
- in implementing MLC 2006
- to organize safety committee and appoint safety representatives onboard

Filing and documentation system must be in accordance with the company SMS.

Placards and notices to be posted in accordance with the company SMS.

You are required to implement the garbage management and the ballast water management systems onboard.

3) The factors to be considered when preparing working arrangements as a mate

- Ship's SMS defines the duties and responsibilities of each person onboard. The chief officer must make sure the duties are assigned according to the requirements of the SMS unless in an emergency.
- Make sure to comply with Work & rest hours unless in an emergency.
- Number of people required for a particular job
- Prioritization of the jobs (important jobs to be finished first)
- Experience and competency of the staff to be utilised
- Risks involve & methods of mitigating the risks.
- Consider about the age of the seafarers. According to MLC 2006, certain work cannot be delegated to people below 18 years of age.
- Prevailing weather condition.
- Availability of equipment. Sometimes you may have to borrow equipment or support from the engine room. In that case, discuss with the 2nd engineer and find when such equipment will be available and accordingly need to plan your work.
- Time available for a job and the time required to complete the work. If the vessel is expecting to berth within another 2 hrs there is no point of starting non urgent work which needs 4 hrs to complete.
- It is not advisable to do painting and chipping work on the accommodation block in the morning as there will be staff who are sleeping after their duty.
- Under normal circumstances, the first priority shall be given to training and drills. Therefore, time shall be saved to do training and drills.
- Master's orders and instructions.

4) BIMMS agreement

BIMMS stands for Bangladesh, India, Maldives, Myanmar and Sri Lanka. This is an agreement between these countries which facilitates non-compliance of international regulations (with reference to certification and training requirements) when sailing between these ports for ships registered under these flags.

The holders of the unlimited COCs and the near coastal voyage (NCV) COCs issued by the said Administration are eligible to sail between these countries.

5) MOU (Memorandum of Understanding) with regards to PSC inspections and their objectives

PSC inspections of foreign ships in national ports are encourage by IMO to verify that the conditions of the ship and its equipment comply with the requirements of international regulations and that the ship is manned and operated in compliance with these rules.

If these inspections in a region can be closely co-ordinated, following can be ensured,

- Many ships can be inspected
- Unnecessary inspection of the same ship can be avoided.
- Delays can be avoided.
- Monitoring of substandard ships
- Sharing of details of ship's information, between countries in that region can be done.
- Easy access to the other PSC details around the world.

MOU are arranged to co-ordinate this PSC inspections. The objectives of MOU are to harmonize and co-ordinate of PSC activities and to develop practical recommendations which can be forwarded to IMO for further examinations.

Parties to the MOUs can detain vessels if they are not complying with the international requirements provided that the party who is carrying out the inspection has implemented those international requirements in that country. As an example, the Sri Lankan Administration cannot inspect vessels coming to Sri Lankan ports for the compliance of Ballast water management Convention since Sri Lanka is not a party to the said convention.

If the ship's flag state has not implemented a convention, according to that flag state's regulations, their ships are not required to comply with that convention, but, if the port state has implemented that convention, the port state can inspect the vessels coming into their port for the compliance of that convention. Therefore, the ship owners are required to take actions to comply with that convention through Recognized Organizations (RO). In short this is internationally known as 'no more favourable treatments' (just because the flag state has not ratified, does not mean that the ship owners can run substandard ships. When a vessel is going to a foreign port, the ship has to comply with the regulations implemented in the port state).

As an example, if the vessel's flag state has not ratified MARPOL Annex – VI and if the vessel is expecting to visit ports which have ratified the said Annex, the vessel owner is required to take necessary certificates from the vessel's class and need to carry required documents onboard. Otherwise, she could be detained in those countries.

There are few MOU existing at present in the various parts of the world. These MOU include:

- Paris MOU
- Mediterranean MOU
- Tokyo MOU
- Caribbean MOU
- Abuja MOU (West & Central Africa)
- Riyadh MOU (Gulf)
- Latin American MOU
- Black sea MOU

