FUNCTION 2: CARGO HANDLING AND STOWAGE AT THE MANAGEMENT LEVEL

KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	TOTAL HOURS FOR EACH TOPIC	TOTAL HOURS FOR EACH SUBJECT AREA OF REQUIRED PERFORMANCE
COMPETENCE:		
2.1 **PLAN AND ENSURE SAFE LOADING, STOWAGE, SECURING, CARE DURING VOYAGE AND UNLOADING CARGOES**		
2.1.1 APPLICATION OF INTERNATIONAL REGULATION, CODES AND STANDARDS CONCERNING THE SAFE HANDING, STOWAGE SECURING AND TRANSPORT OF CARGOES		
1. Plans and actions conform with International regulations	6	6
2.1.2 EFFECTS OF TRIM AND STABILITY OF CARGOES AND CARGO OPERATIONS		
1. Draft, trim and stability	20	20
2.1.3 STABILITY AND TRIM DIAGRAMS AND STRESS CALCULATING EQUIPMENT		
1. Shear forces, bending moments and torsion moments	8	
2. Compliance with minimum freeboard requirements of the load line regulations	6	
3. Use of automatic data-based (ADB) equipment	2	
4. Knowledge of loading cargoes and ballasting in order to keep hull stress within acceptable limits	6	22
2.1.4 STOWAGE AND SECURING OF CARGOES ON-BOARD SHIP, CARGO HANDLING GEAR AND SECURING AND LASHING EQUIPMENT		
1. Timber deck cargoes	3	
2. Procedures for receiving and delivering cargo	3	
3. Care of cargo during carriage	4	
4. Requirements applicable to cargo-handling gear	4	
5. Maintenance of cargo gear	3	
6. Maintenance of hatch covers	2	19
2.1.5 LOADING AND UNLOADING OPERATIONS, WITH SPECIAL REGARD TO THE TRANSPORT OF CARGOES IDENTIFIED IN THE CODE OF SAFE PRACTICE FOR CARGO STOWAGE AND SECURING		
1. Loading, stowage and discharge of heavy weights	3	
2. Care of cargo during carriage	1	
3. Methods and safeguards when fumigating hold	2	6
2.1.6 GENERAL KNOWLEDGE OF TANKERS AND TANKER OPERATIONS		
1. Terms and definitions	1	
2. Contents and application of ISGOTT	2	
3. Oil tanker operations and related pollution-prevention regulations	3	
4. Chemical tankers	3	

5. Tank cleaning and control of pollution in chemical tankers	2	
6. Gas tankers	3	
7. Cargo operations in gas tankers	2	16
2.1.7 KNOWLEDGE OF THE OPERATIONAL AND DESIGN LIMITATIONS OF BULK CARRIERS		
1. Operational and design limitations of bulk carriers	3	
2. SOLAS chapter XII Additional safety measures for bulk carriers	1	
3. CSR Bulk	1	5
2.1.8 LOADING, CARE AND UNLOADING OF BULK CARGOES		
1. Application of all available shipboard data related to loading, care and unloading of bulk cargoes	5	
2. Code of practice for the safe loading and unloading of bulk carriers (BLU CODE)	1	6
2.1.9 SAFE CARGO HANDLING IN ACCORDANCE WITH THE PROVISIONS OF THE RELEVANT INSTRUMENTS		
1. Establish procedures for safe cargo handling in accordance with the provisions of the relevant instruments such as: o IMDG Code o IMSBC Code o MARPOL 73/78, Annexes III and V	3	3
2.1.10 EFFECTIVE COMMUNICATIONS AND IMPROVING WORKING RELATIONSHIPS		
1. Basic principles for establishing effective communications and improving working relationships between ship and terminal personnel	1	1
2.2 **ASSESS REPRTED DEFECTS AND DAMAGE TO CARGO SPACES, HATCH COVERS AND BALLAST TANKS AND TAKE APPROPRIATE ACTION**		
2.2.1 LIMITATIONS ON STRENGTH OF THE VITAL CONSTRUCTIONAL PARTS OF A STANDARD BULK CARRIER AND INTERPRET GIVEN FIGURES FOR BENDING MOMENTS AND SHEAR FORCES	3	3
2.2.2 METHODS TO AVOID THE DETRIMENTAL EFFECTS ON BULK CARRIERS OF CORROSION, FATGUE AND INADEQUATE CARGO HANDLING	3	3
2.3 CARRIAGE OF DANGEROUS GOODS		
2.3.1 INTERNATIONAL REGULATIONS, STANDARDS, CODE AND RECOMMENDATIONS ON CARRIAGE OF DANGEROUS CARGOES		
1. International regulations and codes including the International Maritime Dangerous Good (IMDG) Code and the International Maritime Solid Bulk Cargoes (IMSBC) Code	3	3
2.3.2 CARRIAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES; PRECAUTIONS DURING LOADING AND UNLOADING AND CARE DURING THE VOYAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES		

1. Dangerous goods in packages	10	
2. Solid bulk cargoes	9	
3. International Code for the Safe Carriage of grain in bulk (International Grain Code)	7	26
TOTAL FOR FUNCTION 2: Cargo Handling and stowage at the management level		**139 hours**

Teaching staff and Administrations should note that the hours for lectures and exercises are suggestions only as regards sequence and length of time allocated to each objective. These factors may be adapted by lecturers to suit individual group of trainees depending on their experience, ability, equipment and staff available for teaching.

2. PLAN AND ENSURE SAFE LOADING, STOWAGE, SECURING, CARE DURING VOYAGE AND UNLOADING CARGOES

2.1.1. APPLICATION OF INTERNATIONAL REGULATION, CODES AND STANDARDS CONCERNING THE SAFE HANDING, STOWAGE SECURING AND TRANSPORT OF CARGOES

The proper stowage and securing of cargoes is of the utmost importance for the safety of life at sea. Improper stowage and securing of cargoes has resulted in numerous serious ship causalities and caused injury and loss of life, not only at sea but also during loading and discharge.

In order to deal with problem and hazards arising from improper stowage and securing of certain cargoes on ship, the International Maritime Organization has issued guidelines in the form of either assembly resolutions or circulars adopted by the Maritime Safety Committee; these are listed hereunder:

- Safe stowage and securing of cargo units and other entities in ships other than cellular containerships, resolution A.489 (XII);
- Provisions to be included in the Cargo security manual to be carried on board ships, MSC/Circ-385;
- Guidelines for securing arrangement for the transport of road vehicles on ro-ro ships, resolution A.581 (14).
- IMO / ILO Guidelines for packing cargo in freight containers or vehicles;
- Hazards associated with the entry into enclosed spaces, MSC/Circ. 487.

The accelerations acting on a ship in a seaway result from a combination of longitudinal, vertical and predominantly transverse motions. The forces created by these accelerations give rise to the majority of securing problems.

The hazards arising from these forces should be dealt with by taking measures both to ensure proper stowage and securing of cargoes on board and to reduce the amplitude and frequency of ship motions.

The purpose of this code is to provide an international standard to promote the safe stowage and securing of cargoes by:

- Drawing the attention of shipowners and ship operators to the need to ensure that the ship is suitable for its intended purpose;
- Providing advice to ensure that the ship is equipped with proper cargo securing means;
- Providing general advice concerning the proper stowage and securing of cargoes to minimize the risk to the ship and personnel;
- Providing specific advice on those cargoes which are known to create difficulties and hazards with regard to their stowage and securing:
- Advising on action which may be taken in heavy sea conditions; and
- Advising on actions which may be taken to remedy the effect of cargo shifting.

In providing such advice, it should be done be borne in mind that the master is responsible for the safe conduct of the voyage and the safety of the ship, its crew and its cargo.

All cargoes should be stowed and secure in such a way that the ship and persons on board are not put at risk.

The safe stowage and securing of cargoes depend on proper planning, execution and supervision.

Personnel commissioned to task of cargo stowage and securing should be properly qualified and experienced.

Personnel planning and supervising the stowage and securing of cargo should have a sound practical knowledge of the application and content of the Cargo Security Manual, if provided.

In all cases, improper stowage and securing of cargo will be potentially hazardous to the securing of the cargoes and to the ship itself.

Decision taken for measures of stowage and securing cargo should be based on the most severe weather conditions which may be expected by experience for the intended voyage.

Ship-handling decision taken by the master, especially in bad weather conditions, should take into account the type and stowage position of the cargo and the securing arrangements.

- **Application**

This code applies to cargoes carried on board ships (other than solid and liquid bulk cargoes and timber stowed on deck) and, in particular, to those cargoes whose stowage and securing have proved in practice to create difficulties.

- **Forces**

Forces, which have to be absorbed by suitable arrangements for stowage and securing to prevent cargo shifting, are generally composed of components acting relative to the axes of the ships:

- Longitudinal;
- Transversal; and
- Vertical

Remark: for the purpose of stowage and securing cargo, longitudinal and transverse forces are considered predominant.

Transverse force alone, or the resultant of transverse, longitudinal and vertical forces, normally increase with the height of the stow and the longitudinal distance of the stow from the ship’s centre of motion in a seaway. The most severe forces can be expected in the furthest forward, the furthest aft and the highest stowage position on each side of the ship.

The transverse forces exerted increase directly with the metacentric height of the ship. An undue metacentric height may be caused by:

- Improper design of the ship;
- Unsuitable cargo distribution; and
- Unsuitable bunker and ballast distribution

Cargo should be so distributed that the ship has a metacentric height in excess of the required minimum and, whenever practicable, within an acceptable upper limit to minimize the forces acting on the cargo.

In addition to the forces referred to above, cargo carried on deck may be subjected to forces arising from the effects of wind and green seas.

Improper shiphandling (course or speed) may create adverse forces acting on the ship and the cargo.

The magnitude of the forces may be estimated by using the appropriate calculation methods as contained in the cargo securing manual, if provided.

Although the operation of anti-roll devices may improve the behavior of the ship in a seaway, the effect of such devices should not be taken into account when planning the stowage and securing of cargoes.

- **Behaviour of cargoes**

Some cargoes have a tendency to deform or to compact themselves during the voyage, which will result in a slackening of their securing gear.

Cargoes with low friction coefficient, when stowed without proper friction-increasing devices such as dunnage, soft boards, rubber mats, etc., are difficult to secure unless tightly stowed across the ship.

- Criteria for estimating the risk of cargo shifting
- When estimating the risk of cargo shifting, the following should be considered:
- Dimensional and physical properties of the cargo;
- Location of the cargo and its stowage on board;
- Suitability of the ship for the particular cargo;
- Suitability of the securing arrangements for the particular cargo;
- Expected seasonal weather and sea conditions;
- Expected ship behavior during the intended voyage;
- Stability of the ship;
- Geographical are of the voyage; and
- Duration of the voyage

These criteria should be taken into account when selecting suitable stowage and securing methods and whenever reviewing the forces to be absorbed by the securing equipment.

Bearing in mind the above criteria, the master should accept the cargo on board his ship only if he is satisfied that it can be safety transported.

2.1.2. EFFECTS OF TRIM AND STABILITY OF CARGOES AND CARGO OPERATIONS

- **To find the change of draft forward and aft due to change of trim**

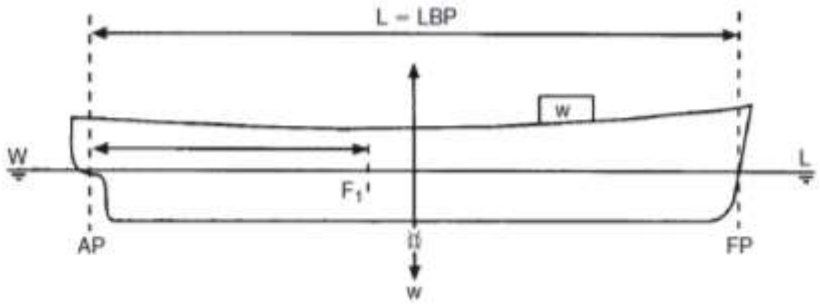
When a ship changes trim it will obviously cause a change in the drafts forward and aft. One of these will be increased and the other decreased. A formula must now be found which will give the change in drafts due to change of trim.

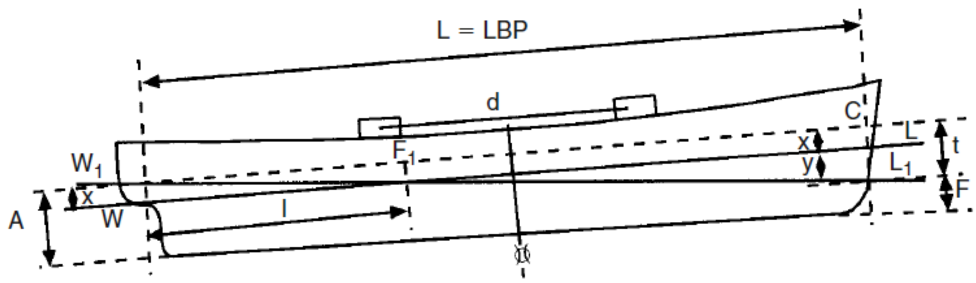
Consider a ship floating upright as shown in Figure below. F_1 represents the position of the centre of flotation which is *l* metres from aft. The ship's length is L metres and a weight 'w' is on deck forward.

Let this weight now be shifted aft a distance of'd' metres. The ship will trim about F_1 and change the trim't' cms by the stern as shown in Figure below.

W_1C is a line drawn parallel to the keel.

'A' represents the new draft aft and 'F' the new draft forward. The trim is therefore equal to A-F and, since the original trim was zero, this must also be equal to the change of trim.





Let 'x' represent the change of draft aft due to the change of trim and let 'y' represent the change forward.

In the triangles WW_1F_1 and W_1L_1C, using the property of similar triangles:

$$\frac{x \text{ cm}}{l \text{ m}} = \frac{t \text{ cm}}{L \text{ m}}$$

or

$$x \text{ cm} = \frac{l \text{ m} \times t \text{ cm}}{L \text{ m}}$$

$$\therefore \text{Change of draft aft in cm} = \frac{l}{L} \times \text{Change of trim in cm}$$

where

l = the distance of centre of flotation from aft in metres, and
L = the ship's length in metres

t will also be noticed that $x + y = t$

$\therefore$ Change of draft F in cm = Change of trim Change of draft A

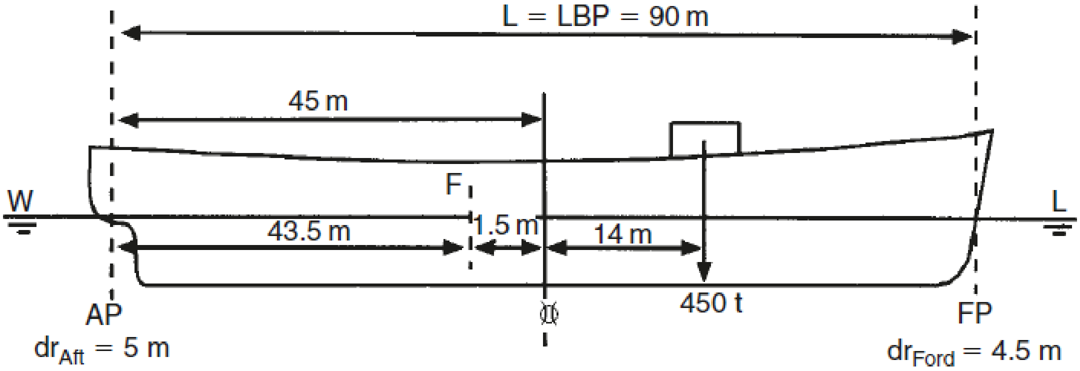
- **The effect of loading and/or discharging weights**

When a weight is loaded at the centre of flotation it will produce no trimming moment, but the ship's drafts will increase uniformly so that the ship displaces an extra weight of water equal to the weight loaded. If the weight is now shifted forward or aft away from the centre of flotation, it will cause a change of trim. From this it can be seen that when a weight is loaded away from the centre of flotation, it will cause both a bodily sinkage and a change of trim.

Similarly, when a weight is being discharged, if the weight is first shifted to the centre of flotation it will produce a change of trim, and if it is then discharged from the centre of flotation the ship will rise bodily. Thus, both a change of trim and bodily rise must be considered when a weight is being discharged away from the centre of flotation.

Example 1

A ship 90 m long is floating at drafts 4.5 m F and 5.0mA. The centre of flotation is 1.5 m aft of amidships. TPC 10 tonnes. MCT 1 cm. 120 tonnes m. Find the new drafts if a total weight of 450 tonnes is loaded in a position 14 m forward of amidships.



$$\text{Bodily sinkage} = \frac{w}{TPC} = \frac{450}{10}$$

$$\text{Bodily sinkage} = 45 \text{ cm}$$

$$\text{Change of trim} = \frac{\text{Trim moment}}{\text{MCT 1 cm}} = \frac{450 \times 15.5}{120}$$

$$\text{Change of trim} = 58.12 \text{ cm by the head}$$

$$\text{Change of draft aft} = \frac{l}{L} \times \text{Change of trim} = \frac{43.5}{90} \times 58.12$$

$$\text{Change of draft aft} = 28.09 \text{ cm}$$

$$\text{Change of draft forward} = \frac{46.5}{90} \times 58.12$$

$$\text{Change of draft forward} = 30.03 \text{ cm}$$

Original drafts	5.000 m A	4.500 m F
Bodily sinkage	+0.450 m	+0.450 m
	5.450 m	4.950 m
Change due trim	−0.281 m	+0.300 m
Ans. New drafts	5.169 m A	5.250 m F

Note. In the event of more than one weight being loaded or discharged, the net weight loaded or discharged is used to find the net bodily increase or decrease in draft, and the resultant trimming moment is used to find the

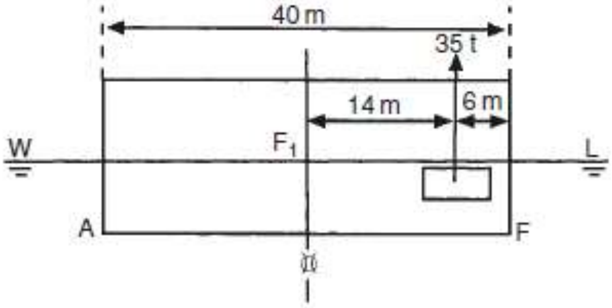
change of trim.

Also, when the net weight loaded or discharged is large, it may be necessary to use the TPC and MCT 1 cm at the original draft to find the approximate new drafts, and then rework the problem using the TPC and MCT 1cm for the mean of the old and the new drafts to find a more accurate result.

Example 2

A box-shaped vessel 40m x 6m x 3 m is floating in salt water on an even keel at 2 m draft F and A. Find the new drafts if a weight of 35 tonnes is discharged from a position 6 m from forward. MCT 1cm = 8.4 tonnes m.

$$\text{TPC} = \frac{\text{WPA}}{97.56}$$
$$= \frac{40 \times 6}{97.56}$$
$$\text{TPC} = 2.46 \text{ tonnes}$$



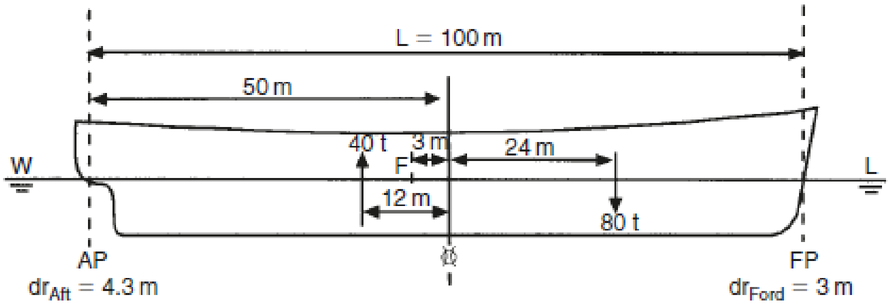
$$\text{Bodily rise} = \frac{w}{\text{TPC}}$$
$$= \frac{35}{2.46}$$
$$\text{Bodily rise} = 14.2 \text{ cm}$$
$$\text{Change of trim} = \frac{w \times d}{\text{MCT 1 cm}}$$
$$= \frac{35 \times 14}{8.4}$$
$$\text{Change of trim} = 58.3 \text{ cm by the stern}$$
$$\text{Change of draft aft} = \frac{1}{L} \times \text{Change of trim}$$
$$= \frac{1}{2} \times 58.3 \text{ cm}$$
$$\text{Change of draft aft} = 29.15 \text{ cm}$$
$$\text{Change of draft forward} = \frac{1}{2} \times 58.3$$
$$\text{Change of draft forward} = 29.15 \text{ cm}$$

Original drafts	2.000 m A	2.000 m F
Bodily rise	−0.140 m	−0.140 m
	1.860 m	1.860 m
Change due trim	+0.290 m	−0.290 m
Ans. New drafts	2.150 m A	1.570 m F

Example 3

A ship 100 m long arrives in port with drafts 3 m F and 4.3m A. TPC 10 tonnes. MCT 1 cm 120 tonnes m. The centre of flotation is 3 m aft of amidships.

If 80 tonnes of cargo is loaded in a position 24 m forward of amidships and 40 tonnes of cargo is discharged from 12 m aft of amidships, what are the new drafts?



Cargo loaded	80 tonnes
Cargo discharged	40 tonnes
Net loaded	40 tonnes

$$\text{Bodily sinkage} = \frac{w}{TPC} = \frac{40}{10}$$

Bodily sinkage = 4 cm

To find the change of trim take moments about the centre of flotation.

Weight	Distance from C.F.	Moment to change trim by head	Moment to change trim by stern
+80	−27	2160	–
−40	+9	360	–
		2520	–

$$\text{Change of trim} = \frac{\text{Trim moment}}{\text{MCT 1 cm}}$$
$$= \frac{2520}{120}$$
$$\text{Change of trim} = 21 \text{ cm by the head}$$
$$\text{Change of draft aft} = \frac{l}{L} \times \text{Change of trim}$$
$$= \frac{47}{100} \times 21$$
$$\text{Change of draft aft} = 9.87 \text{ cm}$$
$$\text{Change of draft forward} = \frac{53}{100} \times 21$$
$$\text{Change of draft forward} = 11.13 \text{ cm}$$

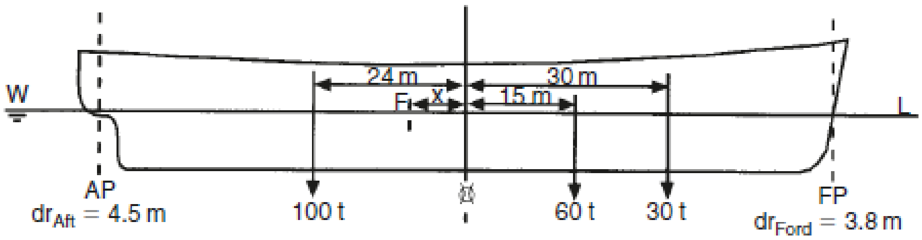
Original drafts	4.300 m A	3.000 m F
Bodily sinkage	+0.040 m	+0.040 m
	4.340 m	3.040 m
Change due trim	−0.099 m	+0.111 m
Ans. New drafts	4.241 m A	3.151 m F

- **Using trim to find the position of the centre of flotation**

Example

A ship arrives in port floating at drafts of 4.50 m A and 3.80 m F. The following cargo is then loaded:
100 tonnes in a position 24 m aft of amidships
30 tonnes in a position 30 m forward of amidships
60 tonnes in a position 15 m forward of amidships

The drafts are then found to be 5.10 m Aand 4.40 m F. Find the position of the longitudinal centre of flotation aft of amidships.
Original drafts 4.50 m A 3.80 m F give 0.70 m trim by the stern, i.e. +70 cm.
New drafts 5.10 m A 4.40 m F give 0.70 m trim by the stern, i.e. +70 cm.
Therefore there has been no change in trim, which means that



The moment to change trim by the head _ The moment to change trim by the stern.
Let the centre of flotation be 'x' metres aft of amidships. Taking moments, then,

$$100(24 - x) = 30(30 + x) + 60(15 + x)$$
$$2400 - 100x = 900 + 30x + 900 + 60x$$
$$190x = 600$$
$$x = 3.16\ \text{m}$$

Ans. Centre of flotation is 3.16 metres aft of amidships.

Note. In this type of question it is usual to assume that the centre of flotation is aft of amidships, but this may not be the case. Had it been assumed that the centre of flotation was aft of amidships when in actual fact it was forward, then the answer obtained would have been minus.

Remember. Levers, moments and trim by the stern all have a + ve sign. Levers, moments and trim by the head all have a - ve sign.

- **Loading a weight to keep the after draft constant**

When a ship is being loaded it is usually the aim of those in charge of the operation to complete loading with the ship trimmed by the stern.

Should the ship's draft on sailing be restricted by the depth of water over a dock-sill or by the depth of water in a channel, then the ship will be loaded in such a manner as to produce this draft aft and be trimmed by the stern.

Assume now that a ship loaded in this way is ready to sail. It is then found that the ship has to load an extra weight. The weight must be loaded in such a position that the draft aft is not increased and also that the maximum trim is maintained.

If the weight is loaded at the centre of flotation, the ship's drafts will increase uniformly and the draft aft will increase by a number of centimetres equal to w/TPC. The draft aft must now be decreased by this amount.

Now let the weight be shifted through a distance of'd' metres forward.

The ship will change trim by the head, causing a reduction in the draft aft by a number of centimetres equal to l/L x Change of trim.

Therefore, if the same draft is to be maintained aft, the above two quantities must be equal. i.e.

$$\frac{l}{L} \times \text{Change of trim} = \frac{w}{TPC}$$

So

$$\text{Change of trim} = \frac{w}{TPC} \times \frac{L}{l} \text{ -------------------- (I)}$$

$$\text{Change of trim} = \frac{w \times d}{\text{MCT 1cm}} \text{ ----------------- (II)}$$

Equate (I) and (II)

$$\therefore \frac{w \times d}{\text{MCT 1cm}} = \frac{w}{\text{TPC}} \times \frac{L}{l}$$

or

$$d = \frac{L \times \text{MCT 1cm}}{l \times \text{TPC}}$$

where
d = the distance forward of the centre of flotation to load a weight to keep the draft aft constant
L = the ship's length, LBP
l = the distance of the centre of flotation to the stern

2.1.3. STABILITY AND TRIM DIAGRAMS AND STRESS CALCULATING EQUIPMENT

- Strength curves for ships

Strength curves consist of five curves that are closely inter-related. The curves are:

1. Weight curve – tonnes/m run or kg/m run.

2. Buoyancy curve – either for hogging or sagging condition – tonnes/m or kg/m run.

3. Load curve – tonnes/m run or kg/m run.

4. Shear force curve – tonnes or kg.

5. Bending moment curve – tonnes m or kg m.

Some firms use units of MN/m run, MN and MN. m.

- **Buoyancy curves**

A buoyancy curve shows the longitudinal distribution of buoyancy and can be constructed for any wave formation using the Bonjean curves.

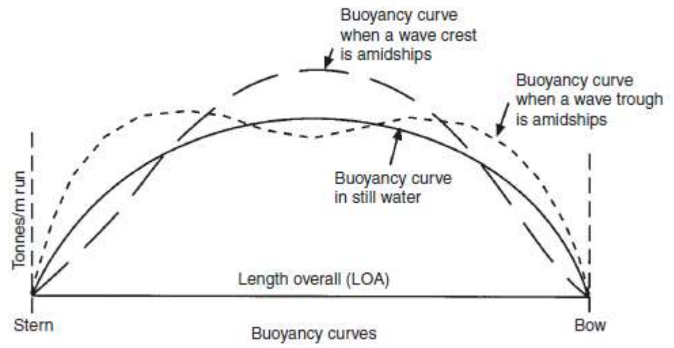
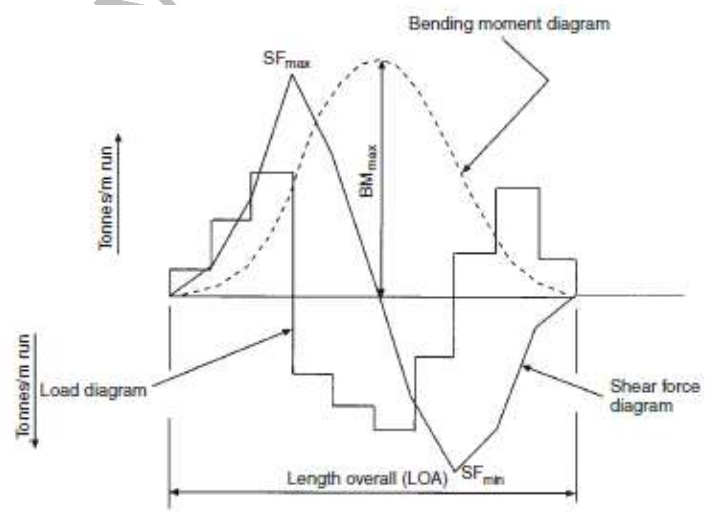


Fig. 51.1

curves for a ship are shown for the still water condition and for the conditions of maximum hogging and sagging. It should be noted that the total area under each curve is the same, i.e. the total buoyancy is the same. Units usually tonnes/m run along the length of the ship.

Load curves

A load curve shows the difference between the weight ordinate and buoyancy ordinate of each section throughout the length of the ship. The curve is drawn as a series of rectangles, the heights of which are obtained by drawing the buoyancy curve (as shown in Figure below) parallel to the weight curve at the mid-ordinate of a section and measuring the difference between the two curves. Thus the load is considered to be constant over the length of each section. An excess of weight over buoyancy is considered to produce a positive load whilst an excess of buoyancy over weight is considered to produce a negative load. Units are tonnes/m run longitudinally.



Showing three ship strength curves for a ship in still water conditions

- **Shear forces and bending moments of ships**

The shear force and bending moment at any section in a ship may be determined from load curve. It has already been shown that the shearing force at any section in a girder is

the algebraic sum of the loads acting on either side of the section and that the bending moment acting at any section of the girder is the algebraic sum of the moments acting on either side of the section.
It has also been shown that the shearing force at any section is equal to the area under the load curve from one end to the section concerned and that the bending moment at that section is equal to the area under the shearing force curve measured from the same end to that section.
Thus, for the mathematically minded, the shear force curve is the first order integral curve of the load curve and the bending moment curve is the first-order integral curve of the shearing force curve. Therefore, the bending moment curve is the second-order integral curve of the load curve.
Figure below shows typical curves of load, shearing force and bending moments for a ship in still water.
After the still water curves have been drawn for a ship, the changes in the distribution of the buoyancy to allow for the conditions of hogging and sagging can be determined and so the resultant shearing force and bending moment curves may be found for the ship in waves.

Example
A box-shaped barge of uniform construction is 32 m long and displaces 352 tonnes when empty, is divided by transverse bulkheads into four equal compartments. Cargo is loaded into each compartment and level stowed as follows:

No. 1 hold – 192 tonnes	No. 2 hold – 224 tonnes
No. 3 hold – 272 tonnes	No. 4 hold – 176 tonnes

Construct load and shearing force diagrams, before calculating the bending moments at the bulkheads and at the position of maximum value; hence draw the bending moment diagram.

$$\text{Mass of barge per metre run} = \frac{\text{Mass of barge}}{\text{Length of barge}}$$

$$= \frac{352}{32}$$

$$= 11 \text{ tonnes per metre run}$$

$$\text{Mass of barge when empty} = 352 \text{ tonnes}$$

$$\text{Cargo} = 192 + 224 + 272 + 176$$

$$= 864 \text{ tonnes}$$

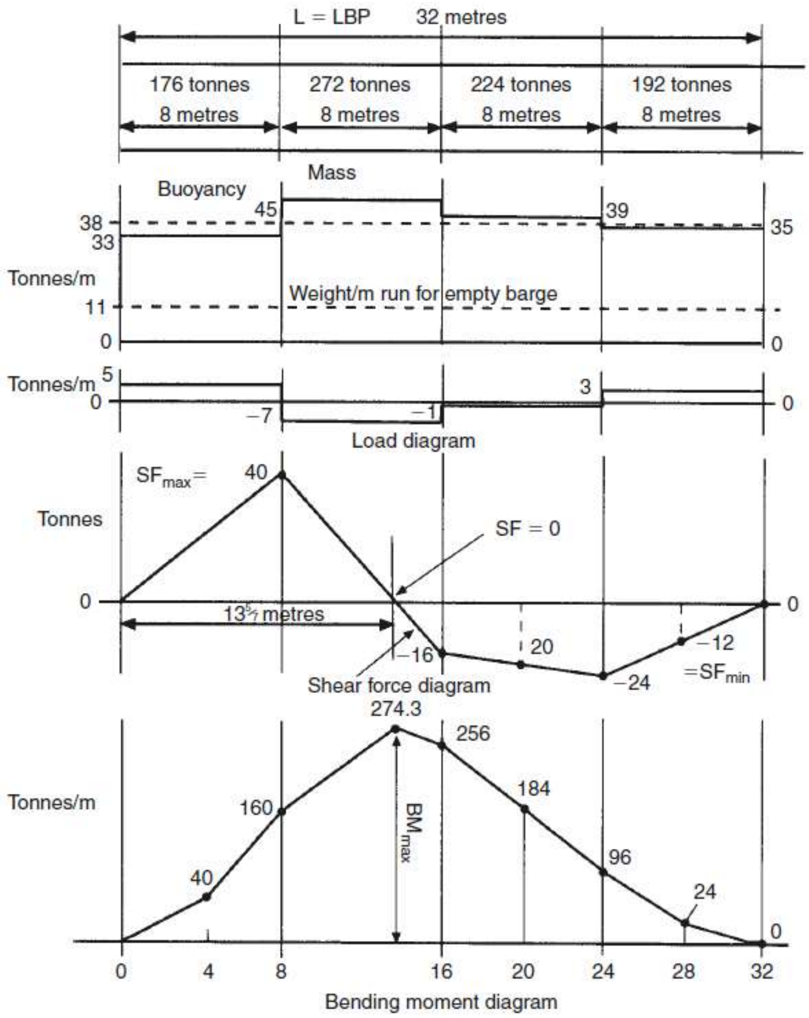
$$\text{Total mass of barge and cargo} = 352 + 864$$

$$= 1216 \text{ tonnes}$$

$$\text{Buoyancy per metre run} = \frac{\text{Total buoyancy}}{\text{Length of barge}}$$

$$= \frac{1216}{32}$$

$$= 38 \text{ tonnes per metre run}$$



Bending moments along the barge's length

$$BM_8 = \frac{8 \times 40}{2} = 160 \text{ t m}$$

$$= \underline{160 \text{ tonnes m}}$$

$$BM_0 = 0 \text{ t m}$$

$$BM_4 = \frac{20 \times 4}{2} = 40 \text{ t m}$$

$$BM_8 = \frac{8 \times 40}{2} = 160 \text{ t m}$$

$$BM_{13\frac{5}{7}} = \frac{13\frac{5}{7} \times 40}{2} = 274.3 \text{ t m}$$

$$BM_{16} = \left(\frac{13\frac{5}{7} \times 40}{2}\right) - \left(\frac{2\frac{2}{7} \times 16}{2}\right) = 256 \text{ t m}$$

$$BM_{20} = 256 - \left(\frac{16 + 20}{2}\right) \times 4 = 184 \text{ t m}$$

$$BM_{24} = 184 - \left(\frac{20 + 24}{2}\right) \times 4 = 96 \text{ t m}$$

$$BM_{28} = 96 - \left(\frac{24 + 12}{2}\right) \times 4 = 24 \text{ t m}$$

$$BM_{32} = 24 - \left(\frac{12 \times 4}{2}\right) = 0 \text{ t m}$$

- **Murray's method**

Murray's method is used to find the total longitudinal bending moment amidships on a ship in waves and is based on the division of the Total Bending Moment into two parts:

(a) the Still Water Bending Moment,

(b) the Wave Bending Moment.

The Still Water Bending Moment is the longitudinal bending moment amidships when the ship is floating in still water.

When using Murray's method the Wave Bending Moment amidships is that produced by the waves when the ship is supported on what is called a 'Standard Wave'. A Standard Wave is one whose length is equal to the length of the ship (L), and whose height is equal to 0.607 $\sqrt{L}$, where L is measured in metres.

The Wave Bending Moment is then found using the formula:

$$WBM = b \times B \times L^{2.5} \times 10^{-3} \text{ tonnes metres}$$

where B is the beam of the ship in metres and b is a constant based on the ship's block coefficient (C_b) and on whether the ship is hogging or sagging.

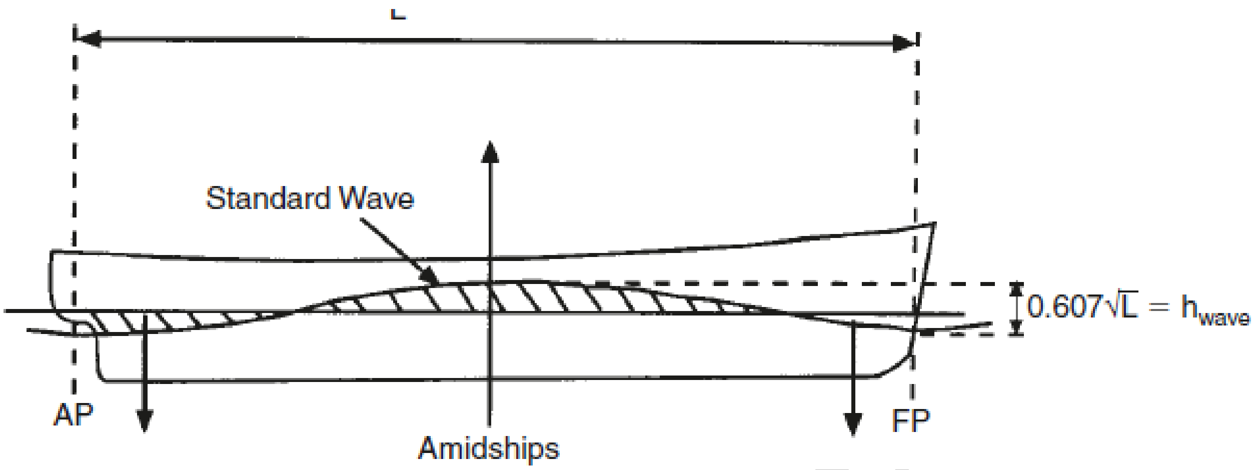
The value of b can be obtained from the table on the following page.

The Still Water Bending Moment (SWBM)

Let

W_F represent the moment of the weight forward of amidships.

B_F represent the moment of buoyancy forward of amidships.



Murray's coefficient 'b' values

Murray's coefficient 'b' values

C_b	Values of b	
	Hogging	Sagging
0.80	10.555	11.821
0.78	10.238	11.505
0.76	9.943	11.188
0.74	9.647	10.850
0.72	9.329	10.513
0.70	9.014	10.175
0.68	8.716	9.858
0.66	8.402	9.541
0.64	8.106	9.204
0.62	7.790	8.887
0.60	7.494	8.571

Let
W_A represent the moment of the weight aft of amidships.
B_A represent the moment of the buoyancy aft of amidships.
W represent the ship's displacement.
then:

$$\text{Still Water Bending Moment (SWBM)} = W_F - B_F = W_A - \mathbf{B}_A$$

This equation can be accurately evaluated by resolving in detail the many constituent parts, but Murray's method may be used to give an approximate solution with sufficient accuracy for practical purposes.

The following approximations are then used:

$$\text{Mean Weight Moment } (M_W) = \frac{W_F + W_A}{2}$$

This moment is calculated using the full particulars of the ship in its loaded condition.

$$\text{Mean Buoyancy Moment } (M_B) = \frac{W}{2} \times \text{Mean LCB of fore and aft bodies}$$

An analysis of a large number of ships has shown that the Mean LCB of the fore and aft bodies for a trim not exceeding 0.01L can be found using the formula:

Mean LCB = L x C

where L is the length of the ship in metres, and the value of C can be found from the following table in terms of the block coefficient (Cb) for the ship at a draft of 0.06 L.

Murray's coefficient 'C' values

Draft	*C*
0.06 L	$0.179C_b + 0.063$
0.05 L	$0.189C_b + 0.052$
0.04 L	$0.199C_b + 0.041$
0.03 L	$0.209C_b + 0.030$

The Still Water Bending Moment Amidships (SWBM) is then given by the formula:

$$\text{SWBM} = \text{Mean Weight Moment } (M_W) - \text{Means Buoyancy Moment } (M_B)$$

or

$$\text{SWBM} = \frac{W_F + W_A}{2} - \frac{W}{2} \times L \times C$$

where the value of C is found from the table above.
If the Mean Weight Moment is greater than the Mean Buoyancy Moment then the ship will be hogged, but if the Mean Buoyancy Moment exceeds the Mean Weight Moment then the ship will sag. So

(i) If $M_W > M_B$ ship hogs
(ii) If $M_B > M_W$ ship sags } $M_W \backslash M_B$

The Wave Bending Moment (WBM)

The actual Wave Bending Moment depends upon the height and the length of the wave and the beam of the ship. If a ship is supported on a Standard

Wave, as defined above, then the Wave Bending Moment (WBM) can be calculated using the formula:

$$WBM = b \times B \times L^{2.5} \times 10^{-3} \text{ tonnes metres}$$

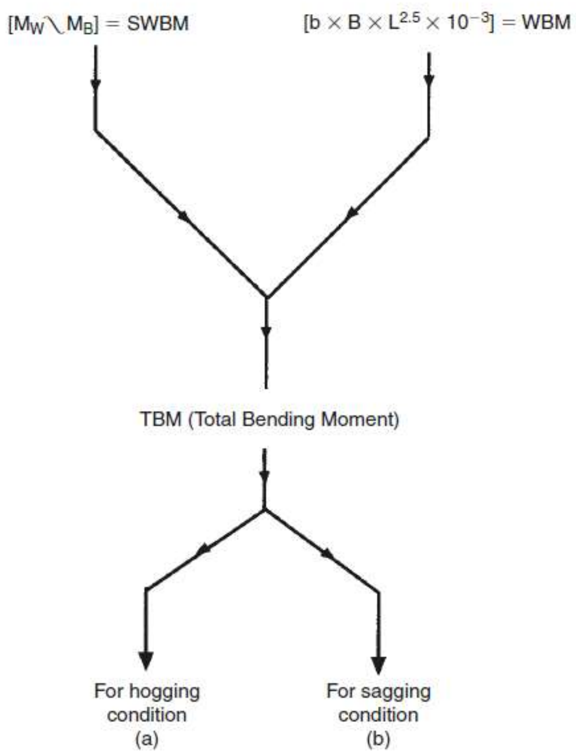
where B is the beam of the ship and where the value of b is found from the table previously shown.