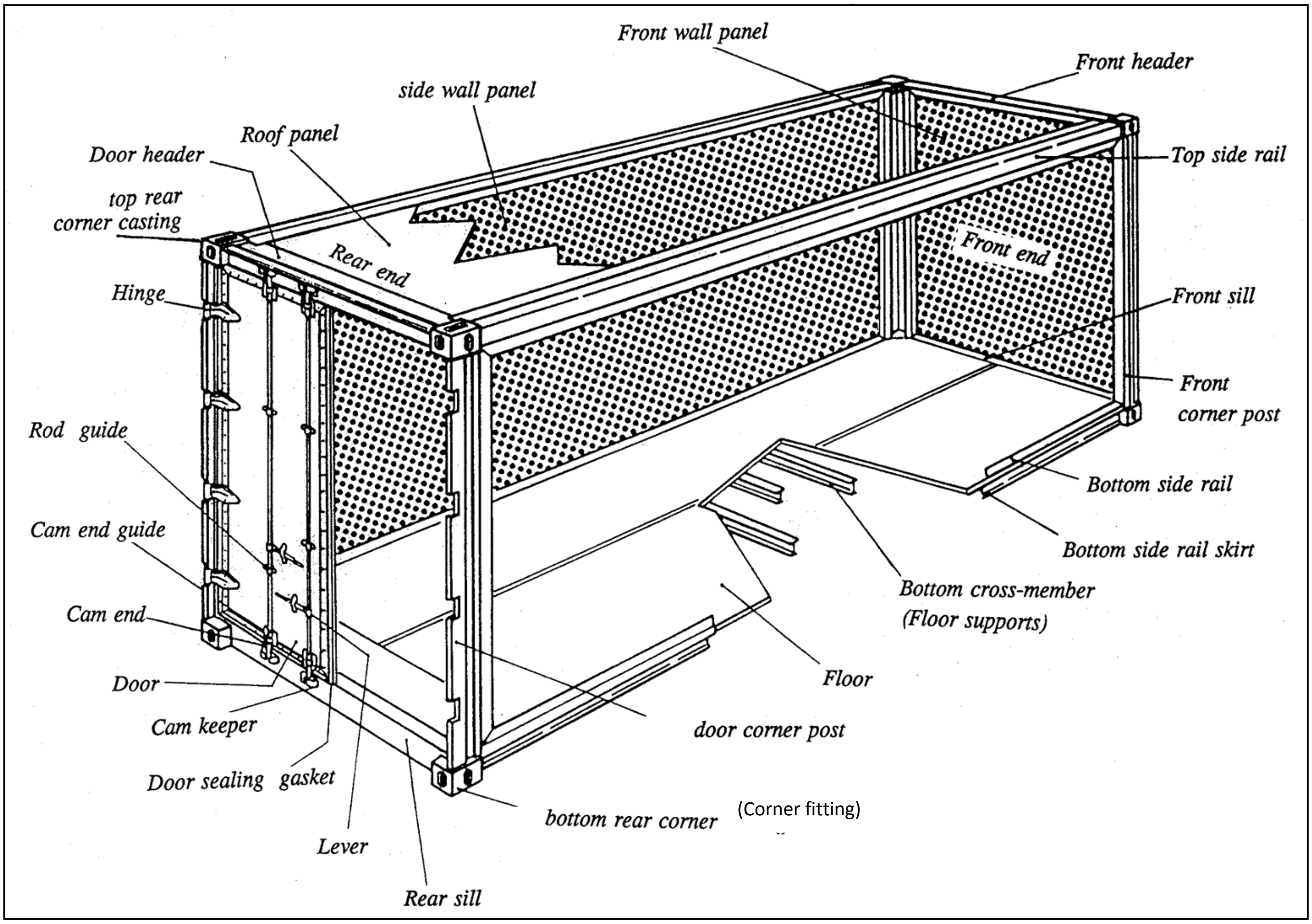
Sri Lanka is party to Indian MOU which is based in Goa, India. The Indian MOU covers a region from East coast and South coast of South Africa to the West coast of Australia, including the Persian Gulf. Following countries are party to the Indian MOU.

- Australia
- Eritrea
- India
- Iran
- Kenya
- Maldives
- Mauritius
- Oman
- South Africa
- Sri Lanka
- Sudan
- Tanzania
- Yemen

6) The purpose of aerating sewage before it goes to settling tanks

There are certain bacteria in sewage that will be help full in de-composting sewage quickly. Oxygen is required for these bacteria. Therefore, the sewage should be aerated.

7) Names of parts of a container



8) Ship's plans to be available onboard and in the company

The following plans and documents shall be kept available onboard and in the company. The DPA is responsible for maintaining these plans and the documents ashore.

- General arrangement plan
- Capacity plan
- Hydrostatic curves
- Loading manual
- Midship section plan
- Scantling plan
- Plans of separate decks if available
- Shell expansion plan
- Plans of transverse bulkheads
- Plans of rudder and rudder stock
- Plans of cargo hatch covers if available.

9) Sri Lanka is not party to the following important conventions, protocols and annexes of the conventions[85]