Example

The length LBP of a ship is 200 m, the beam is 30 m and the block coefficient is

0.750. The hull weight is 5000 tonnes having LCG 25.5 m from amidships. The mean LCB of the fore and after bodies is 25 m from amidships. Values of the constant b are: hogging 9.795 and sagging 11.02.

Given the following data and using Murray's method, calculate the longitudinal bending moments amidships for the ship on a Standard Wave with: (a) the crest amidships and (b) the trough amidships. Use Figure below to obtain solution.



Item	*Weight*	*LCG from amidships*
No. 1 hold	1800 t	55.0 m aft
No. 2 hold	3200 t	25.5 m forward
No. 3 hold	1200 t	5.5 m forward
No. 4 hold	2200 t	24.0 m aft
No. 5 hold	1500 t	50.0 m aft
Machinery	1500 t	7.5 m aft
Fuel oil	400 t	8.0 m aft
Fresh water	150 t	10.0 m forward

Item	*Weight*	*LCG from amidships*	*Moment*
No. 1 hold	1800	55.0 m forward	99 000
No. 2 hold	3200	25.5 m forward	81 600
No. 3 hold	1200	5.5 m forward	6600
No. 4 hold	2200	24.0 m aft	52 800
No. 5 hold	1500	50.0 m aft	75 000
Machinery	1500	7.5 m aft	11 250
Fuel oil	400	8.0 m aft	3200
Fresh water	150	10.0 m forward	1500
Hull	5000	25.5 m	127 500
	16 950		458 450

To find the Still Water Bending Moment (SWBM)

$$\text{Mean Weight Moment } (M_W) = \frac{W_F + W_A}{2}$$

$$= \frac{458\,450}{2}$$

$$\underline{M_W = 229\,225 \text{ t m}}$$

$$\text{Mean Buoyancy Moment } (M_B) = \frac{W}{2} \times \text{LCB} = \frac{16\,950}{2} \times 25$$

$$= 211\,875 \text{ t m}$$

$$\text{Still Water Bending Moment (SWBM)} = M_W - M_B$$

$$= 229\,225 - 211\,875$$

$$\text{SWBM} = 17\,330 \text{ t m (hogging) because } M_W > M_B$$

Wave Bending Moment (WBM)

$$\text{Wave Bending Moment (WBM)} = b \times B \times L^{2.5} \times 10^{-3} \text{ t m}$$

$$\text{WBM hogging} = 9.795 \times 30 \times 200^{2.5} \times 10^{-3} \text{ t m}$$

$$= 166\,228 \text{ t m}$$

$$\text{WBM sagging} = 11.02 \times 30 \times 200^{2.5} \times 10^{-3} \text{ t m}$$

$$= 187\,017 \text{ t m}$$

Total Bending Moment (TBM)

$$\text{TBM hogging} = \text{WBM hogging} + \text{SWBM hogging}$$

$$= 166\,228 + 17\,350$$

$$= \underline{183\,578 \text{ t m}}$$

$$\text{TBM sagging} = \text{WBM sagging} - \text{SWBM hogging}$$

$$= 187\,017 - 17\,350$$

$$= \underline{169\,667 \text{ t m}}$$

Answer (a) with crest amidships, the Total Bending Moment, TBM is 183 578 tonnes metres.

Answer (b) with trough amidships, the Total Bending Moment, TBM is 169 667 tonnes metres.

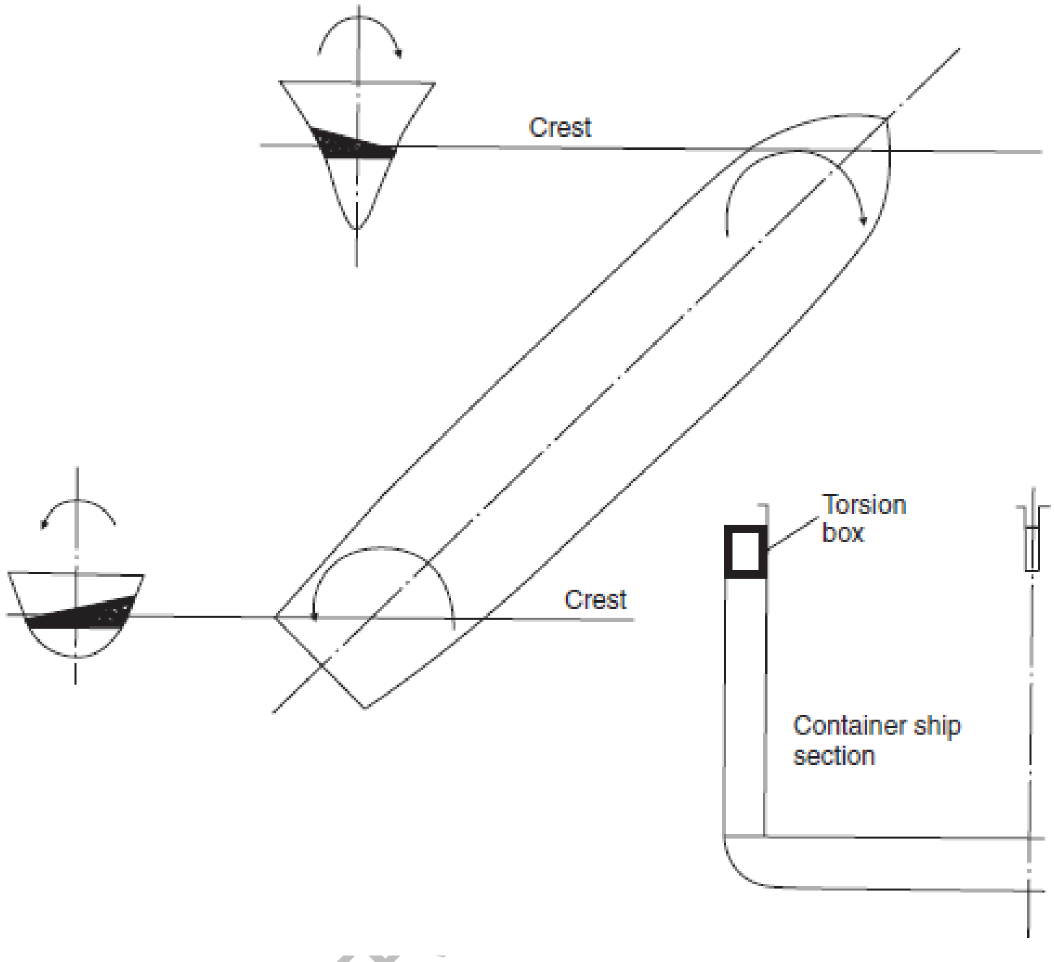
The greatest danger for a ship to break her back is when the wave crest is at amidships, or when the wave trough is at amidships with the crests at the stem and at the bow.

In the previous example the greatest BM occurs with the crest amidships.

Consequently, this ship would fracture across the upper deck if the tensile stress due to hogging condition became too high.

Torsion

When any body is subject to a twisting moment which is commonly referred to as torque, that body is said to be in 'torsion'. A ship heading obliquely (45°) to a wave will be subjected to righting moments of opposite direction at its ends twisting the hull and putting it in 'torsion'. In most ships these torsional moments and stresses are negligible but in ships with extremely wide and long deck openings they are significant. A particular example is the larger container ship where at the topsides a heavy torsion box girder structure including the upper deck is provided to accommodate the torsional stresses.



Torsion

2.1.4. STOWAGE AND SECURING OF CARGOES ON-BOARD SHIP, CARGO HANDLING GEAR AND SECURING AND LASHING EQUIPMENT

All cargoes should be stowed and secured in such a way that the ship and persons on board are not put in risk.

The safe stowage and securing of cargoes depend on proper planning, execution and supervision.

Personnel commissioned to tasks of cargo towage and securing should be properly qualified and experienced.

Personnel planning and supervising the stowage and securing of cargo should have a sound practical knowledge of the application and content of the cargo securing manual, if provided.

In all cases, improper stowage and securing of cargo will be potentially hazardous to the securing of other cargoes and to the ship itself.

Decisions taken for measures of stowage and securing cargo should be based on the most severe weather condition which may be expected by experience for the intended voyage.

Ship-handling decisions taken by the master, especially in bad weather conditions should take into account the type and stowage position of the cargo and the securing arrangements.

- **Stability**

The ship should be supplied with comprehensive stability information which takes into account timber deck cargo. Such information should enable the master, rapidly and imply, to obtain accurate guidance as to the stability of the ship under varying conditions of services. Comprehensive rolling period tables or diagrams have proved to be a very useful aid in verifying the actual stability conditions.

The stability of the ship at all times, including during the process of loading and unloading timber deck cargo, should be positive and to a standard acceptable to the administration. It should be calculated having regard to:

- The increased weight of the timber weight of the timber deck cargo due to:
- Absorption of water in dried or seasoned timber, and
- Ice accretion, if applicable;
- Variation on consumables;
- The free surface effect of liquid in tanks; and
- The weight of water trapped in broken spaces within the timber deck cargo and especially logs.

The master should:

- Cease all loading operations if a list develops for which there is no satisfactory explanation and it would be imprudent to continue loading;
- Before proceeding to sea, ensure that:
- The ship is upright
- The ship has an adequate metacentric heigh; and
- The ship meets the required stability criteria.

Ship carrying timber deck cargoes should operate, as far as possible, with a safe margin of stability and with metacentric height which is consistent with safety requirements but such metacentric height should not be allowed to fall below the recommended minimum.

However, excessive initial stability should be avoided as it will result in rapid and violent motion in heavy seas which will impose large sliding and racking forces in the cargo causing high stresses on the lashings. Operational experience indicates that metacentric height should preferably not exceed 3% of the breadth in order to prevent excessive accelerations in rolling provided that the relevant stability criteria are satisfied.

This recommendation may not apply to all ships and the master should take into consideration the stability information obtained from the ship's stability manual.

- **Stowage**

Before timber deck cargo is loaded on any are of the weather deck:

- Hatch covers and other openings to spaces below that area should be securely closed and battened down;
- Air pipes and ventilators should be efficiently protected and check- valves or similar devices should be examined to ascertain their effectiveness against the entry of water;
- Accumulations of ice and snow on such are should be removed; and
- It is normally preferable to have all deck lashings, uprights, etc., in position before loading on that specific area. This will be necessary should a preloading examination of securing equipment be required in the loading port.
- The timber deck cargo should be so stowed that:

- Safe and safety access to the crew's quarters, pilot boarding access, machinery spaces and all other areas regularly used in the necessary working of the ship is provided at all times;
- Where relevant, openings that gives access to the areas described can be properly closed and secured against the entry of water;
- Safety equipment, devices for remote operation of valves and sounding pipes are left accessible; and
- It is compact and will not interfere in any way with the navigation and necessary working of the ship.

During loading, the timber deck cargo should be kept free of any accumulations of ice and snow.

Upon completion of loading, and before sailing a thorough inspection of the ship should be carried out. Soundings should also be taken to verify that no structural damage has occurred causing an ingress of water.

- **Height and extent of timber deck cargo**

The height of the timber deck cargo above the weather deck on a ship within a seasonal winter zone in winter should not exceed one third of the extreme breadth of the ship.

The height of timber deck cargo should be restricted so that:

- Adequate visibility is assured;
- A safe margin of stability is maintained at all stages of the voyage;

- Any forward-facing profile does not present overhanging shoulders to a head sea; and
- The weight of the timber deck cargo does not exceed the designed maximum permissible load on the weather deck and hatches.

On ships provided with, and making use of, their timber load line, the timber deck cargo should be stowed so as to extend:

- Over the entire available length of the well or wells between superstructures and as practicable to end bulkheads;
- At least to the after end of the aftermost hatchway in the case where there is no limiting superstructure at the after end;
- Athwartships as close as possible to the ship's side, after making due allowance for obstructions such as guardrails, bulwark stays , uprights, pilot boarding access, etc., provided any area of broken stowage thus created at the side of the ship does not exceed a mean of 4% of the breadth; and
- To at least the standard height of a superstructure other than a raised quarterdeck.

The basic principle for the safe carriage of any timber deck cargo is a solid stowage during all stages of the deck loading. This can only be achieved by constant supervision by shipboard personnel during the loading process.

- **Securing**

Every lashing should pass over the timber deck cargo and be shackled to eyeplates suitable and adequate for the intended purpose and efficiently attached to the deck stringer plate or other strengthened points. They should be installed in such a manner as to be, as far as practicable, in contact with the timber deck cargo throughout its full height.

All lashings and components used for securing should:

- Possess a breaking strength of not less than 133kN;
- After initial stressing, show an elongation of not more than 5% at 80% of their breaking strength; and
- Show no permanent deformation after having been subjected to a proof load of not less than 40% of their original breaking strength.

- The number and size of rope clips utilized should be in proportion to the diameter of the wire rope and should not be less than four, each spaced at intervals of not less than 15 cm;

- The saddle portion of the clip should be applied to the live load segment and the U-boit to the dead or shortened end segment;
- Rope clips should be initially tightened so that they visibly penetrate into the wire rope and subsequently be re-tightened after the lashing has been stressed.

Greasing the threads of grips, clips, shackles and turnbuckles increases their holding capacity and prevents corrosion.

- **Physical properties of timber cargoes**

Stowage factors

Typical values for density and stowage factors are given in the table below for different types of timber deck cargoes.

Type of timber cargo	Density [ton / m^3]	Volume factor [m^3 hold space / m^3 cargo]	Stowage factor [m^3 hold space / ton of cargo]
Sawn wood			
Packages of sawn wood with even ends	0.5 – 0.8	1.4 -1.7	1.8 – 3.4
Packages of sawn wood with uneven ends	0.5 – 0.8	1.6 – 1.9	2.0 - 3.8
Packages of planed wood with even ends	0.5	1.2 – 1.4	2.4 - 2.8
Round wood			
Coniferous round wood, fresh (bark on)	0.9 – 1.1	1.5 - 2.0	1.4 - 2.2
Broad-leaf round wood, fresh (bark on)	0.9 – 1.5	2.0 - 2.5	1.3 - 2.8
Round wood, dried (bark on)	0.65	1.5 - 2.0	2.3 - 3.1
Debarked coniferous round wood, fresh	0.85 – 1.2	1.5 – 2.0	1.2 – 2.4
Debarked broad-leaf round wood, fresh	0.9 – 1.0	1.5 – 2.5	1.5 – 2.8
Debarked round wood, dried	0.6 – 0.75	1.2 – 2.0	1.6 – 3.3

Typical values for density and stowage factors

The densities and stowage factors in the table above are presented for information purpose only to aid preplanning operations. The corresponding values for actual loads may vary significantly from those presented in the table depending on the timber type and condition. During actual loading more accurate values of the cargo weight are obtained by repeated checks of the vessel's displacement. The weights of sawn wooden packages are normally more accurate.

The weight of uncovered timber cargo may change during a voyage due to loss or absorption of water (but wrapped bundled cargoes do not). Timber cargo stowed under deck may lose weight whereas timber stowed on deck may gain weight by absorption of water. Particular attention should be given to the impact that these and other changing conditions have on stability throughout a voyage.

Friction factors

Cargo at rest is prevented from sliding by static friction. When movement has been initiated the resistance of the material contact is reduced and sliding is counteracted by dynamic friction.

The static friction may be determined by an inclination test. The angle ρ is measured when the timber cargo starts to slide. The static friction is calculated as:

$\mu = \tan(\rho)$.

Five inclination tests should be performed with the same combination of materials.

The highest and the lowest values should be disregarded and the friction factor is taken as the average of the three middle values. This average figure should be rounded down to the nearest fraction of 0.05.

If the values are intended to be used for non-winter conditions, the coefficient of friction for both dry and wet contact surfaces should be measured in separate series of tests and the lower of the two values are to be the used when designing cargo securing arrangements.

If the values are intended to be used for winter conditions when exposed surfaces are covered by snow and ice, the lowest coefficient of friction found for either dry, wet or snowy and icy contact surfaces should be used when designing cargo securing arrangements.

If not specially measured the dynamic friction factor may be taken as 70% of the static values.

The following values of static friction for the mentioned conditions may be used when designing securing arrangements for timber deck cargoes unless the actual coefficient of friction is measured and documented as described above.

Contact surface	**Non-winter conditions** *Dry or wet*	**Winter conditions**
Sawn wooden package		
against painted steel	0.45	0.05
against sawn wood	0.50	0.30
against plastic cover or webbing slings	0.30	0.25
Round wood		
coniferous round wood (bark on) *against* painted steel	0.35	
coniferous round wood (bark on) *between layers*	0.75	

Typical values of static friction for different material combinations

Static friction may be used for tight block stowage arrangements as well as for the design of frictional lashing systems such as top-over lashing systems.

Dynamic friction should be used for non-rigid lashing systems, which due to elasticity of securing equipment allow for minor dislocation of the cargo before full capacity of the securing arrangement is reached.

Plastic covers

Plastic sheeting is often used on packages of sawn wood to protect the cargo. High friction coatings (friction coefficient 0.5 and above) can be incorporated into plastic sheeting as an important means of improving the safe transport of these cargoes.

Special precautions should be taken to prevent slippery plastic hoods with low friction coefficients, from being used as a sawn wood package cargo covering on deck.

Package marking

All sawn wooden packages should be clearly marked with the volume of the package.

The marking should be clearly visible on the top of the package as well as both long sides.

Water absorption

Sea spray may increase the weight of the timber deck cargo and thus influence the stability.

The weight increase of the timber varies with time, exposure and type of timber. The value of increased weight of timber deck cargo due to water absorption should be considered in accordance with the 2008 IS Code and special instructions in Annex C.

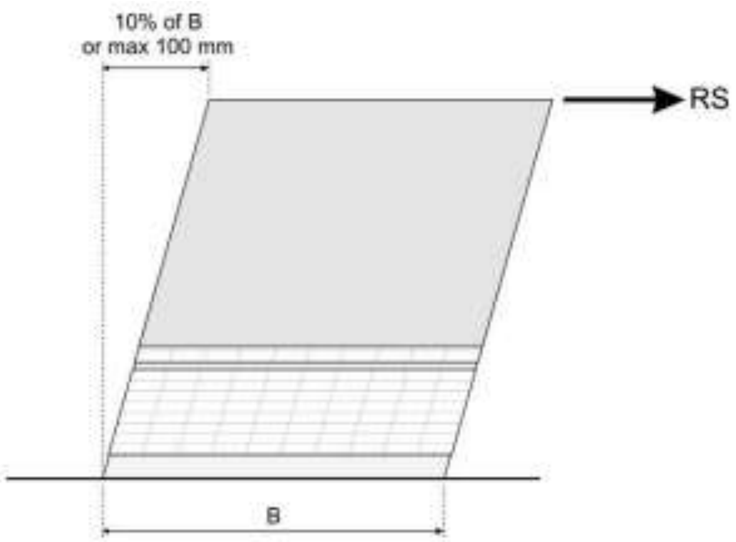
Weight of ice

During cold weather conditions ice may form from sea spray and the stability may be affected as the ice can add weight rapidly. Any increase in weight due to water absorption should be considered before calculating the increase due to the weight of ice.

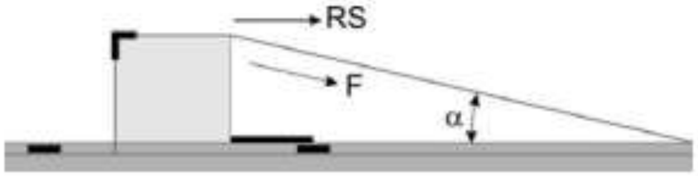
Rigidity of sawn wood packages

- The Racking Strength, RS, of a sawn wood package is defined as the horizontal force that a package can withstand per metre package length without collapsing or deforming more than 10% of its width, B, or a maximum of 100 mm as shown in figure below.

The racking strength of timber packages can be measured by a test setup as shown in figure below. The angle α should not be greater than 30º.



Racking strength of timber packages



Test setup for racking strength

The Racking Strength, RS, is taken as the applied force F ·cos α (see figure above) when the package collapses or when the deflection in the top is 10% of the package width, B, or maximum 100 mm.

Racking strength measurements will have to be carried out by the shipper and the information should be provided to the master as part of the required cargo information mentioned in SOLAS chapter VI.

- **Physical properties of timber deck cargoes**

- Friction

Friction is one of the most important factors preventing cargo from shifting. Deck cargo may shift due to a lack of internal friction. Snow, ice, frost, rain, and other slippery surface conditions drastically affect friction. Special consideration should be given to package materials, contact surfaces, and weather conditions.

Static friction may be used for tight block stowage arrangements as well as for the design of frictional lashing systems such as top-over lashing systems.

Dynamic friction should be used for non-rigid lashing systems, e.g. loop lashings, which due to elasticity of securing equipment allow for minor dislocation, of the cargo before full capacity of the securing arrangement is reached.

- Rigidity of timber packages

The rigidity of timber packages is of great importance for the stability of the deck cargo and the racking strength of the timber packages should be taken into consideration when securing systems are designed. The racking strength should not be less than 3.5 kN/m of package length.

Example of poor rigidity

Procedures for receiving and delivering cargo

The shipping documents´ receipt function:

In the frame of carriage by sea shipping documents act as receipts representing that the goods were shipped for carriage and representing as well the condition in which those goods were shipped. This can be evidenced in the statements incorporated by the parties in the document. This function is generally represented by statements as to the:

1. the apparent order and condition of the goods;
2. the quantity, packages and weight of the cargo; and
3. its leading marks. Although the statements within the shipping documents are not considered as contractual clauses but as mere representations of fact, these statements are material whenever litigation arises in terms of the evidence power they have.

Although the receipt function of the different shipping documents is in principle the same, the effect of its function as receipts varies according to the legal regime that applies to the contract.

In a claim arising due to loss, shortage or damage of cargo, the starting point for the innocent party to prove his case, and in many cases the only proof the innocent party has is based on the descriptions made in the shipping document. For the innocent party, it is important to be able to use the receipt function of the shipping document in all of its extent in order to avoid the burden of proof to be reversed having to assume the burden that in principle is one of the carrier.

The problem comes when the representations in the shipping document, due to a qualification made by the carrier, becomes irrelevant as evidence of the state of the cargo, or what is even worse do not represent the real condition of the cargo received by the carrier. Consequently, in any of these cases is to the claimant (cargo interest) to prove via alternative means of evidence that the goods were shipped and that the shortage or damages suffered by the cargo occurred during the time the goods were under the carrier control.

Bills of Lading

The bill of lading is a record of the quantity of cargo and of its apparent order and condition at the time of shipment and, as such, is a vitally important document. Cargo damage or shortage claims can result from errors in the quantity and condition of cargo recorded on the bills of lading. The bill of lading also represents the cargo itself and possession of the original bill indicates who is entitled to receive the cargo at the discharge port. If you have any doubt about dealing with bill of lading problems, call the local P&I correspondent immediately.

- **The Bill of Lading's receipt function:**

The bill of lading contains "an acknowledgement by the carrier that he has received the goods in question" as described by the shipper and as such, it will be the basis to defend the parties' position in a cargo dispute.

The importance of the bill of lading as evidence is because this document "is considered to be a binding receipt or acknowledgement as to shipment on board the carrier's ship." Nevertheless, in practice and as a matter of law it can be seen that this evidence purpose disappears once the carrier includes a qualification to the statements within the Bill of lading.

The statements into the bill of lading are usually inserted by the shipper. However, that information is understood to be ratified by the carrier once his master on his behalf signs the bill of lading. From that moment on, it can be argued that the bill of lading is evidence of the goods as received by the carrier and the representations incorporated in it can produce effects to the parties involved in the contract of carriage and to third parties who might become part of that contract, such as the consignee or the indorsee of the bill of lading.

- **General Procedures**

Typical discrepancies with bills of lading:

- wrong port and date;
- quantity of cargo incorrect;
- description of cargo incorrect;
- condition of cargo incorrect.

- check the details on the bills against tally sheets, mate's receipts, boat notes, draft surveys;
- note on the bills any details of damaged cargo, or short-delivered cargo, or any other discrepancies. (Guidelines on how to describe pre-shipment damage to steel cargoes is contained in the Club's Guide to P&I Cover. If in doubt call the local P&I correspondent and ask for a surveyor).

It is not your job to decide whether the cargo is marketable, only to decide whether it is in apparent good order and condition, this is particularly relevant to steel cargoes.

- Typical Problems
  - shipper objects to the bills being claused - notify your owner or manager and P&I correspondent immediately;
  - if you suspect that the agents have signed bills on your behalf without checking the mate's receipts or without noting on the bills any remarks which are in the mate's receipts – inform your owner or manager immediately;
  - the bill of lading is not presented at the discharge port by the person requesting delivery of the cargo - notify your owner or manager or the P&I correspondent immediately.
- Golden Rules
  - never sign wrongly dated bills;
  - never sign clean bills for damaged cargo or for cargo which is not in apparent good order and condition;
  - never sign bills for cargo which has not been loaded;
  - always call the P&I correspondent if you have any problem with the condition and quantity of cargo or with the bills of lading;
  - never deliver cargo to a third party without presentation of the original bill;
  - never discharge cargo against a letter of indemnity without your owner's or manager's or the Club's agreement.

If it is agreed to retain one original bill of lading on board against which the cargo may be delivered, the shippers'/charterers' instructions for procedures at the discharge port must be strictly followed. In such a case, to protect the shipowner from a claim for mis-delivery of the cargo, all original bills of lading should be endorsed as follows:

"One original bill of lading retained on board against which delivery of cargo may properly be made on instructions received from shippers/charterers."

- always advise your owner or manager of any deviation which involves cargo discharge.

Cargo damage associated with the history of the voyage

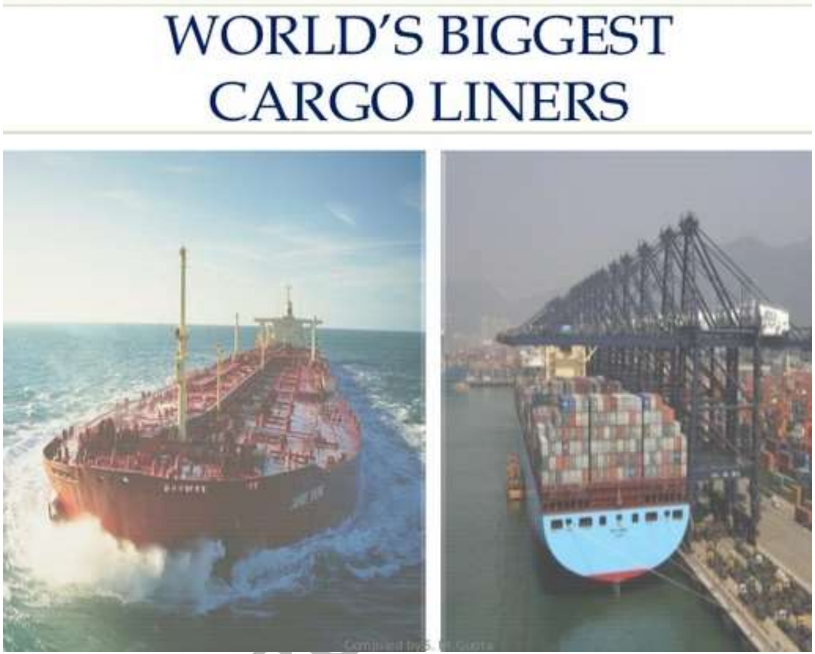
Cargo refers to:

The goods and commodities carried during transit by:

- Rail, road, sea or air from one place to another.

The cargo transported by sea is subjected to manifold risk such as:

- Loss or damage at the port and
- Loss or damage during the voyage



Marine cargo insurance provides the insurance cover in respect of:

- Loss of or damage to cargo during transit by:
  - Rail, road, sea or air.

Thus marine cargo insurance covers the following:

- Export and import shipments by ocean
- Transshipments
- Shipment by inland vessels
- Consignments sent by rail, road, air &
- Articles sent by post

Marine cargo insurance covers the shipper of the goods, if the goods are damage or lost during transit.

- The cargo policy covers the risk associated with the transshipment of goods.
- The policy could be issued to cover a single shipment or
- If regular shipments are made:
  - An open policy can be issued which insures the good/ cargo automatically whenever a shipment is made.

Marine insurance is a contract under which the insurer undertakes to indemnify the insured:

- In the manner and to the extend thereby agreed
- Against marine losses, incidental to marine adventures.

It may be defined as a form of insurance covering loss or damage to:

- Vessels or to cargo during transportation.

Care of cargo during carriage

- **Stowage Methods**

Bagged Cargo (paper bags)

These should be stowed on double dunnage. Ideally the first layer should be stowed athwartships on vessels equipped with side bilge systems. Steelwork should be covered by brown paper or matting to prevent bags making contact. Torn bags should be refused on loading. Canvas rope slings should be made up in the hatchway centre to avoid dragging and bursting bags. Hooks should never be used with paper bag cargoes. When stowing, bag on bag stow is good for ventilation, whereas bag on half bag is poor for ventilation but good for economical use of space.

Barrels

Stowed 'bung' uppermost on wood beds, in a fore and aft direction. 'Quoins' are used to prevent movement of the cargo when the vessel is in a seaway. Barrels should never be stowed more than eight high.

Coal (bulk)

Check that bilge suctions are in working order and that limber boards are tight fitting. Remove all spar ceiling, stow in the 'tween deck, and cover with a tarpaulin or other similar protection. Plug 'tween deck scuppers.

Remove all dunnage and make arrangements for obtaining temperatures at all levels if engaged on a long voyage. Ensure that the coal levels are well trimmed and provide the compartment with surface ventilation whenever weather conditions permit.

Copra

As it is liable to spontaneous combustion, it should be kept dry and clear of steelwork surfaces, which are liable to sweat. Copra beetle will get into any other cargoes which are stowed in the same compartment.

Cotton

Bales are liable to spontaneous combustion, so that the hold must be dry and clean, free of oil stains etc. Adequate dunnage should be laid and all steelwork covered to prevent contact with cargo. Wet and damaged bales should be rejected at the loading port.

Hoses and fire appliances should be on hand and readily available during the periods of loading, fire wires being rigged fore and aft.

Edible Oils

Deep tank stow, for which the tank must be thoroughly cleaned, inspected, and a certificate issued by a surveyor.

Heating coils will be required, and these should be tested during the period of preparation of the space. All inlets and outlets from the tank should be blanked off. Shippers' instructions with regard to carriage temperatures should be strictly adhered to. A cargo log of these temperatures should be kept. Extreme care should be taken on loading to leave enough 'ullage' for expansion of the oil during passage. Overheating should never be allowed to occur, as damage to the oil will result.

Flour

Susceptible to damage from moisture or by tainting from other cargoes, it should never be stowed with fruit, new timber or grain. Should a fire occur during passage,'dust explosions' are liable from this cargo.

Fruit

Usually carried in refrigerated spaces, especially over long sea passages, it may also be carried chilled under forced ventilation.However, regular checks should be made on ventilation system and compartment temperatures.

This cargo gives off CO2 and will consequently require careful ventilation throughout the voyage.

Glass (Crates)

Crates of glass should never be stowed flat, but on their edge, on level deck space. Plate glass should be stowed athwartships and window glass in the fore and aft line, each crate being well secured by chocks to prevent movement when the vessel is at sea. Overstowing by other cargoes should be avoided.

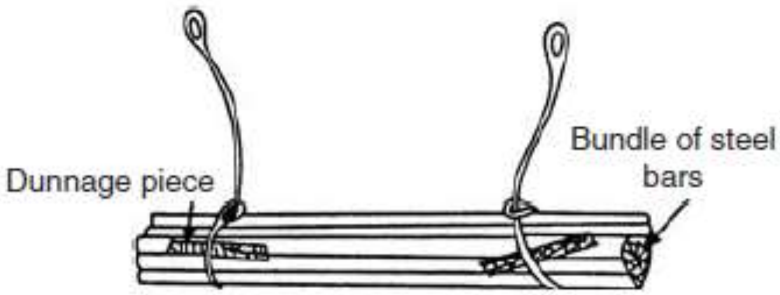
Vehicles

These should be stowed in the fore and aft line, on level deck space.They should be well secured against pitching and rolling of the vessel by rope lashings. Fuel tanks should be nearly empty. Close inspection should be made at the point of loading, any damage being noted on acceptance.

- **CARGO HANDLING**

Use of Snotters

Rope or wire snotters are in common use when general cargo is discharged. Wire snotters are probably the most widely used, but care should be taken that when using them as illustrated in the Figure below, the wire is not



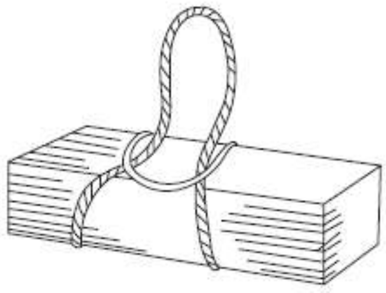
Use of snotters

Logs being loaded up to the hatch coaming by use of wire snotters. NB. Timber below decks eliminates the absorption factor which is always a risk with timber as deck cargo.

allowed to slip along the surface of the steel.This possibility can be eliminated by spreading the area of pressure by inserting a dunnage piece between wire and cargo. Snotters should be secured on alternate sides, passing eye through eye to provide stability to the load.

Use of the Bale Sling Strop

A bale sling strop is more commonly known as a sling or even just a rope strop. it is an endless piece of rope whose ends have been joined by a short splice, used extensively for the slinging of cases or bales, hence its full title.



Use of bale sling strop

Palletisation

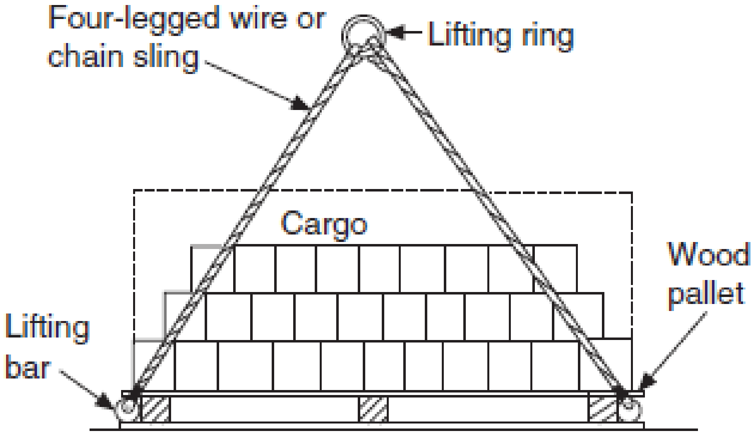
This is a most convenient pre-package cargo-handling technique.

Separate slings of cargo are made up before the vessel berths, which speeds up turn round time, so saving the shipowner considerable port costs.

The cargo is generally stacked on wood pallets, which allows easy handling by the use of fork lift trucks.The upper layer of cargo packages are often banded or the full load may be covered by protective polythene.This securing acts as a stabilising factor when the load is being hoisted, as well as an anti-theft device while the pallet is being loaded, stowed or discharged.

The slings are usually made of steel wire rope, having four legs secured to a lifting ring. Each pair of wire slings holds a steel lifting bar, which is used to lift the ends of the pallet and its cargo.

Each load is usually squared off, and bound secure to reduce broken stowage within the hold, especially so when the vessels are of a flush deck and square corner construction. The pallets cause a certain amount of broken stowage, but this has become an acceptable factor compared to costs of lengthy handling procedures.



Use of pallets

Cargo Nets

Fibre rope cargo nets are in general use throughout the marine industry and are extensively used for such cargoes as mail bags, personal effects etc. where the extra strength and wear resistance of a wire rope net is not required.

Wire rope cargo nets are designed for longer life, and are stouter than fibre nets. They carry a bigger load with greater safety, and tend not to distort under the most difficult conditions. Fibre rope nets are generally of a knotted mesh, but may be woven. The mesh of a wire rope net will contain a specially designed clip at every cross, to provide reinforcement for the net as well as protecting the wire from wear.

Timber Dogs

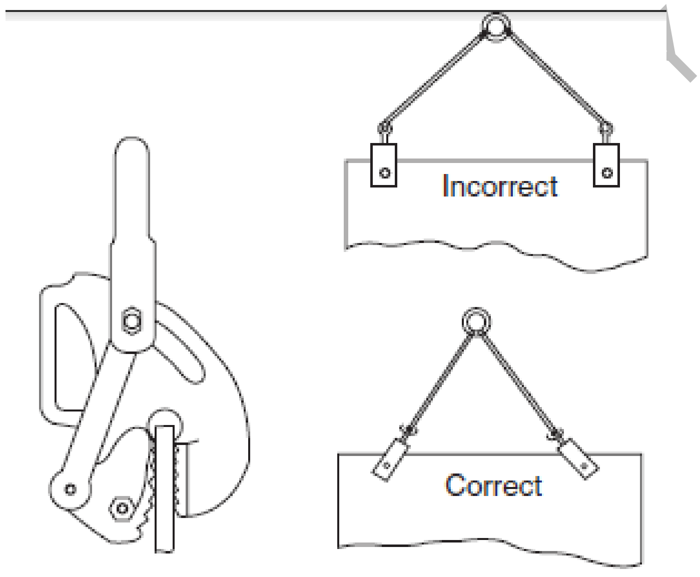
Timber dogs are used purely for the lifting of short heavy logs. The weight of the log causes the sharpened dogs to exercise an even greater grip when inserted into the grain end of the timber. Extreme caution should be observed with this method of lifting, to ensure that the point of the dog is well embedded before starting the lift.

Timber dogs

Plate Clamps

If the construction of the plate will permit this method of lifting, then it should be employed.Whether or not the construction of the plate structure lends itself to the use of shackles and slings, or to plate clamps, only one plate should be lifted at any one time.

When lifting with plate clamps, loads must not exceed the marked capacity of the clamp, and the jaws must be as narrow as possible for the plate thickness. Before lifting the plate, it should be checked to ensure that it is properly gripped, and under no circumstances should packing be used between the jaws and the plate. When two clamps are to be used, they should be inclined and secured in the line of the sling, once the slack has been taken out of the slings.



Use of plate clamps

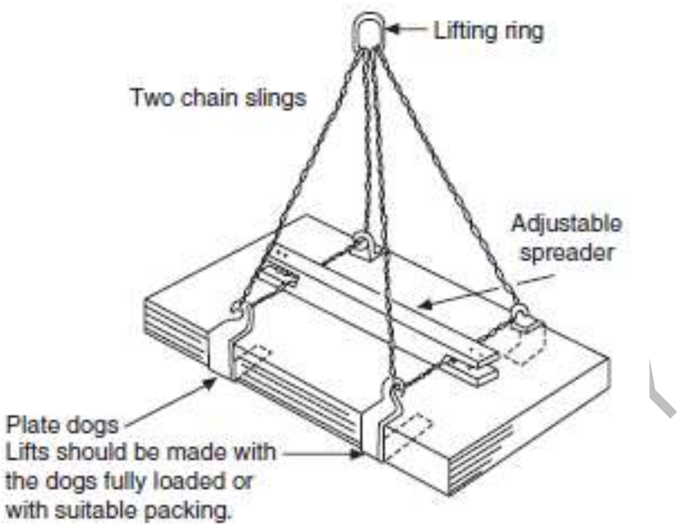
Slinging Sheet Metal

In this operation plate dogs or can hooks can be used. They are based on a similar holding operation, where the hooks or dogs are tensioned together by a single chain sling (per pair) drawing them tight about the load. The purpose of the adjustable spreader is to prevent the two slings closing up and disturbing the stability of the load.

Use of Chain Slings

Chain slings (Figure below) are used for such heavy types of load as metal castings. Extreme care should be observed with any load, but even more so with a heavy lift, especially if chain slings are employed. There is a tendency for links in the sling to kink inside each other, and if the sling is pulled clear, the links or any kinks in the chain could cause the load to tip, with possible dangerous consequences. It should be remembered that a kink in a chain is a severe weakening factor and should be avoided at all costs.

Timber bearers to provide a clear for the sling to be safely released should be used when landing loads of this nature.



Use of plate dogs

- **Ventilation**

Natural

This is the most common form of ventilation when cowls are trimmed into the wind to take in outside air, and trimmed back to wind to allow the air circulation an exit from the hold. Fans may be incorporated into this cowl ventilator system especially for the lower hold regions where fans assist delivery and air extractors assist the exhaust system.

Cowls may also be fitted with manually operated closure flaps.

Forced

More recent developments in ventilating systems have led to air being predried before entering the hold. In some cases the temperature of the air as well as its humidity may be controlled before entering the compartment. This artificial or forced ventilation, has become increasingly popular because, when properly used, it can almost prevent any sweat damage to cargo.

- **Refrigerated cargoes**

Refrigerated cargoes include meat carcases, carton (packed) meat, fruit, cheese, butter, fish and offal. Ships are specifically designed for their carriage, with separate spaces in holds and ’tween decks, each fitted with suitable insulation and individual control of ventilation. Ordinary general cargoes may be carried in the spaces at other times, the temperature being regulated accordingly for the type of cargo being carried.

Insulation around a compartment consists of either a fibreglass or polystyrene type of packing over the steelwork of the vessel, with an aluminium alloy facing. This insulation is comparatively fragile and requires regular inspection and maintenance.

Cooling a compartment on modern vessels is achieved by circulating pre-cooled air by means of fans. The air is cooled by an ordinary refrigeration plant employing a refrigerant with the most practical qualities, namely, a high thermaldynamic efficiency, low costs, low working pressure, low volume non-toxicity, non-inflammability, non-explosivity and ready availability from numerous sources.

Typical Refrigerants

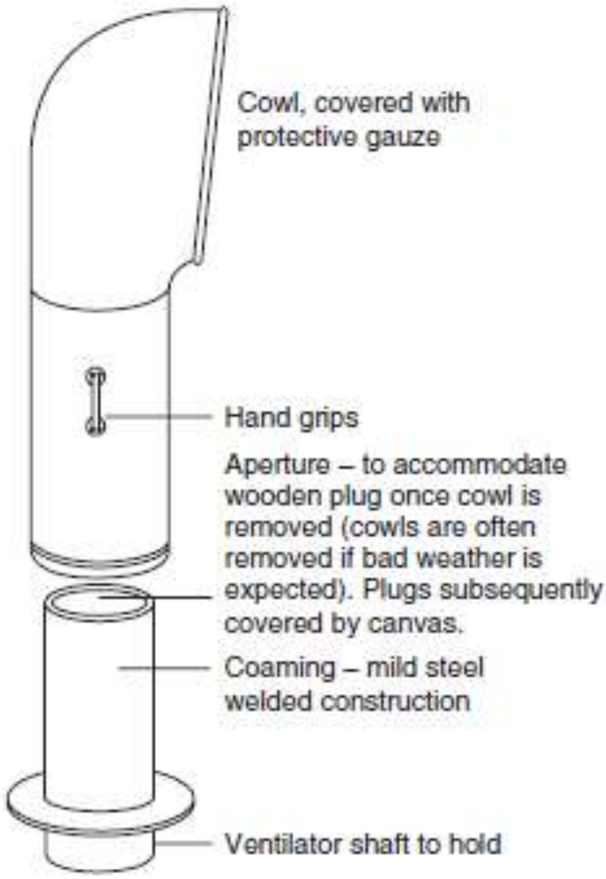
Carbon dioxide (CO_2). Non-poisonous, odourless, with no corrosive action on metal. It has a low boiling point but a high saturated pressure.