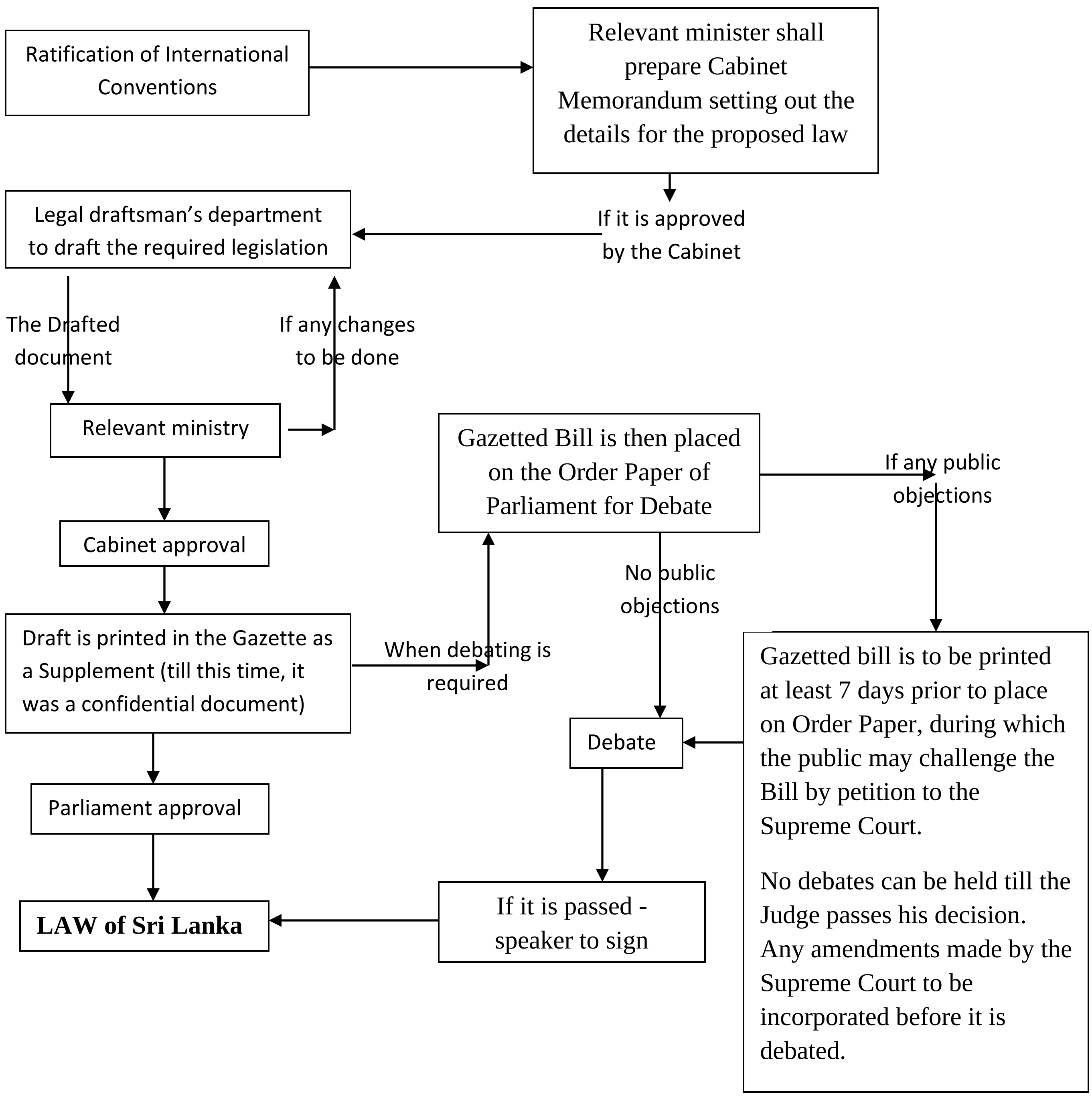
- SOLAS protocol 78 & 88
- Load line protocol 88
- SAR Convention 79
- MARPOL Annex VI
- Bunkers convention
- Antifouling convention 2001
- Ballast water convention 2004

10) Important Acts, Regulations and guidelines applicable to Sri Lankan ships and seafarers[86]

- Merchant Shipping Act No. 52 of 1971
- Merchant Shipping (Amendment) Act No. 36 of 1988
- Merchant Shipping (Training, Certification and Watch Keeping) (STCW'78 as amended)- Gazette No.1987/19 (entered into force on 04/10/2016)
- Marine Pollution Prevention Act, No.35 of 2008
- Carriage of Goods by Sea Act No. 21 of 1982
- MSN issued by the DGMS

[85] http://www.imo.org/en/About/Conventions/StatusOfConventions/Pages/Default.aspx
[86] http://www.dgshipping.gov.lk

11) Procedure of implementing IMO instruments in Sri Lanka



12) Certificates to be carried onboard according to Act number 52 of 1971

- Certificate of registry
- Passenger ship safety certificate
- Cargo ship safety construction certificate,
- Cargo ship safety equipment certificate and
- Cargo ship safety radiotelegraphy certificate or a cargo ship safety radiotelephony certificate
- International load line certificate or Sri Lankan load line certificate

Note the following with regards to Load Line Certificate according to the above Act:

International load line certificate to be issued for the following vessels;

- Existing ships of 150 GT or more[87]
- New ships of 24 m or more in length[88]

(Compiler's note – Existing ships may not exist now, as the Load Line rules were implemented long time back. Therefore, in simple terms, International load line certificate shall be carried on board ships of 24 m or more in length)

All the other vessels need to carry Sri Lanka load line certificate.

Exemptions may be granted for the load line convention in the following circumstances:

a) When trading between neighbouring ports in Ceylon and another ratified state
b) When trading between neighbouring ports in any ratified states
c) Ships of less than 80 t GT engage in coasting
d) Ships of novel kind
e) If a coasting vessel needs to undertake a single international voyage in exceptional circumstance

An international load line exemption certificate to be issued in the case of (d) and (e) above. Vessels of 24 m or more in length not engage in international voyages to be issued with Sri Lanka load line exemption certificate.

Master of the ship is required to put up the Load Line Certificate in some conspicuous place on board the ship, so as to be legible to all persons on board, so long as it remains in force.

[87] Existing ship means a ship which is not a new ship.
[88] New ship means ships built after the Load Line rules were implemented.