Ammonia (NH_3). Poisonous vapour, and therefore requires a separate compartment of its own. It will corrode certain metals, e.g. copper. Has a lower saturated pressure than CO_2.

Freon (CCl_2F_2). Non-poisonous, non-corrosive, and has a low saturated pressure. By far the most popular in modern tonnage.

Properties of a Good Insulating Material

1. Odour. All material used should be odourless to prevent tainting of cargoes.
2. Vermin. The material should be of such a nature, or so treated, that it will not harbour vermin.
3. Moisture. The material should not readily absorb moisture.
4. Fire. Insulation material should be non-combustible, if possible, but at least fire-resistant.
5. Cost. The financial outlay must be considered in view of the quantity of material required.
6. Weight. Not as important as one might think for merchant vessels; however, for ports with shallow water this would become a factor for consideration.
7. Maintenance. Costs of installing and of maintaining the insulation in good condition should be considered at the building/fitting-out stage.
8. Settling. Value of the material is lost if, after settling, the air pockets left will necessitate repacking.
9. Durability. Must be considered in comparison to the life of the vessel.
10. Strength. A great advantage would be if the material was of such quality as to withstand impact when loading or discharging.

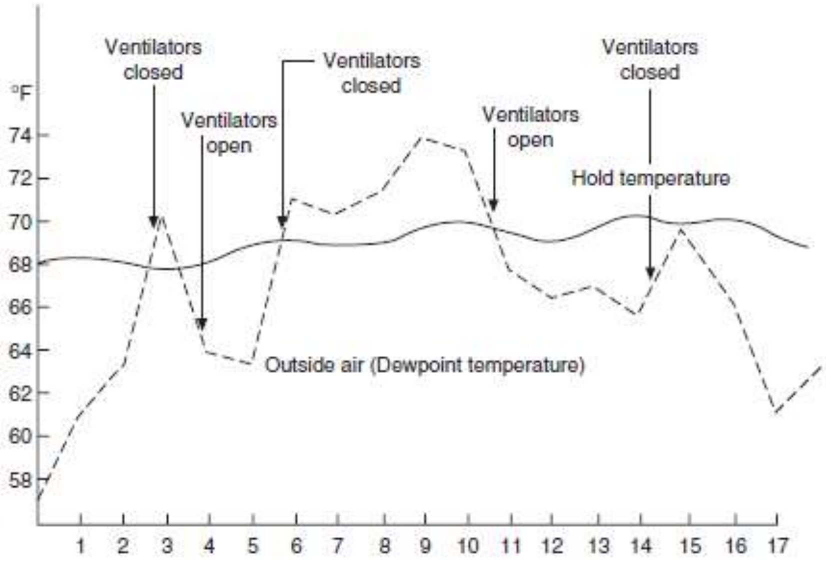


Cowl ventilators

- ***Loading***

Absolute cleanliness is required during the loading of refrigerated cargo, and the following points should be observed:

1. The compartment should be cleaned of all debris and previous cargo.



Hold temperature and outside Dewpoint temperature graph.

2. The deck should be scrubbed and the bulkheads and deck wiped with a light disinfectant.
3. All bilges must be cleaned and bilge suctions tested.
4. ’Tween deck scuppers must be tested, together with all ‘U’ brine traps.
5. Bilge plugs should be inspected and sealed. Cover plug over bilge suction may be left off for the purpose of survey.
6. Fans must be checked for direction of air flow.
7. Bare steelwork must be insulated.
8. All odours must be cleared from the compartment.
9. All outside ventilation must be shut down.
10. Pre-cooling of the compartment must take place before the cargo is received, times being noted in the cargo log or deck log book.
11. Before loading, the compartment should be surveyed.The surveyors’ comments together with the opening temperature of the chamber should be recorded in the mate’s deck log book.

Any dunnage required for the cargo should be of a similar standard of cleanliness as that of the compartment. All slings, chains etc. should also be clean and pre-cooled in advance of cargo reception.

- ***Carriage of goods in deep tanks***

Deep tanks are cargo compartments that may be used for the carriage of dry or liquid cargoes.They are usually found in dry cargo vessels at the bottom of one of the holds, forming what would normally be the lower hold portion of the hatch. Some vessels were built with deep tanks either side of the shaft tunnel (three-island type vessels),where they ran from the midships machinery space, aft.

The openings into the tank are as follows:

1. Main lid.
2. Manhole entrance.
3. Ventilator trunkings.
4. Sounding pipe (usually in the hat box or well).
5. Ullage pipes.
6. Bilge suction line (into the hat box or well).
7. Ballast line.
8. CO2 Fire Extinguishing line (not always fitted).
9. Steam inlet pipes for heating coils.

When the tank is to be used for dry cargo, the following actions should be carried out before loading the cargo:

a. Open CO2, if fitted.
b. Blank off ballast line.
c. Check bilge suction and leave the bilge line open.
d. Blank off steam inlet to heating coils. Coils may sometimes be removed.
e. Open or close ventilator trunks, as required.

Product	*Specific gravity*	*Cu.ft per tonne*
Coconut oil	0.925–0.931	38.8
Palm oil	0.920–0.926	38.9
Palm nut	0.952	37.5
Tallow	0.911–0.915	39.4
Whale oil	0.880–0.884	40.76

Cargoes carried in deep tanks

When the tanks is to be used for liquid ballast, the following actions are necessary:

a. CO2 lines should be blanked off.
b. Bilge line opened.
c. Steam inlet to heating coils sealed off.
d. Ventilator trunks opened.
e. Ballast bend fitted.
f. Main lid hard rubber packing should be inspected and checked for deterioration. If found in good condition, the locking bolts should be seen to be well screwed down to obtain even pressure on the seal. Manholes should be treated in a similar manner.

Preparation of Deep Tanks to Receive Liquid Cargo

Tanks must be tested by a head of water equal to the maximum to which the tank may be subjected, but not less than 2.44 m above the crown of the tank.

The rubber seal should be inspected for any signs of deterioration about the perimeter of the main lid. Any rubber gaskets about the inspection manholes should be seen to be in good order and to make a good air/water seal.

After the tank has been tested, it should be thoroughly cleaned and sealed. No rust spots or oil patches etc. should be visible. Hat boxes and wells should be meticulously cleaned and sealed off, and ballast and CO_2 lines blanked off. Pressure valves should be fitted into ventilators and the steam coils fitted and tested.

Once all preparations have been completed, the tank must be inspected by a surveyor before loading and a certificate of the tank's condition will be issued.

Dangerous/hazardous cargoes

(In dry cargo/container ships or Roll On, Roll Off vessels)

In the event of any dangerous goods or harmful substances being carried aboard the vessel, reference to 'The International Maritime Dangerous Goods (IMDG)' code should be consulted. Additionally, the Chemical Data

Sheets contained in the Tanker Safety Guide (Gas and Chemical) issued by the International Chamber of Shipping may be appropriate.

Such goods/substances must be classified, packaged and labelled in accord with the Merchant Shipping Regulations. Such trailers or vehicles should be given special consideration when being loaded and inspected for leakage prior to loading on the vessel. Such vehicles/containers should also be provided with adequate stowage that will provide good ventilation in the event of leakage whilst in transit, e.g., upper deck stowage, exposed to atmosphere is recommended as a general rule.

Deck Officers should pay particular attention to the securing of such transports to ensure negative movement of the unit. Special attention should also be given to the securing of adjacent units to prevent escalation of cargo shifting in a seaway.Tank vehicles may not necessarily be carrying hazardous goods, but any spillage of the contents could act as a lubricant on surrounding units and generate a major cargo shift on Ro-Ro vessels in heavy seas.

In the event that a cargo parcel/unit is found to be 'leaking' or have exposed hazards, the nature of the cargo should be ascertained and personnel kept clear of the immediate area until the degree of hazard is confirmed.

In any event the unit should not be accepted for shipment and rejected until satisfactorily contained.

Where a hazardous substance is discovered at sea, to be a threat to personnel, full information should be sought as soon as possible. Any action taken would reflect on the nature of the substance and the emergency actions stipulated in carriage instructions. It may become prudent to seek additional instructions from the manufacturer of the substance and act accordingly.

The Shipping Procedure for the Loading and Transportation of Hazardous Goods

The shipping procedure for hazardous/dangerous goods is as follows:

1. The shipper is responsible for obtaining the 'Export Licences' for the shipment.
2. The shipper would also be responsible for marking and labelling the goods to be shipped in accord with the IMDG Code.
3. The shipper would then be in a position to contact the Shipping Companies Agents and must provide:The Number of packages, their weight, the value, the volume, and any special requirements that may be required for the cargo.
4. Customs clearance would be required, and the goods may be liable to inspection.
5. The bill of lading is also liable to be endorsed, especially if packages are damaged and are rejected.
6. The goods would be listed in the ship's manifest and on the ship's cargo plan.
7. Ship's Officers would check the details of the goods including the labelling, the respective UN Number, the condition of the package, together with any special stowage requirements prior to loading the cargo.
8. Throughout this procedure the Ship's Master has the right to accept or reject the cargo prior to loading.

Once stowed on board the vessel the IMDG Code requirements would be followed throughout the period of the voyage.

Monitoring of Hazardous Cargoes

Different operators monitor the shipment of Hazardous Goods in various ways but each vessel needs to be fully aware of the position of the cargo, its class and the emergency procedures that are involved if transport difficulties arise. Ferry operators tend to identify on a cargo stowage outline the position of the 'special unit', and the relevant details are recorded once it has arrived for shipment.

Requirements applicable to cargo-handling gear

It is a requirement of most national regulations that cargo-handling gear should be inspected once a year by the Chief Officer (Annual Inspection), in addition to the usual working checks by the Officer of the Deck. The cargo gear would also be thoroughly examined under survey every five years.

The surveyor at the 5 yearly inspections will pay particular attention to all associated fittings on the derrick, mast and deck. He will check for any excessive wear or corrosion, and may carry out hammer tests. All blocks, shackles, links, chains, and wires will be examined to ensure that they are all in a satisfactory condition. Should any component have suffered damage, this should be replaced, and, provided that the component is individually tested, a retest on the rig is not required.

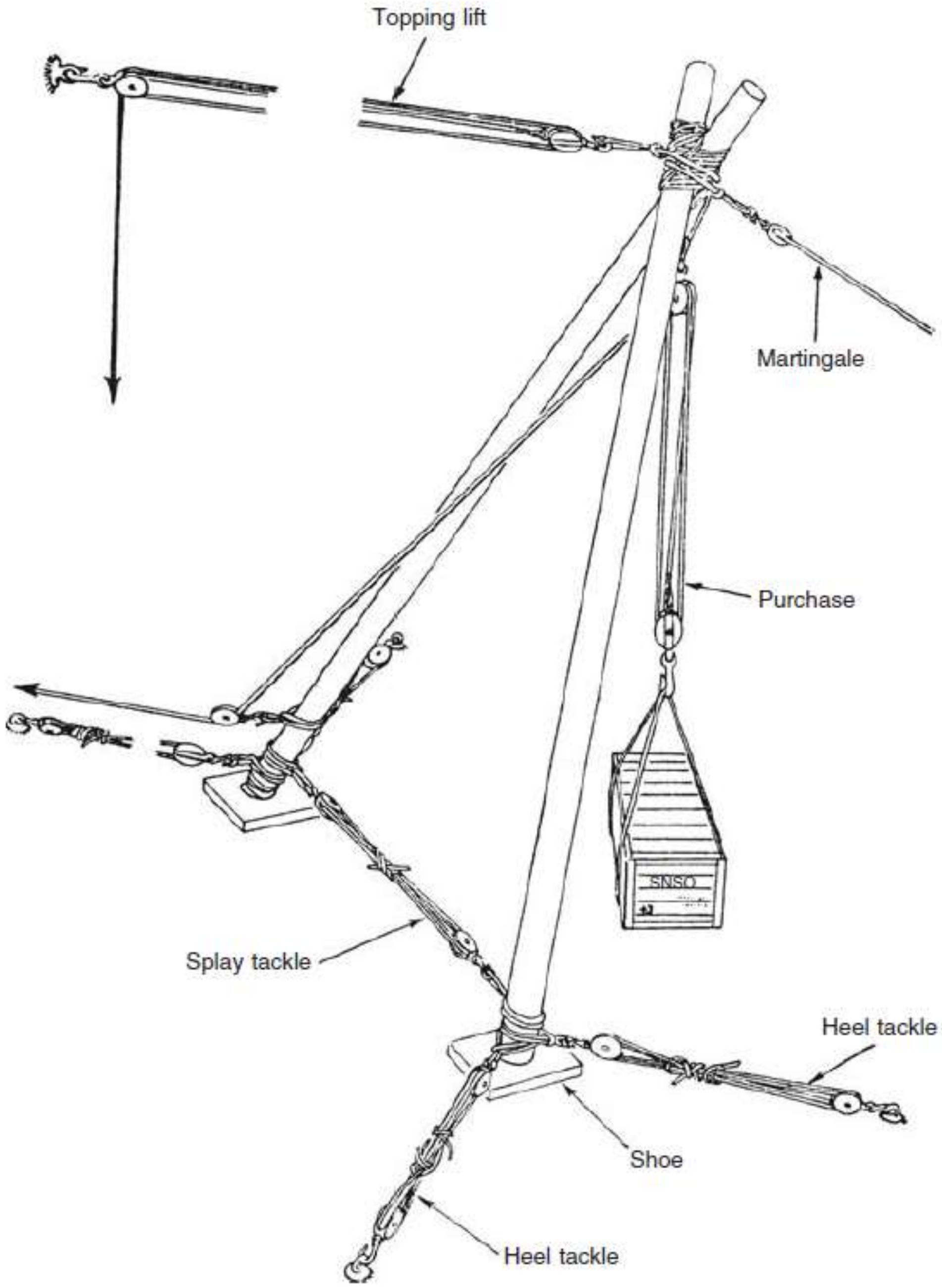
When a survey inspection takes place, the gear will be given a more detailed examination, and a drilling test may be required. It is recommended that the derrick should be retested at the third and each subsequent survey inspection.

Safe working load	*Proof load*
Up to 20 tonnes	25% in excess of SWL
Exceeding 20 tonnes but not exceeding 50 tonnes	5 tonnes in excess of SWL
Over 50 tonnes	10% in excess of the SWL

Tests on derricks

> Proof load is defined by the SWL + % tonnage to which the lifting equipment is tested to e.g. 60 tons SWL, derrick proof load = 66 tonnes.

Where the SWL of a derrick exceeds 15 tonnes, the proof load is to be applied by hoisting movable weights by the cargo purchase, and with the weights in the hoisted position the derricks are to be swung as far as possible in both directions. Where the SWL is 15 tonnes or less, the proof load may be applied, if desired, by means of a spring or hydraulic balance.



Rigging of sheer legs

The rigging of sheer legs and gyns has become generally obsolete.

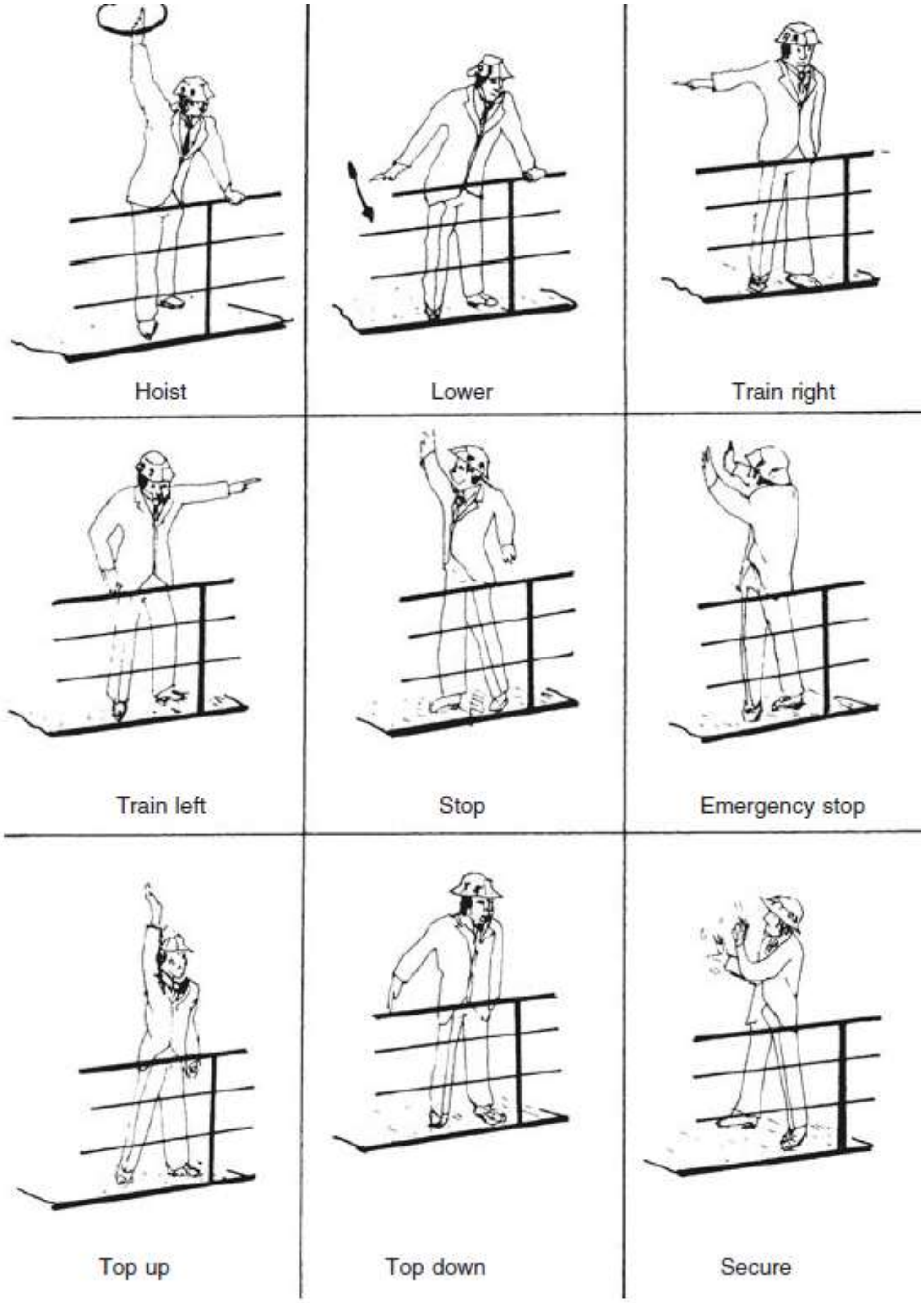
However, it is still used as a rigging exercise when training cadets or junior seaman.

- ***Calculating stresses in derricks by empirical formula***

The cargo officer should be aware that when using the empirical formula, shown with the following examples, the additional effort applied to the hauling part to overcome friction has always been taken as one-tenth. This may not necessarily always be the case. Cargo-handling gear may achieve efficient bearings, but this cannot be guaranteed 100 per cent and the allowance for friction should be based on the advice of the manufacturer.

When calculating the size of wire or rope to use in a tackle, the SWL is taken as one-sixth of the breaking strain. However, industry may in practice operate safe working loads of one-fifth of the breaking strain.

It should also be remembered that less friction is encountered when using sheaves of a large diameter than sheaves of a small diameter. Similarly less



Code of hand signals used when working winches, cranes or derricks

friction is found when using a thinner rope than a thicker. Consequently, maximum advantage is gained by the use of the larger sheaves and the thinner rope.

Should a heavy lift be required, the officer should bear in mind that a multi-sheave block (over four sheaves) will have a considerable weight of its own.The rig will add additional weight to the load and could effectively neutralise any mechanical advantage gained by the use of a heavy duty rig.

EXAMPLE 1

Calculate the size of manilla rope to use if the stress on the hauling part will be not greater than 3 tonnes.

Use the formula $\frac{2D^2}{300}$ as the breaking strain for manilla rope.

$$\frac{\text{Breaking strain}}{6} = \text{Safe working load}$$

As the given stress on the hauling part = 3 tonnes, the SWL = 3 tonnes.

$$\frac{2D^2}{300} = 3 \times 6$$

Transpose

$$2D^2 = 18 \times 300$$

$$D^2 = \frac{18 \times 300}{2}$$

$$D^2 = 2700$$

$$D = \sqrt{2700}$$

$$\text{Diameter of rope} = 51.96\,\text{mm} = \underline{\underline{52\,\text{mm}}}$$

- **Maintenance of hatch covers**

Poor maintenance of hatch covers causes leakage leading to cargo damage and represents a hazard to the ship and its crew. Although hatch covers are simple and durable, their sealing gaskets are easily damaged. The quality of sealing is affected by lack of alignment and poor gasket compression. When hatch covers are opened at the end of an ocean voyage, look for signs of leakage such as rust staining or drip marks.

Regular adjustment and repair, by ship's staff, will reduce the overall cost of maintenance.

Painting double drainage channels will help to prevent corrosion.

Always keep a detailed record of maintenance. Take care during extensive hatch cover repair to avoid cover distortion.

Rubber Gaskets

Keep clean and free from paint. If physically damaged, permanently set-in or aged, replace with minimum one metre lengths. Always follow the manufacturer's instructions when renewing gaskets.

Gasket Channels

If gasket channels are badly corroded, causing the hatch packing to hang loose, the packing should be removed and the channel repaired by welding new metal strips which should be painted before fitting new rubber. Always follow proper fire prevention safety procedures. Make sure that cargo spaces are free of cargo and combustible material. When conducting extensive structural repairs, remove the hatch covers to shore.

Hatch Cover Structure

Repair or replace any damaged, worn or defective hatch covers or coamings. Consult with the ship's classification society before commencing repair. Paint new structure immediately.

Compression Bars

Effective sealing is only possible with a straight, undamaged and non-corroded compression bar.

Compression bars which are not in this condition should be repaired or replaced, taking care to align the bars properly.

Remember to carry out a chalk test to check alignment, both during and after repair.

Landing Pads

Hatch sealing is arranged by design to give the correct compression of the gasket when there is metal-to-metal contact on the hatch landing pad, side plate, or inter-panel block. If landing pads are reduced in height (check with manufacturers' drawings) because of wear, repair is essential.

Hatch Wheel Trackways

Trackways can corrode. They are weakened by abrasive wear and tear. When weakened, trackways can distort and break, affecting hatch movement and alignment. Deterioration is visible to the naked eye. Repair by replacing the worn or damaged material with sufficient new material to restore strength. Always keep hatch wheel trackways clean and painted.

Hatch Coamings

Look for cracks at coaming corners. If any are found, consult the ship's classification society before commencing repairs in case the coaming needs to be reinforced.

Examine coaming support brackets for corrosion where they connect with the ship's deck.

Make sure coamings and their support brackets are painted.

Coamings can be damaged by cargo equipment during loading or discharge. Look out for damage and repair if found.

Hatch Cleats and Wedges

It is important for compression washers to be adjusted correctly. A locking nut for adjusting compression is situated at the base of the cleat. The procedure to alter compression is as follows:

- close hatch and secure for sea;
- place the cam of the cleat in the hatch socket as if to lock it, but leave it unlocked (the cam should move freely and fit snugly in its housing);
- adjust the locking nut until the compression washer touches the underside of the hatch coaming or its steel washer;
- turn the locking nut one full turn to achieve the desired tension;
- do not over-tighten;
- protect the thread on completion.

When closing and securing a hatch for sea passage, check the tension in side cleats.

Cleats should never be adjusted in isolation, adjust all cleats along the hatch skirt at the same time.

Hatch Cross-Joints

It is essential for the cross-joint to be in good condition and properly aligned.

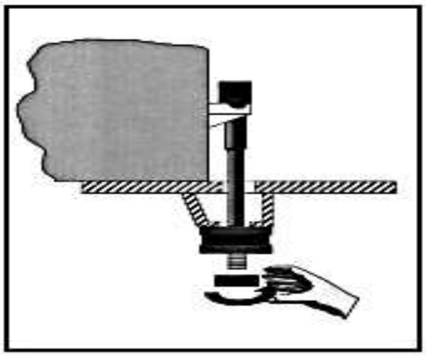
Maintenance and repair should focus on:

- examination of the cross-joint structure for corrosion.
- examination of joint hinges for pin wear, blade cracking or weld failure. (Re-grease the hinge pin bushes making sure grease reaches the hinge pins).
- examination of the steel-to-steel inter-panel blocks and locators for wear. (Check the top plate of hatch panels, they should be level when closed).
- checking the gap between panels when they are closed. Misalignment could be caused by an incorrectly adjusted cylinder or the wheel tracks could be worn.

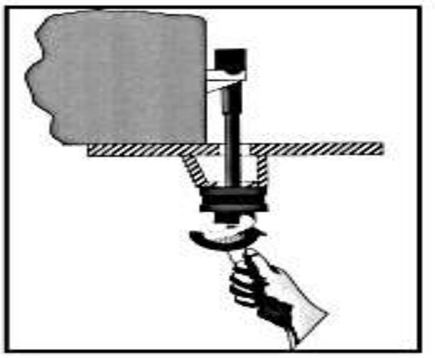
Hatch Wheels

Hatch wheel spindles and bearings (where fitted) need to be greased regularly. Check the wheel spindle for wear and the wheel housing for physical damage. Repair if the spindle is worn or if the wheels are out of alignment.

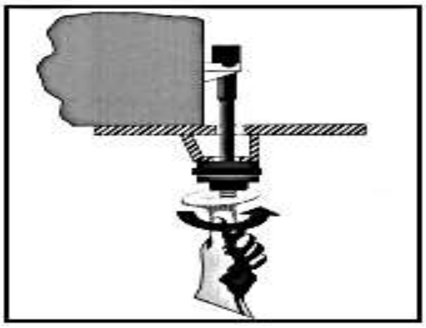
Procedure to adjust a quick acting cleat



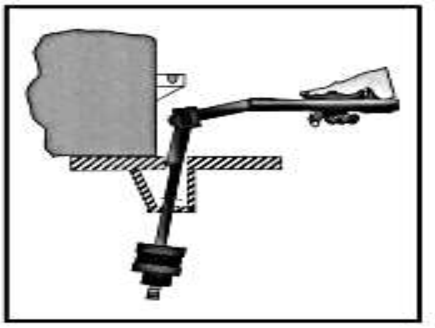
a) Assemble cleat in snug & crutch



b) Screw nut on spindle until it touches washer



c) Tighten one complete turn of the nut



d) Disengage cleat with quick release lever

Drain Channels and Non-Return Valves

Clean coaming tops and cross-joint channels by removing any loose scale or cargo residue by brushing or hosing. Clean coaming drain holes and check that the non-return valve is functioning.

Greasing

Wheel spindles, cleat spindles, hinge pins, hydraulic cylinder protective sheaths, cleat wedges, drive chain sprockets, toothed rack and cylinder spherical bearings need to be kept well greased.

Re-grease every month if necessary, and always apply new grease after the ship has passed through heavy weather.

Painting

Corrosion occurs mainly at the panel ends along the cross-joint or where access is difficult, but it can also occur on the underside of a panel, especially along hatch beams. Regular painting will be necessary.

Inert Gas

Hatch covers with a double skin, in the form of a closed box, are filled with inert gas. After structural repair, the inner spaces must be re-inerted. This is done by inserting special tablets (available from the hatch cover manufacturer) into the space and welding shut. Never allow water to penetrate the box construction.

Hydraulic Systems and Components

The cleanliness and viscosity of hydraulic oil must be checked. Samples of the oil should be sent to a chemist for testing (use the same company that checks and tests your fuel and lubricating oil). The hydraulic system is provided with bleed points from which samples can be taken.

Hydraulic oil should be changed every five years or after there have been significant repairs, such as piping or cylinder replacement.

Hydraulic oil filters should be changed every twelve months. Do not contemplate repairing the hydraulic system without the proper components and skilled fitters.

Use of Sealing Tape and Foam Fillers

The use of sealing tape and foam fillers should be limited to:

- emergency use. When hatches are known or thought to be leaking and there is insufficient time to complete permanent repairs;
- charterers' requirement. Charterers may require owners to apply sealing tape when highly water-sensitive cargoes are carried;
- fumigation tape is usually applied to hatch covers during fumigation. The tape is not heavy duty and should be removed when fumigation has finished.

Foam fillers can be used to fill the air space which is formed along the cross-joint of two closed panels. In heavy weather foam fillers may be washed away, their use should never be solely relied upon to prevent water ingress.

2.1.5. LOADING AND UNLOADING OPERATIONS, WITH SPECIAL REGARD TO THE TRANSPORT OF CARGOES IDENTIFIED IN THE CODE OF SAFE PRACTICE FOR CARGO STOWAGE AND SECURING

Loading, stowage and discharge of heavy weights

The master should be provided with sufficient information on any heavy cargo offered for shipment so that he can properly plan its stowage and securing; the information should at least include the following:

1. Gross mass;
2. Principal dimensions with drawing or pictorial descriptions, if possible;
3. Location of the centre of gravity;
4. Bedding areas and particular bedding precautions if applicable;
5. Lifting points or slinging positions; and
6. Securing points, where provided, including details of their strength.

Location of stowage

When considering the location for stowing a heavy cargo item, the typical distribution of accelerations on the ship should be kept in mind:

1. Lower accelerations occur in the midship sections and below the weather deck; and
2. Higher accelerations occur in the end sections and above the weather deck.

When heavy items are to be stowed on deck, the expected "weather side" of the particular voyage should be taken into account if possible.

Heavy items should preferably be stowed in the fore-and-aft direction.

Distribution of weight

The weight of the item should be distributed in such a way as to avoid undue stress on the ship's structure. Particularly with the carriage of heavy items on decks or hatch covers, suitable beams of timber or steel of adequate strength should be used to transfer the weight of the item on to the ship's structure.

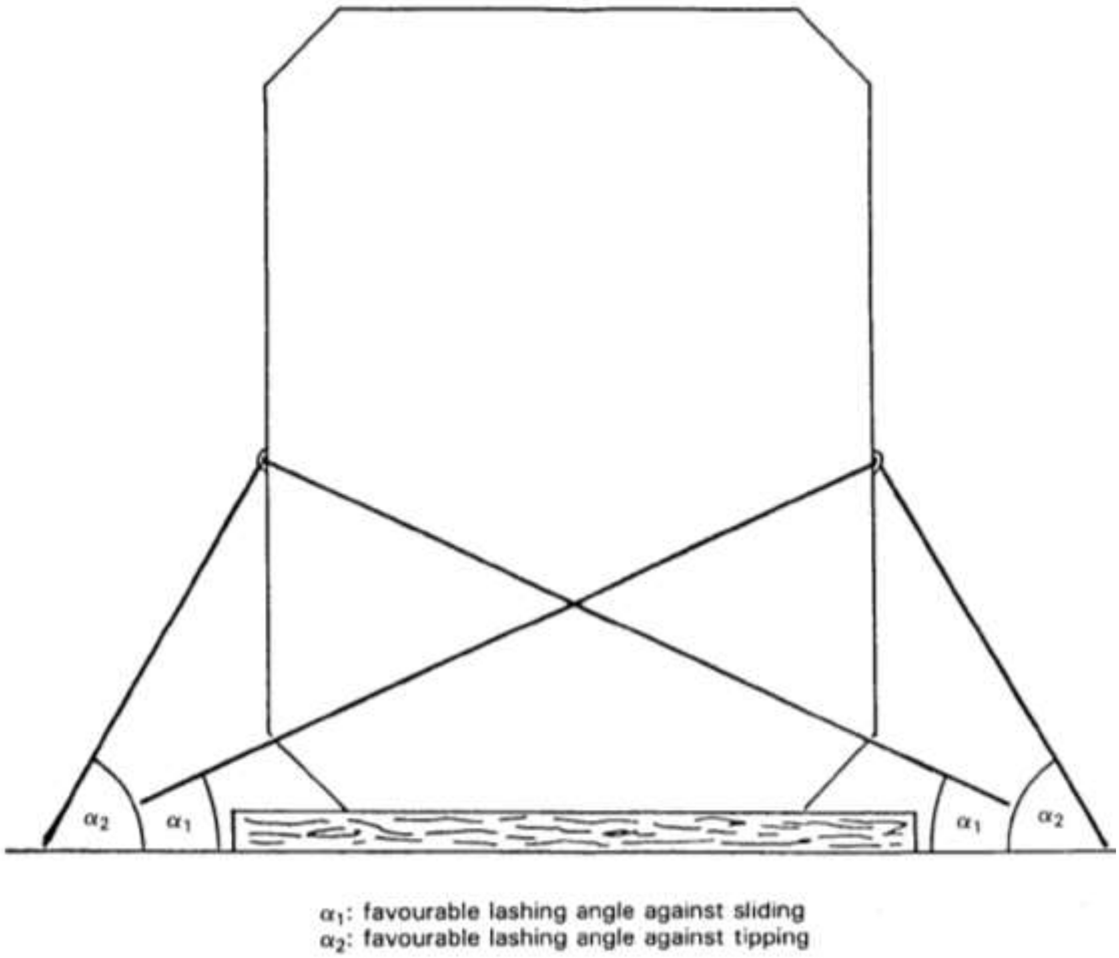
Securing against sliding and tipping

Whenever possible, timber should be used between the stowage surface and the bottom of the unit in order to increase friction. This does not apply to items on wooden cradles or on rubber types or with similar bottom material having a high coefficient of friction.

The securing devices should be arranged in a way to withstand transverse and longitudinal forces which may give rise to sliding or tipping.

The optimum lashing angle against sliding is about 25º, while the optimum lashing angle against tipping is generally found between 45º and 60º.

If a heavy cargo item has been dragged into position on greased skid board or other means to reduce friction, the number of lashing used to prevent sliding should be increased accordingly.



Principles of securing heavy items against sliding and tipping

If, owing to circumstances, lashings can be set at large angles only, sliding must be prevented by timber shoring, welded fittings or other appropriate means. Any welding should be carried out in accordance with accepted hot work procedures.

Securing against heavy seas on deck

Whilst it is recognized that securing cargo items against heavy seas on deck is difficult, all efforts should be made to secure such items and their supports to withstand such impact and special means of securing may have to be considered.

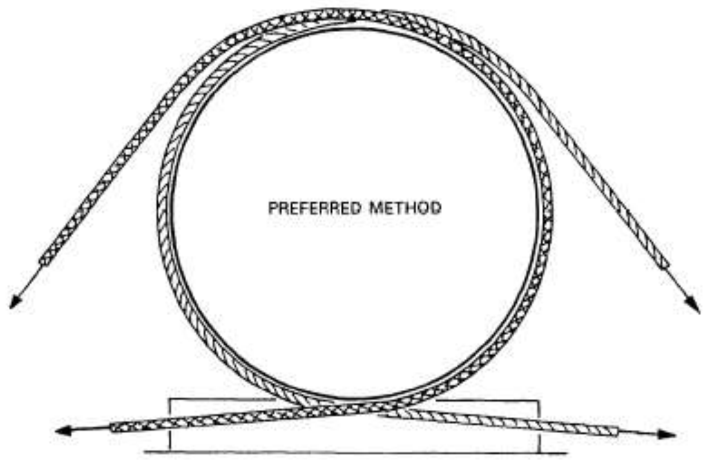
Heavy cargo items projecting over the ship's side

Items projecting over the ship's side should be additionally secured by lashing acting in longitudinal and vertical directions.

Attachment of lashings to heavy cargo items

If lashings are to be attached to securing points on the item, these securing points should be of adequate strength and clearly marked. It should be borne in mind that securing points designed for road or rail transport may not be suitable for securing the item on board ship.

Lashing attached to items without securing point should pass around the item, or a rigid part thereof, and both ends of the lashing should be secured to the same side of the unit.



Principle of securing heavy items having no suitable securing points

Composition and application of securing devices

Securing devices should be assembled so that each component is of equal strength.

Connecting elements and tightening devices should be used in the correct way. Consideration should be given to any reduction of the strength of the lashing during the voyage through corrosion, fatigue or mechanical deterioration and should be compensated by using stronger securing material.

Particular attention should be paid to the correct use of wire, grips and clips. The saddle portion of the clip should be applied to the live load segment and the U-bolt to the dead or shortened end segment.

Securing devices should be arranged in such a way that each device takes its share of load according to its strength.

Mixed securing arrangement of devices with different strength and elongation characteristics should be avoided.

Maintenance of securing arrangements

The integrity of the securing arrangement should be maintained throughout the voyage.

Particular attention should be paid to the need for tight lashing, grips and clips and to prevent weakening through chafing. Timber cradles, beddings and shoring should be checked.

Greasing the thread of clips and turnbuckles increase their holding capacity and prevents corrosion.

Securing calculation

Where necessary, the securing arrangements for heavy cargo items should be verified by an appropriate calculation.

Methods and safeguards when fumigating holds

Fumigation is a procedure that is used throughout the world to eradicate pests that infest all types of goods, commodities, warehouses, processing factories and transport vehicles including ships and their cargoes.

What are fumigants and how do they work?

Fumigants are gases, which are toxic to the target infestation. They can be applied as gas, liquid or in solid formulations, but after vaporisation from liquids or reaction products from solids, always act in the gaseous phase. They act either as respiratory poisons, or as suffocants in the case of controlled or modified atmospheres. On release, they mix with air at a molecular level.

They are capable of rapidly diffusing from one area to another and through commodities and buildings.

Fumigants should not be confused with smoke, which are solid particles in air, or with mists, aerosols or fogs, which are liquid droplets, of various sized, in air. Smokes, mists, aerosols or fogs are not fumigants as they are unable to diffuse and do not reach deep seated infestations in commodities or structures.

The fumigant gases used to carry out the fumigation process are numerous, but the most commonly used currently for the treatment of ships cargoes are phosphine and methyl bromide. Others used are carbon dioxide and more recently sulfuryl fluoride, which is starting to replace the use of methyl bromide.

How does a fumigant gas work effectively?

The critical parameters, which need to be considered for fumigants to be effective are:

- Nature of infestation (type of pest, e.g. rodent, insect or beetle, and stage of its life cycle).
- Type of fumigant applied.

- Concentration and distribution of gas.
- Temperature.
- Length of time fumigant must be applied.
- Method by which fumigant is administered
- Containment of fumigant. Nature of commodity.
- Nature of commodity packaging.
- Monitoring system.
- Ventilation system.

Aim of fumigation

Fumigation aims to create an environment, which will contain an effective concentration of fumigant gas at a given temperature, for a sufficient period of time to kill any live infestations. Both the time measured (hours or days) of exposure and concentration of gas is critical to fumigation efficiency. Dosages applied are usually expressed as grams per cubic metre, concentrations measured during the fumigation are usually expressed in parts per million (PPM) or grams per cubic metre, and total concentrations actually achieved, as concentration-timeproducts (CTPs).

The fumigation process is not completed until ventilation has been effectively carried out, and removal of any residues is completed.

Fumigants that can be used for intransit fumigation of bulk and bagged cargoes in ships' holds. The most widely used fumigant for intransit fumigation is phosphine (PH_3). The gas is normally generated from aluminium phosphide or sometimes magnesium phosphide, but can also be applied direct from cylinders.

Methyl bromide should never be used for fumigation intransit.

Insecticides such as dischlorvos, pirimiphos-methyl, malathion, permethrin and others may be sprayed on to the grain during loading. These are nit fumigants and should be allowed providedata is probide to the master as set out in IMO.

Intransit fumigation of bulk and bagged cargoes with phosphine gas

Phosphine is only fully effective if a lethal concentration is maintained for a period of time that can be as little as 3 days or as much as 3 weeks.

The actual time needed will vary according to the cargo temperatures, insect species that may be present, and the system of fumigation.

This is the reason why fumigation with phosphine is almost always carried out during the voyage (intransit) so that the voyage time can be used to ensure a fully effective treatment.

Probing aluminium phosphide in retrievable sleeves into a bulk cargo

When the owners/charterers/master agree to fumigation being carried out intransit with phosphine, the master should ensure he is familiar with the requirements of IMO

This will enable the master to be clear what the obligations of both fumigator and master are. A checklist of these obligations is as follows:

- Fumigator

To provide written documentation in respect of the following:

- Pre-fumigation inspection certificate.
- Standard safety recommendations for vessels with fumigated grain cargoes.
- Gas tightness statement.
- Statement of vessel suitability for fumigation and fumigant application compliance.
- Manufacturer's information or safety data sheet.
- First aid and medical treatment instructions
- Fumigation certificate.
- Fumigation plan.

Ventilating the cargo pior to discharge

Checking the gas concentrations in the cargo prior to discharge

- Instructions for the use of the phosphine gas detecting equipment.
- Precautions and procedures during voyage.
- Instructions for aeration and ventilation.
- Precautions and procedures during discharge.
- Also to provide sufficient additional respiratory protective equipment (RPE) where necessary to the vessel, to ensure the requirements of IMO in respect of RPE are available for the duration of the voyage. (Note; the RPE may consist of SCBA or canister respirators or a combination of both but the minimum requirement is for 4 sets of RPE).