13) Deck logbook entries

- Shall contain sufficient navigational information for the purpose of reconstructing a voyage:
  - Ship's positions at regular intervals
  - Course alterations and speed alterations
  - Weather condition
  - Precautions observed during severe weather conditions
  - Behaviour of the vessel (rolling, pitching etc.)
  - Bridge watch level
  - If lookouts posted
  - Whether the vessel is on auto pilot or hand steering
  - Engine room unmanned and maned times
  - Change of con
  - Testing of bridge equipment while arrival and departure
  - Abnormal occurrences such as accidents, groundings, pollutions, salvage operations, observances of pollutions/dangers to navigation reporting made
  - Times of POB, EOSP, first line ashore, all fast, FWE, anchor let gone, vessel brought up, singled up, vessel under way, commenced heaving up anchor, anchor aweigh, pilot away, BOSP etc.

- Entries by Chief officer:
  - Daily cargo lashing inspections
  - Maintenance work carried on deck
  - Opening and closing of watertight doors while the vessel is at sea
  - Daily freshwater ROB
  - Departure draughts

14) Dust explosion

Dust explosion may occur due to the development of internal pressure created by heat and pressure which are created by of rapid burning of cargo dust. The following elements shall be available to generate a dust explosion:

- Dust (combustible particulate solid),
- Suspension in the air,
- Sufficient concentration
- Source of ignition
- Air (Oxygen)

Dust explosions may occur with any type of cargo which generates dust sufficient enough have correct concentration such as grain, coal, sugar, certain types of metal etc. Most of the dust explosions have taken place in processing plants where generate large concentrations of dust, but not much dust explosions have taken place on board ships. Onboard ships this may be avoided by means of:

- reducing the generation of dust by sprinkling water on the cargo if possible
- removing all possible sources of ignition
- reducing dust formation by slow cargo operations

15) Definitions of terms commonly used on tankers

a) Clinnage

This is the cargo residue that attaches to the bulkheads of an oil cargo hold after the cargo is discharged.

b) Gas Free

This is an atmospheric condition in a tank when it is free from any concentration of inflammable, noxious or toxic gases and vapours.

c) Gas freeing

This is the process of creating normal atmospheric conditions inside the tank wherein oxygen level is 21%.

d) Upper Flammable Limit or Upper Explosive Limit (UFL or UEL)

This is the concentration of a hydrocarbon gas in an air sample above which there is insufficient oxygen to support & propagate combustion. This varies with different types of oils but for crude oils generally it is taken as 10% by volume of the hydrocarbon gas in air.

e) Lower Flammable Limit or Lower Explosive Limit (LFL or LEL)

This is the concentration of a hydrocarbon gas in an air sample below which there is insufficient hydrocarbon to support and propagate combustion. for crude oils generally it is taken as 1% by volume of the hydrocarbon gas in air.

f) Flammable range (Explosive range)

This is the range of hydrocarbon gas concentrations in a sample of air between the lower and the upper flammable limits. Therefore, such air mixtures are capable of being ignited and or burning.

g) Flash point

This is the lowest temperature at which a liquid gives off sufficient gas to form a flammable gas mixture (gas and oxygen) near the surface of the liquid.

h) Ignition point

This is the lowest temperature that the surface layers of oil will be ignited and burning will be continued if a source of ignition is introduced. If the cargo and its empty space is in the flammable range, it will not be ignited as long as the temperature is below it's ignition point.

i) Bonding

Connecting of two or more steel structures to allow continues flow of electricity is known as bonding. This is different from earthing, because earthing means, connecting a steel structure and the earth to allow current to pass into earth.

j) Inerting

This is the process of filling a compartment with IG in order to bring down the oxygen content to 8% or less or for the purpose of increasing the pressure in a tank.

k) Purging

Inerting a tank which is already contains IG for the purpose of reducing the oxygen content in the tank or to create a positive pressure inside the tank or both.

l) Wedge Formula

A mathematical means to approximate small quantities of liquid and solid cargo and free water on board prior to loading and after discharge based on cargo compartment dimensions and vessel trim. The wedge formula is to be used only when the liquid does not touch all bulk heads of the vessel's tanks.

m) Wedge Table

A pre-calculated vessel table based on the wedge formula and displayed much like the vessel's usual ullage tables. These tables, however, are for small quantities (remaining on board) when the cargo or free water does not touch all bulkheads of the vessel tank.

n) Vessel Experience Factor (VEF)

The VEF is the historical differebce in the ship and shore figures for a ship over a period of time. A VEF is used to assess the validity of quantities delivered to the ship that are derived from shore measurements.

Vessel capacity tables are often calculated from the vessel's building plans, rather than based on accurate physical tank calibration measurements. This means that there are usually differences between the quantity of a cargo measured in a calibrated shore tank or by a custody transfer meter, and the quantity determined by vessel tank measurements.

For any given vessel a simple ratio can be found between the quantity of liquid measured onboard the vessel and the corresponding measurent by a load or discharge facility. A historical compilation of this ratio, typically over 10 voyages, is known as the Vessel Experience Factor (VEF).

In simple situations the application of a VEF is the principle way a chief officer ia able to assess if the bill of lading quantity is reliable[89].