Master

- Appoint a competent crewmember to accompany the fumigator during the inspections/testing of empty holds prior to loading to determine whether they are gas tight, or can be made gas tight and, if necessary, what work is to be carried out to ensure they are gas tight.
- Ensure the crew is briefed on the fumigation process before fumigation takes place.
- Ensure the crew search the vessel thoroughly to ensure there are no stowaways or other unauthorised personnel onboard before fumigation takes place.
- Appoint at least two members of the crew to be trained by the fumigator to act as representatives of the master during the voyage to ensure safe conditions, in respect of the fumigations, are maintained onboard the ship during the voyage.
- After the fumigant has been applied and appropriate tests have been completed, the master should provide his representative to accompany the fumigator, to make a check that all working spaces are free of harmful concentration of gas.
- When the fumigator has discharged his responsibilities, the fumigator should formally hand over in writing responsibility to the master for maintaining safe conditions in all occupied areas, which the master should accept.
- It must be clearly understood by the master that, even if no leakage of fumigant is detectable at the time of sailing, this does not mean that leakage will not occur at some time during the voyage due to the movement of the ship or other factors. This is why it is essential the master ensures regular checks are carried out during the voyage.
- During the voyage, the master should ensure that regular checks for gas leakage should be made throughout all occupied areas and the findings recorded in the ships log. If any leakage is detected appropriate precautions to avoid any crew being exposed to harmful concentrations must be taken. If requested to do so by the fumigator, the master may, prior to arrival at the first discharge port, start the ventilation of the cargo spaces.
- Prior to arrival at the first discharge port the master should inform the authorities at the port that the cargo has been fumigated intransit.
- On arrival at the discharge port the master should not allow discharge of the cargo to commence until he is satisfied that the cargo has been correctly ventilated and aluminium phosphide residues that can be removed have been removed, and that any other requirements of the discharge port have been met.

Fumigation of empty cargo holds and/or accommodation to eradicate rodent or insect infestation

Methyl bromide is the most common fumigant used for this purpose (although hydrogen cyanide (HCN) or sulfuryl fluoride may be used in some countries) as it is normally possible to achieve an effective fumigation of the empty spaces in 12-24 hours.

The crew should be landed and remain ashore until the ship is certified 'gas free' in writing by the fumigator.

- The intransit fumigation of freight containers.

The reason for the fumigation of containers is normally to try to ensure that when the goods arrive at the discharge port they are free of live pests/ insects.

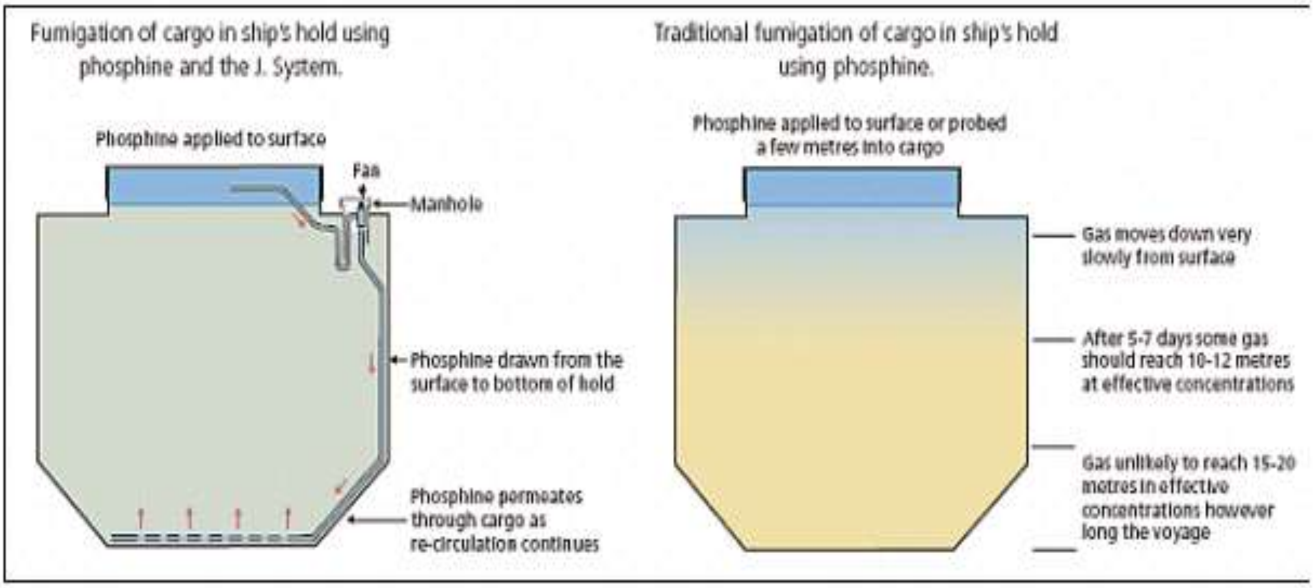
Containers are normally fumigated and subsequently ventilated prior to being loaded onboard the ship.

Containers that have been fumigated and subsequently ventilated and where a 'certificate of freedom from harmful concentration of gas' has been issued, can be loaded onboard ships as if they had not been fumigated.

- Frequently containers are fumigated but not ventilated prior to loading and these containers are therefore
    - Obligations on the fumigator
        - The fumigator must ensure that, as far as is practicable, the container is made gas tight before the fumigant is applied.
        - The fumigator must ensure that the containers are clearly marked with appropriate warning signs stating the type of fumigant used and the date applied and all other details as required by the IMDG Code and IMO Recommendations Annex 3.
        - The fumigator must ensure the agreed formulation of fumigant is used at the correct dosage to comply with the contractual requirements.
    - Obligations on the exporter
        - The exporter must ensure that the containers are clearly marked by the fumigator with appropriate warning signs stating the type of fumigant used and the date applied and all other details as required by the IMDG Code and IMO Recommendations Annex 3.
        - The exporter must ensure that the master is informed prior to the loading of the containers.
        - The exporter must ensure that shipping documents show the date of fumigation and the type of fumigant and the amount used all as required in the IMDG Code, volume 1, page 35 and specifically section 9.9.
    - Obligations on the master
        - The master must ensure that he knows where containers under fumigation are stowed.

- The master must ensure he has suitable gas detection equipment onboard for the types of fumigant present, and that he has received instructions for the use of the equipment.
- Prior to arrival of the vessel at the discharge port the master should inform the authorities at the discharge point that he is carrying containers under fumigation.
- If the master (or his representative) suspects that unmarked containers may have been fumigated and loaded onboard they should take suitable precautions and report their suspicions to the authorities prior to arrival at the discharge port.

o Obligations on the receivers
- The receiver (or his agent) must ensure that any fumigant residues are removed, and the container checked and certificated as being free from harmful concentrations of fumigant by a suitably qualified person before the cargo in the container is removed.



2.1.6. GENERAL KNOWLEDGE OF TANKERS AND TANKER OPERATIONS

Contents and application of the International Safety Guide for Oil Tankers and Terminals (lSGOTT)

The main purpose of ISGOTT is to provide recommendations and guidance's on the safe carriage and handling of crude oil and petroleum for tankers and terminals. It does not provide a definitive description of how cargo operations should be conducted on board a tanker.

By combining the content of the Tanker Safety Guide and the International Oil Tanker and Terminal Safety Guide ISGOTT was first published in 1978 and it is recommended that a copy of the guide is kept on board every tanker. The safety, security and the environmental performance on tankers have improved considerably in recent years, these improvements are the result of the good practices adopted by the industry and the dedication to protect the people it employs. The commitment to continuously improve is demonstrated by the tanker industry effort's to keep the International Safety for Oil and Terminals (ISGOTT) updated all the time. The ISGOTT provide the best practices on the oil tankers but also embraces arisk-based view of things by enhancing the risk awareness.

They also encourage the seafarers and their employers to identify the risks in everyday operations on board a tanker. Safety is the most important thing in the tanker industry and the ISGOTT has become the standard reference when regarding the safe operation of oil tankers and the terminals.

The guide has to be kept updated so it can reflect on the changes in ship design, operating practices, latest technology and legalizations. ISGOTT is divided into four sections, general information, tanker information, terminal information and the management of the tanker and terminal interface. The authors of ISGOTT still believe that it will provide the best technical guidance on tankers in the future and hopes that operators ensure that the recommendations in the guide are read, fully understood and followed. (ISGOTT. p x, xxi-xxii).

Oil tanker operations and related pollution-prevention regulations

MARPOL Annex I – Prevention of Pollution by Oil

Oil tankers transport some 2,400 million tonnes of crude oil and oil products around the world by sea. Most of the time, oil is transported quietly and safely.

Measures introduced by IMO have helped ensure that the majority of oil tankers are safely built and operated and are constructed to reduce the amount of oil spilled in the event of an accident. Operational pollution, such as from routine tank cleaning operations, has also been cut.

The most important regulations for preventing pollution by oil from ships are contained in Annex I of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL), The International

Convention for the Safety of Life at Sea (SOLAS), 1974 also includes special requirements for tankers.

Chemical tankers

- International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (IBC Code)

Carriage of chemicals in bulk is covered by regulations in SOLAS Chapter VII - Carriage of dangerous goods and MARPOL Annex II - Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk.

Both Conventions require chemical tankers built after 1 July 1986 to comply with the International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (IBC Code).

The IBC Code provides an international standard for the safe carriage by sea of dangerous and noxious liquid chemicals in bulk. To minimize the risks to ships, their crews and the environment, the Code prescribes the design and construction standards of ships and the equipment they should carry, with due regard to the nature of the products involved. In December 1985, by resolution MEPC.19(22), the Code was extended to cover marine pollution aspects and applies to ships built after 1 July 1986.

In October 2004, IMO adopted revised MARPOL Annex II Regulations for the control of pollution by noxious liquid substances in bulk. This incorporates a four-category categorization system for noxious and liquid substances and it entered into force on 1 January 2007.

Consequential amendments to the International Bulk Chemical Code (IBC Code) were also adopted in October 2004, reflecting the changes to MARPOL Annex II. The amendments incorporate revisions to the categorization of certain products relating to their properties as potential marine pollutants as well as revisions to ship type and carriage requirements following their evaluation by the Evaluation of Hazardous Substances Working Group.

Ships constructed after 1986 carrying substances identified in chapter 17 of the IBC Code must follow the requirements for design, construction, equipment and operation of ships contained in the Code.

Ships subject to the Code shall be designed to one of the following standards:

A type 1 ship is a chemical tanker intended to transport chapter 17 products with very severe environmental and safety hazards which require maximum preventive measures to preclude an escape of such cargo.

A type 2 ship is a chemical tanker intended to transport chapter 17 products with appreciably severe environmental and safety hazards which require significant preventive measures to preclude an escape of such cargo.

A type 3 ship is a chemical tanker intended to transport chapter 17 products with sufficiently severe environmental and safety hazards which require a moderate degree of containment to increase survival capability in a damaged condition.

Thus, a type 1 ship is a chemical tanker intended for the transportation of products considered to present the greatest overall hazard and type 2 and type 3 for products of progressively lesser hazards. Accordingly, a type 1 ship shall survive the most severe standard of damage and its cargo tanks shall be located at the maximum prescribed distance inboard from the shell plating.

Gas tanker

- International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)

The International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) applies to gas carriers constructed on or after1 July 1986. Gas carriers constructed before that date should comply with the requirements of the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk or the Code for Existing Ships Carrying Liquefied Gases in Bulk.

The purposes of these codes is to provide an international standard for the safe transport by sea in bulk of liquefied gases and certain other substances, by prescribing the design and construction standards of ships involved in such transport and the equipment they should carry so as to minimize the risk to the ship, its crew and to the environment, having regard to the nature of the products involved.

The basic philosophy is one of ship types related to the hazards of the products covered by these codes, each of which may have one or more hazard properties. A further possible hazard may arise owing to the products being transported under cryogenic (refrigerated) or pressure conditions.

Severe collisions or strandings could lead to cargo tank damage and uncontrolled release of the product. Such release could result in evaporation and dispersion of the product and, in some cases, could cause brittle fracture of the ship's hull. The requirements in the codes are intended to minimize these risks as far as is practicable, based upon present knowledge and technology.

The IGC Code is kept under review, taking into account experience and technological development. The layout of this code is in line with the International Code for the Construction of Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code).Gas tankers

This section provides a general overview of the different types of gas tanker, their construction and their equipment as set out in the IGC Code.

2.1.7. KNOWLEDGE OF THE OPERATIONAL AND DESIGN LIMITATIONS OF BULK CARRIERS

Operational and design limitations of Bulk carriers Trainees should be able to identify the problems generally considered to be associated with bulk carriers, such as high density cargoes, leading to loss of buoyancy or structural failure, if holds are flooded in the loaded condition, high loading rate, leading to possible loss of control of load condition; with consequent high stresses, vulnerability to internal damage during cargo loading and discharging operations, leading to protective coating damage, accelerated corrosion, and local structural failure, low freeboard, leading to high green sea loads on deck structures, vulnerability to flooding of forward holds, rapid corrosion caused by corrosive cargo. Many points have been included in the detailed teaching, which the Instructors should point out to trainees.

SOLAS Chapter XII Additional Safety Measures for Bulk Carriers

Following a spate of losses of bulk carriers in the early 1990s, IMO in November 1997 adopted new regulations in SOLAS containing specific safety requirements for bulk carriers, Chapter XII - Additional Safety Measures for Bulk Carriers. In the same month, the 20th Assembly of IMO adopted the "BLU Code" - the Code of Practice for the safe loading and unloading of bulk carriers (resolution A.862(20).

Following the 1998 publication of the report into the sinking of the bulk carrier Derbyshire, the Maritime Safety Commitee (MSC) initiated a further review of bulk carrier safety, involving the use of Formal Safety Assessment (FSA) studies to help assess what further changes in regulations might be needed.

In December 2002, at its 76th session, the MSC adopted amendments to SOLAS chapter XII and the 1988 Load Lines Protocol and also agreed to a number of recommendations to further improve bulk carrier safety.

In December 2004, the MSC adopted a new text for SOLAS chapter XII, incorporating revisions to some regulations and new requirements relating to double-side skin bulk carriers. These amendments entered into force on 1 July 2006.

December 2002 SOLAS amendments relating to bulk carrier safety
December 2004 - revised SOLAS chapter XII adopted
Free-fall lifeboats on bulk carriers
Further information - bulk carrier background

SOLAS Chapter XII - Additional Safety Measures for Bulk Carriers

The new SOLAS chapter XII Additional Safety Measures for Bulk Carriers was adopted by Conference held in November 1997 and it entered into force on 1 July 1999.

The regulations state that all new bulk carriers 150 metres or more in length (built after 1 July 1999) carrying cargoes with a density of 1,000 kg/m3 and above should have sufficient strength to withstand flooding of any one cargo hold, taking into account dynamic effects resulting from presence of water in the hold and taking into account the recommendations adopted by IMO.

For existing ships (built before 1 July 1999) carrying bulk cargoes with a density of 1,780 kg/m3 and above, the transverse watertight bulkhead between the two foremost cargo holds and the double bottom of the foremost cargo hold should have sufficient strength to withstand flooding and the related dynamic effects in the foremost cargo hold.

Cargoes with a density of 1,780 kg/m3 and above (heavy cargoes) include iron ore, pig iron, steel, bauxite and cement. Lighter cargoes, but with a density of more than 1,000 kg/m3, include grains such as wheat and rice, and timber.

The amendments take into account a study into bulk carrier survivability carried out by the International Association of Classification Societies (IACS) at the request of IMO. IACS found that if a ship is flooded in the forward hold, the bulkhead between the two foremost holds may not be able to withstand the pressure that results from the sloshing mixture of cargo and water, especially if the ship is loaded in alternate holds with high density cargoes (such as iron ore). If the bulkhead between one hold and the next collapses, progressive flooding could rapidly occur throughout the length of the ship and the vessel would sink in a matter of minutes.

IACS concluded that the most vulnerable areas are the bulkhead between numbers one and two holds at the forward end of the vessel and the double bottom of the ship at this location. During special surveys of ships, particular attention should be paid to these areas and, where necessary, reinforcements should be carried out.

The criteria and formulae used to assess whether a ship currently meets the new requirements, for example in terms of the thickness of the steel used for bulkhead structures, or whether reinforcement is necessary, are laid out in IMO standards adopted by the 1997 Conference.

Under Chapter XII, surveyors can take into account restrictions on the cargo carried in considering the need for, and the extent of, strengthening of the transverse watertight bulkhead or double bottom. When restrictions on cargoes are imposed, the bulk carrier should be permanently marked with a solid triangle on its side shell. The date of application of the new Chapter to existing bulk carriers depends on their age. Bulk carriers which are 20 years old and over on 1 July 1999 have to comply by the date of the first intermediate or periodic survey after that date, whichever is sooner. Bulk carriers aged 15-20 years must comply by the first periodical survey after 1 July 1999, but not later than 1 July 2002. Bulk carriers less than 15 years old must comply by the date of the first periodical survey after the ship reaches 15 years of age, but not later than the date on which the ship reaches 17 years of age.

December 2002 SOLAS amendments relating to bulk carrier safety

The MSC at its 76th session in December 2002 adopted amendments to chapter XII (Additional Safety Measures for Bulk Carriers) of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended to require the fitting of high level alarms and level monitoring systems on all bulk carriers, in order to detect water ingress.

The recommendation for the fitting of such alarms was first highlighted during the meeting of the Working Group on Bulk Carrier Safety held during the MSC's 74th session in December 2001, following on from recommendations of the United Kingdom Report of the re-opened formal investigation into the loss of the Derbyshire.

The new regulation XII/12 on Hold, ballast and dry space water level detectors will require the fitting of such alarms on all bulk carriers regardless of their date of construction. The requirement is expected to enter into force on 1 July 2004, under the tacit acceptance procedure.

In addition, a new regulation XII/13 on Availability of pumping systems would require the means for draining and pumping dry space bilges and ballast tanks any part of which is located forward of the collision bulkhead to be capable of being brought into operation from a readily accessible enclosed space.

A further regulation affecting bulk carriers was also adopted: Access to spaces in cargo areas of oil tankers and bulk carriers. The new regulation II-1/3-6 in SOLAS chapter II-1 (Construction - structure, subdivision and stability, machinery and electrical installations), Part B (Subdivision and stability), is intended to ensure that vessels can be properly inspected throughout their lifespan, by designing and building the ship to provide suitable means for access. Associated Technical provisions for means of access for inspections, also adopted, are mandatory under the new regulation.

CSR Bulk

On 14 December 2005 the Common Structural Rules for Tankers and Bulk Carriers were unanimously adopted by the IACS Council for implementation on 1 April 2006. The Council was satisfied that the new rules have been based on sound technical grounds, and achieve the goals of more robust and safer ships.

The then Chairman of IACS, Bob Somerville, declared it "an historic moment - one of the most important single steps in the development of maritime rules that IACS has ever been involved with".

IACS now implements the CSR maintenance program via the IACS CSR Knowledge Centre (KC). All the agreed Q&As and CIs (Common Interpretations) are published on the IACS web site without delay in order to assist its Member Societies and Industry in implementing the CSR in a uniform and consistent manner. IACS organisational structure and work process and procedures pertaining to maintenance, harmonisation and further development of IACS CSR for Double Hull Oil Tankers and Bulk Carriers are detailed in IACS Procedure Volume 4.

In Nov 2008 IACS launched the IACS CSR Tracking Database (www.iacs-csrtrack.org.uk) to provide users easy and quick access to full revision history of CSR Rules on a paragraph by paragraph basis.

2.1.8. LOADING, CARE AND UNLOADING OF BULK CARGOES

Code of practice for the safe loading and unloading of bulk carriers (BLU code)

Bulk carriers were developed in the 1950s to carry large quantities of non-packed commodities such as grains, coal and iron ore. Some 5,000 bulk carriers trade around the world, providing a crucial service to world commodities' transportation.

The Code of Practice for the Safe Loading and Unloading of Bulk Carriers is a mandatory IMO code, adopted in November 1997 under Resolution A.862(20).Both the BLU manual and BLU Code are included within the IMSBC Code, which replaces the BC Code, becomes mandatory from 1 January 2010.

It provides guidance to owners and masters of bulk carriers, charterers, terminal operators and other parties concerned for the safe handling, loading and unloading of solid bulk cargoes. The recommendations in the Code are subject to terminal and port requirements, or national regulations.

It primarily covers the safety of ships loading and unloading solid bulk cargoes, excluding grain, and reflects current issues, best practices and legislative requirements. Broader safety and pollution issues, such as those covered by the SOLAS, MARPOL and Load Line Conventions, are not specifically included in the Code.

It is linked to, but is not mandatory under, regulation VI/7 (Loading, unloading and stowage of bulk cargoes) of SOLAS 74, as amended by resolution MSC.47(66).

Contains sections and appendices as follows:

Section 1. Definitions;

Section 2. Suitability of ships and terminals;

Section 3. Procedures between ship and shore prior to the ship's arrival;

Section 4. Procedures between ship and terminal prior to cargo handling;

Section 5. Cargo loading and handling of ballast;

Section 6. Unloading cargo and handling of ballast;

Appendix 1. Recommended contents of port and terminal information books;

Appendix 2. Loading or unloading plan;

Appendix 3. Ship/shore safety checklist;

Appendix 4. Guidelines for completing the ship/shore safety checklist;

Appendix 5. Form for cargo information.

The requirements of individual terminals and port authorities should be published in terminal and port information books. The type of information which should be given in these books is listed in Appendix 1 of the BLU Code. Such a book should be given to the master of any bulk carrier arriving at a loading or unloading port or terminal.

2.1.9. SAFE CARGO HANDLING IN ACCORDANCE WITH THE PROVISIONS OF THE RELEVANT INSTRUMENTS

Establish procedures for safe cargo handling in accordance with the provisions of the relevant instruments such as:

- IMDG Code

CLASSIFICATION OF DANGEROUS GOODS

The International Maritime Dangerous Goods (IMDG) Code was developed as a uniform international code for the transport of dangerous goods by sea covering such matters as packing, container traffic and stowage, with particular reference to the segregation of incompatible substances.

The Carriage of dangerous goods and marine pollutants in sea-going ships is respectively regulated in the International Convention for the Safety of the Life at Sea (SOLAS) and the International Convention for the Prevention of pollution from Ships (MARPOL).