16) Free board notice

Some flag states require displaying a free board and the departure draughts at a conspicuous place onboard the vessel (at a place where all the staff members can see) before departure from a port and till arrival at the next port. The format of this notice also will be given from the relevant flag. Refer the below freeboard notice which is an actual freeboard notice issued by a flag[90].

[89] https://www.nepia.com/articles/vessel-experience-factor/

[90] MGN 579 (M), MCA, UK, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/681179/MGN_579__M__Load_Line_Final.pdf

Draught of Water and Freeboard Notice

MSF 2004 / REV 0605

SHIP ______________________________ PORT OF REGISTRY ________________________ GROSS TONNAGE _______________

(1) Summer freeboard ______________________________ millimetres corresponding to a mean draught of ________________ millimetres

(2) Winter freeboard ______________________________ millimetres corresponding to a mean draught of ________________ millimetres

(3) Tropical freeboard ______________________________ millimetres corresponding to a mean draught of ________________ millimetres

(4) Winter North Atlantic freeboard ______________________ millimetres corresponding to a mean draught of ________________ millimetres

(5) Allowance for fresh water for all freeboards other than Timber freeboards ____ millimetres

(6) Timber Summer freeboard ________________________ millimetres corresponding to a mean draught of ________________ millimetres

(7) Timber Winter freeboard ________________________ millimetres corresponding to a mean draught of ________________ millimetres

(8) Timber Tropical freeboard ________________________ millimetres corresponding to a mean draught of ________________ millimetres

(9) Timber Winter North Atlantic freeboard__________________ millimetres corresponding to a mean draught of ________________ millimetres

(10) Allowance for fresh water for Timber freeboards ____ millimetres

NOTES:

1. The particulars to be given above of freeboards and allowances for fresh water to be taken from the load line certificate currently in force in respect of the ship.
2. All freeboards given on the load line certificate must be stated.
3. The mean draught to be given above is the mean of the draughts which would be shown on the scales of measurement on the stem and on the sternpost of the ship if it were so loaded that the upper edge of the load line on each side of the ship appropriate to the particular freeboard were on the surface of the water.
4. Where the draught is shown on the scales of measurement on the stem and on the stern post of the ship in feet the mean draught must be given in millimetres.

1	2	3	4	5	6	7	6	9
DATE	PLACE	ACTUAL DRAUGHT			MEAN FREEBOARD		SIGNATURE OF MASTER AND AN OFFICER	
		FORWARD	AFT	MEAN	ACTUAL	CORRECTED (See Note 3)	MASTER	AN OFFICER

PARTICULARS OF LOADING

Notes

1. The actual mean freeboard (Column 6) is the mean of the freeboards on each side of the ship at the time when the ship is loaded and ready to leave.
2. If the actual mean freeboard is less than the appropriate minimum saltwater freeboard as shown on the load line certificate there must be entered in Column 7 the corrected freeboard arrived at after making any allowances for density of water, rubbish to be discharged overboard and fuel, water and stores to be consumed on any stretch of river or inland water, being allowances duly entered in the ship's official log-book.
3. If the actual mean freeboard is greater than the appropriate salt water freeboard, Column 7 need not be filled in.

(FORMERLY FRE 13)

An executive agency of the Department for Transport

17) **Cavitation**

This occurs when the pressure in a liquid is reduced suddenly and this will generate air bubbles which generates severe shock waves. This may occur around an impellor of a pump. This air bubble will generate shock waves inside the pump which will cause damages to it.

18) **Chief Officer's duties in implementing MLC 2006**

MLC 2006 is a compilation of all the existing ILO Conventions, and it is applicable to all ships except war ships, fishing vessels, traditional build ships and vessels navigating only in inland water. A chief officer shall ensure that:

- Work and rest hours regulations are complied with and it is recorded. Signed copy of it is handed over to seafarers.
- Shore leave to be granted without hampering safe operations of the vessel while in ports
- Appropriate onboard training shall be provided before assigning new for work
- Night work of seafarers under the age of 18 is prohibited, except required for the purposes of training & must make sure that it does not affect their health. Refer the flag state regulations to identify the meaning of 'night work'.
- No work that may jeopardize their health and safety shall be given to seafarers who are below 18 years of age. Refer the flag state regulations to identify what are the duties that may 'jeopardize their health & safety'.
- Accommodation spaces to be:
  - clean and in a good state
  - sufficiently heated or air conditioned
  - included proper bedding, mattress, tables, lamps etc
  - ventilated properly
  - sufficiently illuminated (natural or artificial)

- Sufficient laundry facilities are available
- Anti-mosquito facilities in place in case the vessel is visiting malaria infected regions
- Sanitary facilities are hygienic, accessible and comfortable
- Cabins are provided with a bed, lamp and table
- Recreational facilities provided to seafarers, which may include:
  - libraries, books and movie DVDs
  - gym to promote health and fitness etc.

- Sufficient and quality food and water available
- Varied choice of meals, respecting religious considerations are available
- Ship's galley is kept in hygienic condition
- Frequent inspections of ship's galley and provision rooms are carried out, and records kept

- Risk assessment methods are in place
- Sufficient personal protective equipment and other safety equipment readily available
- On-board programmes for the prevention of occupational accidents, injuries are available

Documents and certificates that need to be carried on board according to MLC 2006

- Copy of the MLC 2006.
- On board complaint procedures.
- Onboard complain records.
- Flag state regulations concerning repatriation procedures.
- Risk assessment procedures.
- Financial security for death, long term disabilities and repatriation of seafarers. Copy of this document shall be posted at a prominent place onboard.
- If the vessel is taking seafarers from non-ratified countries, a document confirming that the recruiting agency in the non- ratified country is complying with the MLC 2006.
- If applicable, need to have CBA (Collective Bargaining Agreement) onboard.
- Seafarer employment agreement must be available with the seafarer.
- All ships above 500 GT & above, trading in international waters to have:
  - Maritime Labour Certificate (issued by Flag or RO, valid for 5 years and subjected to intermediate inspection)
  - Declaration of Maritime Labour Compliance (DMLC) Part I (issued by Flag or a RO)
  - Declaration of Maritime Labour Compliance (DMLC) Part II (prepared by shipowner)

19) STCW 1978 as amended 2010 requirements (in brief)

a) New ranks which require certificates

- Able seafarer deck
- Able seafarer engine
- Electro-technical officer
- Electro-technical rating
- Electro-technical cadet

b) Work and rest hours

- All persons assigned duty as an officer/crew in charge of a bridge/engine watch, or any seafarer whose duties involve designated safety, prevention of pollution and security duties have to be provided with rest periods as follows:

- Minimum amount of rest in any 7 days period is increased to 77 hours from 70 hours;
- 10 hours rest in any 24 hours period, except during an emergency;
- The hours of rest may be divided into no more than two periods, one of which shall be at least 6 hours in length and the intervals between consecutive periods of rest shall not exceed 14 hours.
- Reduction of rest hours to 70 hours in any 7-day period is allowed for not more than two consecutive weeks.
- Mandatory records to be maintained/reviewed/signed periodically (typically at least once a month) for each individual seafarers' rest hours.

c) Medical standards

- Validity period of Medical certificates is 02 years.
- If the age is below 18 years, maximum period of validity is 01 year.
- If the period of validity of a medical certificate expires in the course of a voyage, then the medical certificate will continue to be valid until the next port of call where a recognized medical practitioner is available, provided that the period does not exceed 03 months.
- In urgent cases, seafarers can work without a valid medical certificate until the next port of call where a recognized medical practitioner is available, provided that:
    - Such time period does not exceed 03 months; and
    - The seafarers are having a recently expired Medical Certificate.

d) Alcohol limits

- Masters, officers and other seafarers, while performing bridge or engine room watch, designated safety, security and prevention of pollution duties should not consume alcohol that would result in a limit greater than;
    - 0.05% blood alcohol level (BAC) or
    - 0.25 mg/l alcohol in the breath.

20) Conversion from one type of a vessel to another type of a vessel

Sometimes, the shipowner may decide to convert an existing vessel to another type of vessel due to various reasons. Few important points where a chief officer should keep in mind is highlighted below in such occasions.

Conversion of bulk carriers to deck cargo carrying ships[91]

- Pontoons and the deck of bulk carriers are strengthened to withstand the sea water pressures only. Therefore, need to strengthen the deck and pontoons to carry deck cargo.
- Stability books and software will have to be upgraded to include wind heeling criteria, positioning of deck cargo on the stability computer etc.
- Need to have additional lashing points on deck.
- Bulk carriers are not required to have a Cargo Securing Manual unless it is also built to carry parcel/unit cargoes which require lashing. Therefore, a new CSM is to be developed or the existing one has to be modified.
- Visibility diagrams to be reassessed.
- When required to load containers on deck;
    - Class notation to be changed to include 'containers'
    - Ensure compliance with the Code of Safe Practice for Cargo Stowage and Securing (CSS Code).
    - Depending upon the size of the vessel, need to have torsional boxes for strengthening purposes.
    - May have to carry out an inclining experiment to calculate the new lightship displacement, KG and LCG.
    - Need to have power sockets to plug in reefer containers.
    - Document of Compliance is required to carry IMDG.
    - Need to have chemical suits and other equipment to handle chemical spillages in accordance with the DOC.
    - Need to have additional medicines to carry IMDG.
- All the certificates to be re-issued.
- Need to consult classification society and the administration for detailed instructions and guidance.

Conversion of tankers to bulk carriers

- Need to remove all fittings related to inert gas system, cargo loading/discharging and tank washing systems.

[91] https://www.dnvgl.com/news/deck-cargo-on-bulk-carriers-what-you-need-to-know-61186

- Longitudinal subdivisions of the tanks are required to be removed.
- Large openings are required on deck.
- May have to have tween decks and tween deck closing mechanisms.
- Additional strengthening on the deck areas and hull is required.
- Need to have lashing points and a CSM if she is expecting to carry cargo which required to be lashed.
- Double skins except the double bottom may have to be removed.
- Tank tops are required to be strengthened as the weight of bulk cargo is higher than the liquid weight and the loadable cargo weights to be re calculated for each cargo hold.
- Inclining experiment to be carried out to calculate the new light ship displacement, LCG and KG.
- All the certificates to be re-issued.
- May have to obtain Document of Authorization if expecting to carry grain cargoes in bulk.
- Need to have new stability books, stability software, tank sounding tables etc.
- Need to consult classification society and the administration for detailed instructions and guidance.
- Finally, conversion to be done in accordance with the regulations for construction of bulk carriers developed by IMO.

21) Information with regards to marine casualty investigations[92]

The flag state or the coastal state or any other interested parties are required to conduct investigations of marine casualties to avoid such incidents happening in future. The objective of the Casual Investigation Code is to provide a common approach for investigations. Such investigations do not seek to apportion blame or determine liability. It is not the purpose of this Code to stop any other form of investigations, including investigations for action in civil, criminal and administrative proceedings. Even though the Code is applicable for admirations or parties involved in casualty investigations, some important information for seafarers are provided below.

Definitions

Serious injury means an injury which is sustained by a person, resulting in incapacitation where the person is unable to function normally for more than 72 hrs, commencing within seven days from the date when the injury was suffered.

[92] Casualty Investigation Code (2008 edition)

Marine casualty means an event, or a sequence of events, that has resulted in any of the following which has occurred directly in connection with the operation of a ship:

- The death or, or serious injury to, a person;
- The loss of a person from a ship;
- The loss, presumed loss or abandonment of a ship;
- Material damage to a ship;
- The stranding or disabling of a ship, or the involvement of a ship in a collision;
- Material damage to marine infrastructure external to a ship, that could seriously endanger the safety of the ship, another ship or an individual; or
- Severe damage to the environment, or the potential for severe damage to the environment, brought about by the damage of a ship or ships.

But, does not include;
A deliberate act or omission, with the intent to cause harm to the safety of a ship, an individual or the environment.

Very serious marine casualty means a marine casualty involving the total loss of the ship or death or severe damage to the environment.

Marine incident means an event, or sequence of events, other than a marine casualty, which has occurred directly in connection with the operations of a ship that endangered, or, if not corrected, would endanger the safety of the ship, its occupants or any other person or the environment.
But, does not include;
A deliberate act or omission, with the intent to cause harm to the safety of a ship, an individual or the environment.
Examples of marine incidents are[93]

- Non-compliance of collision regulations in navigation.
- Non-compliance with work and rest hours.
- Non-compliance with international Conventions and Codes such as SOLAS, ISM Code, STCW, IMDG, ISPS etc.
- Near misses.
- Exceeding the SWL of cargo gears.
- Not using appropriate PPE.

Marine safety investigation means an investigation or inquiry, into a marine casualty or marine incident, conducted with the objective of preventing such events in future.

Other important points of the Code

- The Code requires to conduct a marine safety investigation into every very serious marine casualty by flag state or coastal state or other interested parties or combination of them.

[93] Compiler's own examples

- A marine safety investigation is required to be conducted by the flag state for marine casualties and marine incidents if it is important to prevent marine casualties and marine incidents in future.
- If any seafarers are required to provide evidences, they shall be allowed to return to their ship or be repatriated at the earliest possible opportunity and their human rights shall be respected all the time.
- If any seafarers are required to provide evidences, they shall be informed and allowed access to legal advice, regarding:
  - Any potential risk that they may incriminate them in any proceedings subjected to the investigation;
  - Any right not to self-incriminate or to remain silent
- If a marine safety investigation is commenced, the master, owner and agent of the vessel should be informed as soon as practicable of:
  - The time and place of the investigation;
  - Names and contact details of the marine safety investigation authorities;
  - The relevant details of the legislation under which the investigation is being conducted;
  - The rights and obligations of the parties' subject to the investigation; and
  - The rights and obligations of the state or states conducting the investigation
- Such investigations shall not cause undue delays to a vessel.
- Such investigations shall not detain vessels unnecessarily.
- The investigators shall not remove original documents or equipment from the vessel unless they are extremely required for the investigation. They shall make copies of documents where practicable.
- The investigators may have access to;
  - records held by flag state, owners & classification societies;
  - all recorded data onboard including VDR; and
  - government surveyors, coast guard officers, VTS operators, pilots etc. to collect evidences.

22) Actions to be taken when an anchor is lost and how to refit another anchor

- Note down the position where the anchor was lost and report to the owners and port authority.
- Inform the class and ask for an exemption certificate.
- During the above period, take actions to re-fit the anchor.
- It is always recommended to re-fit the same anchor if it is possible to recover provided it is cost effective and the anchor is not damage.
- If the same anchor is not possible to recover, need to find a suitable secondhand anchor.
- The secondhand anchor should be suitable for the existing cable (because of the wear and tear of the cable) or else, better to replace the whole cable with a new anchor and cable.
- When buying the secondhand anchor, make sure it has a class certificate.
- Discuss with owners and arrange a barge for refitting the anchor.

- Discuss with the barge and see whether he prefers to have the anchor lost side alongside or the opposite side alongside. Accordingly, the master shall discus with the pilot and berth as requested by the barge.
- When about to fit the anchor, the chief officer shall discuss with the barge master about the operation and identify very clearly, whether he needs any support from the ship, who are responsible for what and carry out a risk assessment.
- If required arrange proper lighting and fenders.
- It is preferable to conduct the whole operation with the direct supervision of the chief officer.
- Appoint a reliable and experienced person (preferably, the bosun) to monitor the operation throughout.
- Once fitted, carryout a visual inspection and make sure, it is correctly fitted. Check whether the anchor houses properly and it comes out of the hawse pipe without any problem. Make sure the securing can be applied properly after the anchor is housed.

23) <u>How to change the paint supplier</u>

The paint supplier can be changed for the accommodation area, ship's hull, cargo holds etc. as per the wishes of the ship owner. But it is better to send the paint specifications of the existing paint to the expected new supplier, so that he can provide a compatible paint type.

It is not the same when it comes to the dedicated sea water ballast tanks on ships of 500 GT and above and double-side skin spaces arranged in bulk carriers of 150 m in length and upward. In that case, copy of the Coating Technical File has to be forwarded to the expected new supplier. So that the new paint manufacturer shall provide paints having the same specifications.

24) <u>Fatigue & management of fatigue</u>

As managers onboard ships, chief officers are required to have a good idea about fatigue and fatigue management. Therefore, following summery is taken from MSC.1/Circ.1598 on "Guidance on fatigue", to give you a basic understanding on the subject.

Fatigue means is a condition of physical and/or mental impairment due to;

- inadequate sleep,
- extended wakefulness,
- work/rest requirements out of synchronized with circadian rhythms (biological clock of the body) and

- physical, mental or emotional exertion that can impair alertness and the ability to safely operate a ship or perform safety-related duties.

Fatigue is a problem for all 24-hour-a-day transportation modes and industries, including the maritime industry. Nature of shipping may require;
- the seafarers to work long and irregular hours;
- to work extended hours/contracts periods onboard with varying environmental conditions
- the seafarers to stay and work at the same place
- to work without clear separation between work and recreation

A person may encounter fatigue due to various reasons which includes;
- lack of sleep;
- poor quality of sleep and rest;
- Work/sleep does not match with human circadian rhythm (refer next slide);
- staying awake for long periods;
- stress; and
- excessive workload (prolonged mental and/or physical exertion).

This a very dangerous phenomena specially in the transport sector. Because a fatigued person may encounter one or couple of the below mentioned problems which may lead to catastrophic situations.
- Inability to concentrate
- Diminished decision-making ability
- Poor memory
- Slowing of cognitive processes
- Involuntary need to sleep
- Loss of control of bodily movements
- Health Issues
- Mood change
- Change of attitude

There are many ways to categorize the causes of fatigue. To ensure thoroughness and to provide good coverage of most causes, they have been categorized into five general factors:
- seafarer-specific factors;
- management factors (ashore and aboard ship);
- ship-specific factors;
- environmental factors; and
- operational factors.

How to identify when fatigued

A fatigued person may show one or couple of symptoms listed below.

- Neglecting important areas when decision making
- Slow or no response even in emergencies
- Lapses of attention
- Poor judgement of distance, speed, time, etc.
- Difficulty in concentrating
- Inability to stay awake
- Difficulty with hand-eye coordination skills
- Speech difficulties
- Increased frequency of dropping objects
- Digestion problems
- Anti-social behaviour
- Mood changes
- Ignores normal checks and/or procedures
- Increasing omissions, mistakes

Master's and Chief Officer's duties in mitigating and managing fatigue

Apart from the company responsibilities, the senior officers also have a role to play in mitigating and managing fatigue. These may include:

- Compliance with minimum hours of rest and/or maximum hours of work
- Proper resting of new joiners
- Manage HEAVY and long working hours
- Nutritious food & drinking water is provided
- Provided appropriate meal choices for night shift workers
- Managing of interaction with shore and ship
- Ensure correct people are selected depending upon the type of work to be performed.
- Improving shipboard conditions & proper scheduling of work
- Avoiding potentially hazardous tasks during the circadian lows
- Making awareness of fatigue and conduct fatigue related training
- Report and reduce the impacts of ship design

Training on fatigue and fatigue management

It is also better to give proper training on fatigue and how to manage fatigue to officers and crews as well. This will enhance the safety onboard. Training may include;

- Fatigue, its causes and potential consequences
- Circadian rhythms and body clock
- Importance of proper sleep
- Fatigue countermeasures
- Basic information on sleep disorders
- Understanding of the rules and regulations
- How to identify fatigue
- How to mitigate fatigue
- Importance and responsibility of reporting

How to maintain fitness for duty

Training shall also include how to maintain fitness by;

- taking strategic naps (the most effective - 20 minutes);
- taking advantage of scheduled breaks;
- monitoring and effectively manage sleep
- monitoring fitness for duty including medical fitness;
- reporting any fatigue impairment in themselves and in others
- recording and report actual hours of work and rest
- eating regular, well-balanced meals;
- exercising regularly; and
- limiting the use of medications (if possible)

ISBN 978-624-96669-0-0

Shane Sankaranarayana
Head of Department,
Department of Navigation,
CINEC Campus,
Malabe,
Sri Lanka.
www.cinec.edu