Relevant parts of both SOLAS and MARPOL have been worked out in great detail and are included in the International Maritime Dangerous Goods (IMDG) Code, thus making this Code the legal instrument for maritime transport of dangerous goods and marine pollutants. As of 1st January 2004, the IMDG Code will become a mandatory requirement.

For all modes of transport (sea, air, rail, road and inland waterways) the classification (grouping) of dangerous goods, by type of risk involved, has been drawn up by the UNITED NATIONS Committee of Experts on the Transport of Dangerous Goods (UN).

Class 1: Explosives

Subclass 1.1: Explosives with a mass explosion hazard

Consists of explosives that have a mass explosion hazard. A mass explosion is one which affects almost the entire load instantaneously.

Subclass 1.2: Explosives with a severe projection hazard
Consists of explosives that have a projection hazard but not a mass explosion hazard.

Subclass 1.3: Explosives with a fire
Consists of explosives that have a fire hazard and either a minor blast hazard or a minor projection hazard or both but not a mass explosion hazard.

Subclass 1.4: Minor fire or projection hazard
Consists of explosives that present a minor explosion hazard. The explosive effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package.

Subclass 1.5: An insensitive substance with a mass explosion hazard
Consists of very insensitive explosives with a mass explosion hazard (explosion similar to 1.1). This division is comprised of substances which have a mass explosion hazard but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport.

Subclass 1.6: Extremely insensitive articles
Consists of extremely insensitive articles which do not have a mass explosive hazard. This division is comprised of articles which contain only extremely insensitive detonating substances and which demonstrate a negligible probability of accidental initiation or propagation.

Class 2 :Gases

Subclass 2.1: Flammable Gas
Gases which ignite on contact with an ignition source, such as acetylene and hydrogen. Flammable gas gas means any material which is ignitable at 101.3 kPa (14.7 psi) when in a mixture of 13 percent or less by volume with air, or has a flammable range at 101.3 kPa (14.7 psi) with air of at least 12 percent regardless of the lower limit.

Subclass 2.2: Non-Flammable Gases
Gases which are neither flammable nor poisonous. Includes the cryogenic gases/liquids (temperatures of below -100°C) used for cryopreservation and rocket fuels. This division includes compressed gas, liquefied gas, pressurized cryogenic gas, compressed gas in solution, asphyxiant gas and oxidizing gas. A non-flammable, nonpoisonous compressed gas means any material which exerts in the packaging an absolute pressure of 280 kPa (40.6 psia) or greater at 20°C (68°F), and does not meet the definition of Division 2.1 or 2.3.

Subclass 2.3: Poisonous Gases
Gases liable to cause death or serious injury to human health if inhaled. Gas poisonous by inhalation means a material which is a gas at 20°C or less and a pressure of 101.3 kPa (a material which has a boiling point of 20°C or less at 101.3kPa (14.7 psi)) which is known to be so toxic to humans as to pose a hazard to health during transportation, or in the absence f adequate data on human toxicity, is presumed to be toxic to humans because when tested on laboratory animals it has an LC50 value of not more than 5000 ml/m3.

Class 3:Flammable Liquids

A flammable liquid means a liquid which may catch fire easily or any mixture having one or more components whith any flash point. As example: acetone, diesel, gasoline, kerosene, oil etc. There is strongly recomended for transportation at or above its flash point in a bulk packaging. There are three main groups of flammable liquid.
Low flash point - liquids with flash point below -18°C
Intermediate flash point - liquids with flash point from -18°C. up to +23°C
High flash point group - liquids with flash point from +23°C

Class 4:Flammable solids or substances

Subclass 4.1: Flammable solids
Solid substances that are easily ignited. Self-reactive materials, which are thermally unstable and that can undergo a strongly exothermic decomposition even without participation of air. Readily combustible solids that can cause a fire through friction and show a burning rate faster than 2.2 mm (0.087 inches) per second, or metal powders that can be ignited and react over the whole length of a sample in 10 minutes or less.

Subclass 4.2: Spontaneously combustible solids
Solid substances that ignite spontaneously. Spontaneously combustible material is a pyrophoric material, which is a liquid or solid that can ignite within five minutes after coming in contact with air or a self-heating material that when in contact with air and without an energy supply is liable to self-heat.

Subclass 4.3: Dangerous when wet
Solid substances that emit a flammable gas when wet. Dangerous when wet material is a material that when it makes contact with water is liable to become spontaneously flammable or give off flammable or toxic gas at a rate greater than 1 L per kilogram of the material per hour.

Class 5: Oxidizing substances and organic peroxides

Subclass 5.1: Oxidizing agent
Oxidizing agent means a material that may, generally by yielding oxygen, cause or enhance the combustion of other materials.

Subclass 5.2: Organic peroxide oxidizing agent
Organic peroxide means any organic compound containing oxygen in the bivalent structure and which may be considered a derivative of hydrogen peroxide, where one or more of the hydrogen atoms have been replaced by organic radicals.

Class 6:Toxic and infectious substances

Subclass 6.1: Poison
Toxic substances which are able to cause death or serious hazard to humans health during transportation.

Subclass 6.2: Biohazard
Infectious Substance material is known to contain or suspected of containing a pathogen. Infectious substances are substances which are known or are reasonably expected to contain pathogens. Pathogens are defined as micro-organisms (including bacteria, viruses, rickettsiae, parasites, fungi) and other agents such as prions, which can cause disease in humans or animals.

Class 7:Radioactive substances

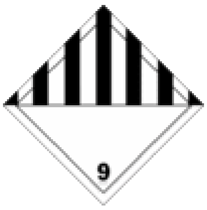
Radioactive
Radioactive substances comprise substances or a combination of substances which emit ionizing radiation

Class 8:Corrosive substances

Corrosive
Corrosive materials means a liquid or solid that causes full thickness destruction of human skin at the site of contact within a specified period of time. A liquid that has a severe corrosion rate on steel or aluminum is also a corrosive material.

Class 9:Miscellaneous dangerous substances and articles

Miscellaneous



A material which presents a hazard during transportation but which does not meet the definition of any other hazard class. This class includes: any material which has an anesthetic, noxious or other similar property which could cause extreme annoyance or discomfort to a flight crew member so as to prevent the correct performance of assigned duties or material for an elevated temperature material, a hazardous substance, a hazardous waste, or a marine pollutant.

- **IMSBC Code**

BULK CARGOES (IMSBC)

Manufacturers of unknown solid bulk cargoes must reach an agreement for transportation

The transport volume of solid bulk cargoes by seagoing ships is growing. By now more than one third of the world's merchant fleet are bulk carriers.

The Maritime Safety Committee of the International Maritime Organization (IMO) has adopted the International Maritime Solid Bulk Cargoes (IMSBC) Code to facilitate the safe and reliable sea transport of solid bulk cargoes. The IMSBC code has become mandatory on 1 January 2011 by references in the SOLAS convention (chapters VI and VII, part A-1).

Purpose of the IMSBC code is a better control and classification of unknown bulk cargoes lacking any assigned properties or hazard group. For this the manufacturer or shipper of such cargoes must reach an agreement with the relevant flag and port state authorities (so called "tripartite agreement").

Approval and classification of unknown solid bulk cargoes

Bulk cargoes not listed in the IMSBC code to be carried on ships flying the German flag or calling at a German port must be approved by the ship safety division of the BG Verkehr. For that purpose please use the IMO-questionnaire.

After verification by the ship safety division the bulk cargo is classified according to its properties and character into one of the following groups:

- Group A:

cargoes which may liquefy, if shipped at a moisture content in excess of their transportable moisture limit.

- Group B:

cargoes which possess a chemical hazard which could give rise to a dangerous situation on a ship.

- Group C:

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

Equipment for the carriage of solid bulk cargoes

The IMSBC code specifies requirements for the design, construction and equipment of ships carrying solid bulk cargoes. Depending on the properties of the cargo special fire protection and ventilation systems are required on board.

- MARPOL 73/78, Annexes III and V

Annex III: Prevention of pollution by harmful substances in packaged form

Entry into force: 1 July 1992

The first of the convention's optional annexes. States ratifying the Convention must accept Annexes I and II but can choose not to accept the other three - hence they have taken much longer to enter into force. Annex III contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications for preventing pollution by harmful substances. The International Maritime Dangerous Goods (IMDG) Code has, since 1991, included marine pollutants.

It aims to prevent or minimise pollution of the marine environment by harmful substances in packaged forms or in freight containers, portable tanks or road and rail tank wagons, or other forms of containment specified in the schedule for harmful substances in the International Maritime Dangerous Goods (IMDG) Code

There may be following sources of pollution (on containerships):

A. Pollution from hold bilges (contaminated with cargo / oil seepage)
B. Pollution from loss overboard of harmful packaged goods (Marine Pollutant as in IMDG Code)

Handling Cargo Hold Bilges on Container vessels

Hold bilges must be sounded at least once daily and also checked for content on the sounding rod (this will indicate if any oil or cargo effluent exists, mingled with water). They must be pumped out, when well within the bilge well depth.

If vessel is in port, bilges should be transferred to the bilge holding tank (where fitted), but if reached tank top level (due rain), then pumping out must only be done after visual check inside hold for uncontaminated of water.

Handling Bilges from other spaces (but, non E/R)

Bilges need to be occasionally pumped from other spaces like Bow thruster room, Bosun store, Void spaces, Cofferdams, Steering flat, Under Deck Passages, etc. In all such cases, they must be only pumped out at sea after confirmation of contents.

Handling of Harmful Packaged goods

If any Marine Pollutant (as per IMDG) leaks from a container into the hold bilges or on deck, it must be collected taking due precautions, as per EMS and disposed off ashore. Accidental loss overboard of containers must be notified to shore authorities, also mentioning the nature of contents esp. if they are a Marine Pollutant. Handling Chemicals and Hazardous waste)

Note : Residues of chemicals, paint and other items used on board for operational purposes, must be disposed off ashore and recorded in Garbage Record Book.

Disposable cargo

Crewmembers should remember that cargo hold wash water from holds containing Harmful to the Marine Environment (HME) cargoes can only be discharged provided that the master determines that there are no adequate reception facilities at the receiving terminal and the ship is en route and as far as practicable from the nearest land, but not less than 12 nautical miles.

Before washing, dry cargo residue should be removed (and bagged for discharge ashore) as far as practicable and holds are swept and the volume of wash water used should be kept to a minimum. Moreover, filters should be used in the bilge wells in order to collect any remaining solid particles and minimise solid residue discharge. Lastly, the discharge should be recorded in the Garbage Record Book and the Flag State is notified utilising the Revised Consolidated Format for Reporting Alleged Inadequacies of Port Reception Facilities.

Annex V: Prevention of pollution by garbage from ships

Entry into force: 31 December 1988

This deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of. The requirements are much stricter in a number of "special areas" but perhaps the most important feature of the Annex is the complete ban imposed on the dumping into the sea of all forms of plastic.

Regulations for the Prevention of pollution by garbage from ships are contained in Annex V of MARPOL 73/78.

Review of Annex V

Garbage from ships can be just as deadly to marine life as oil or chemicals.

The greatest danger comes from plastic, which can float for years. Fish and marine mammals can in some cases mistake plastics for food and they can also become trapped in plastic ropes, nets, bags and other items - even such innocuous items as the plastic rings used to hold cans of beer and drinks together.

It is clear that a good deal of the garbage washed up on beaches comes from people on shore - holiday-makers who leave their rubbish on the beach, fishermen who simply throw unwanted refuse over the side - or from towns and cities that dump rubbish into rivers or the sea. But in some areas most of the rubbish found comes from passing ships which find it convenient to throw rubbish overboard rather than dispose of it in ports.

For a long while, many people believed that the oceans could absorb anything that was thrown into them, but this attitude has changed along with greater awarenes of the environment. Many items can be degraded by the seas - but this process can take months or years, as the following table shows:

Time taken for objects to dissolve at sea	
Paper bus ticket	2-4 weeks
Cotton cloth	1-5 months
Rope	3-14 months
Woollen cloth	1 year
Painted wood	13 years
Tin can	100 years
Aluminium can	200-500 years
Plastic bottle	450 years

Source: Hellenic Marine Environemnt Protection Association (HELMEPA)

The 1973 MARPOL Convention sought to eliminate and reduce the amount of garbage being dumped into the sea from ships.

Under Annex V of the Convention, garbage includes all kinds of food, domestic and operational waste, excluding fresh fish, generated during the normal operation of the vessel and liable to be disposed of continuously or periodically.

Annex V totally prohibits of the disposal of plastics anywhere into the sea, and severely restricts discharges of other garbage from ships into coastal waters and "Special Areas".

The Annex also obliges Governments to ensure the provision of facilities at ports and terminals for the reception of garbage.

The special areas established under the Annex are:

- the Mediterranean Sea
- the Baltic Sea Area
- the Black Sea area
- the Red Sea Area
- the Gulfs area
- the North Sea
- the Wider Caribbean Region and
- Antarctic Area

These are areas which have particular problems because of heavy maritime traffic or low water exchange caused by the land-locked nature of the sea concerned.

Although the Annex was optional, the Annex did receive sufficient number of ratifications to enter into force on 31 December 1988. Provisions to extend port State control to cover operational requirements as regards prevention of marine pollution were adopted as a new regulation 8 to the Annex in 1994 (entering into force on 3 March 1996).

Like similar amendments adopted to the other MARPOL Annexes, the regulation makes it clear that port State control officers can inspect a foreign-flagged vessel "where there are clear grounds for believing that the master or crew are not familiar with essential shipboard procedures relating to the prevention of pollution by garbage".

Implementation, and enforcement, was also the focus of a further new Regulation 9, adopted in 1995, which requires all ships of 400 gross tonnage and above and every ship certified to carry 15 persons or more, and every fixed or floating platform engaged in exploration and exploitation of the seabed, must provide a Garbage Record Book, to record all disposal and incineration operations.

The date, time, position of ship, description of the garbage and the estimated amount incinerated or discharged must be logged and signed. The books must be kept for a period of two years after the date of the last entry. This regulation does not in itself impose stricter requirements - but it makes it easier to check that the regulations on garbage are being adhered to as it means ship personnel must keep track of the garbage and what happens to it.

It may also prove an advantage to a ship when local officials are checking the origin of dumped garbage - if ship personnel can adequately account for all their garbage, they are unlikely to be wrongly penalised for dumping garbage when they have not done so.

Regulation 9 came into force for new ships from 1 July 1997 and from 1 July 1998 all applicable ships built before 1 July 1997 also have to comply: all ships of 400 gross tonnage and above and every ship certified to carry 15 persons or more, and every fixed or floating platform engaged in exploration and exploitation of the seabed.

The Regulation also requires every ship of 12 metres or more in length to display placards notifying passengers and crew of the disposal requirements of the regulation; the placards should be in the official language of the ship's flag State and also in English or French for ships travelling to other States' ports or offshore terminals.

Despite the entry into force of Annex V in 1988, even recent surveys carried out in the United States each year have produced up to 10 tons of garbage per mile of coastline, a record that can probably be matched in may other parts of the world. Plastic forms the biggest single item found.

Persuading people not to use the oceans as a rubbish tip is a matter of education - the old idea that the sea can cope with anything still prevails to some extent but it also involves much more vigorous enforcement of regulations such as Annex V.

Garbage Management Plans

All ships of 400 gross tonnage and above and every ship certified to carry 15 persons or more will have to carry a Garbage Management Plan, to include written procedures for collecting, storing, processing and disposing of garbage, including the use of equipment on board. The Garbage Management Plan should designate the person responsible for carrying out the plan and should be in the working language of the crew.

The regulation is important because it requires ship operators to track their garbage and take notice of what happens to it.

In accordance with regulation 9 of Annex V, all ships of 400 gross tonnage and above and every ship certified to carry 15 persons or more, and every fixed or floating platform engaged in exploration and exploitation of the seabed, must provide a Garbage Record Book, to record all disposal and incineration operations. The date, time, position of ship, description of the garbage and the estimated amount incinerated or discharged must be logged and signed. The books must be kept for a period of two years after the date of the last entry.

Administrations may exempt fixed or floating platform while engaged in exploration and exploitation of the seabed from providing a Garbage Record Book.

Regulation 9 of Annex V of MARPOL 73/78 came into force for new ships from 1 July 1997 but from 1 July 1998 all applicable ships built before 1 July 1997 also have to comply.

Every ship of 12 metres or more in length must also display placards notifying passengers and crew of the disposal requirements of the regulation; the placards should be in the official language of the ship's flag State and also in English or French for ships travelling to other States' ports or offshore terminals.

MEPC/Circ.317 gives Guidelines for the development of garbage management plans and an Appendix to Annex V of MARPOL gives a standard form for a Garbage Record Book.

Shipboard incinerators

The Marine Environment Protection Committee 40th Session 18?25 September 1997 adopted a Standard Specification for Shipboard Incinerators. The specification covers the design, manufacture, performance, operation and testing of incinerators designed to incinerate garbage and other shipboard waste.

2.1.10. EFFECTIVE COMMUNICATIONS AND IMPROVING WORKING RELATIONSHIPS

Basic principles for establishing effective communications and improving working relationship between ship and terminal personnel

All ships nominated for loading should hold the appropriate valid statutory certificate including, if required, the document of compliance for ships carrying solid dangerous goods in bulk. It is recommended that the period of validity of the ship's certificates be sufficient to remain valid during loading, voyage and unloading times, plus a reserve to allow for delay in berthing, inclement weather or both.

The shipowner, manager or operator, when offering a ship for a particular cargo or service, should ensure that the ship:

1. Is maintained in a sound, seaworthy condition;
2. Has on board a competence crew;
3. Has on board at least one officer proficient in languages used at both the loading and unloading ports, or has an officer available who is proficient in the English language; and
4. Is free of defects that may prejudice that ship's safe navigation, loading or unloading.

It is essential that a ship selected to transport a slid bulk cargo be suitable for its intended purpose taking into account the terminal at which it will load or unload.

The character and shipper when accepting a ship for a particular cargo or service should ensure that the ship:

1. Is suitable for access to the planned loading or unloading facilities; and
2. Does not have cargo handling equipment which would inhibit the safety of the loading and unloading operations.

Ships

Ships nominated for bulk loading should be suitable for the intended cargo. Suitable ships should be:

1. Weathertight, and efficient in all respects for the normal perils of the sea and the intended voyage;
2. Provide with an approved stability and loading booklet written in a language understood by the ship's officer concerned and using standard expressions and abbreviation. If the language is neither English, nor French, nor Spanish, a translation into one of these language should be included;
3. Provided with hatch opening of sufficient size to enable the cargo to be loaded, stowed and unloaded satisfactorily; and
4. Provided with the hatch identification numbers used in the loading manual and loading or unloading plan. The location, size and colour of these numbers should be chosen so that they are clearly visible to the operator of the loading or unloading equipment.

It is recommended that all ships which are required to carry out stress calculations should have on board an approved loading instrument for the rapid calculation of such stresses.

All propulsion and auxiliary machinery should be in good functional order. Deck equipment related to mooring and berthing operations, including anchors, cables. Mooring lines, hawsers and winches, should operable and in good order and condition.

All hatches, hatch operating system and safety devices should be in good functional order, and used only for their intended purpose.

List indication lights, if fitted, should be tested prior to loading or unloading and proved operational. Ship's own cargo handling equipment should be properly certified and maintained and used only under the general supervision of suitably qualified ship's personnel.

Terminals

Terminal operators should ensure that they only accept ships that can safety berth alongside their installation, taking into consideration issues such as:

1. Water depth at the berth;
2. Maximum size of the ship;
3. Mooring arrangement;
4. Fendering;
5. Safe access; and
6. Obstructions to loading / unloading operations.

Terminal equipment should be properly certificated and maintained in accordance with the relevant national regulations and/or standards, and only operated by duly qualified and, if appropriate, certificate personnel.

Where automatic weighing equipment is provided, this should be calibrated at regular intervals.

Terminal personnel should be trained in all aspects of the safe loading and unloading of bulk carriers, commensurate with their responsibilities.

The training should be designed to provide familiarity with the general hazards of loading, unloading and carriage of bulk cargoes and the adverse effect improper cargo handling operations may have on the safety of the ship.

Terminal operators should ensure that personnel involved in the loading and unloading operations are duly rested to avoid fatigue.

2.2. ASSESS REPRTED DEFECTS AND DAMAGE TO CARGO SPACES, HATCH COVERS AND BALLAST TANKS AND TAKE APPROPRIATE ACTION

2.2.1. LIMITATIONS ON STRENGTH OF THE VITAL CONSTRUCTIONAL PARTS OF A STANDARD BULK CARRIER AND INTERPRET GIVEN FIGURES FOR BENDING MOMENTS AND SHEAR FORCES

All ships are designed with limits deliberately imposed on their operations to ensure that structural integrity is maintained.

Exceeding these limits may over-stress the structure and lead to catastrophic failure.

The ship’s hull structure is designed to withsand the static loads of the ships weight and sea water pressure acting acting on the hull and the dynamic loads on the hull due to waves and ship motion.

Overloading in any one cargo hold space will increase static stress in the hull structure and reduce the capacity of the hull structure to withstand dynamic loads when the ship is at sea.

Bulk carrier hull configuration does not alter significantly with size: the most widely recognized structural arrangement is a single deck ship with a double bottom, hopper tanks, single skin transverse framed side shell, topside tanks and deck hatchways.

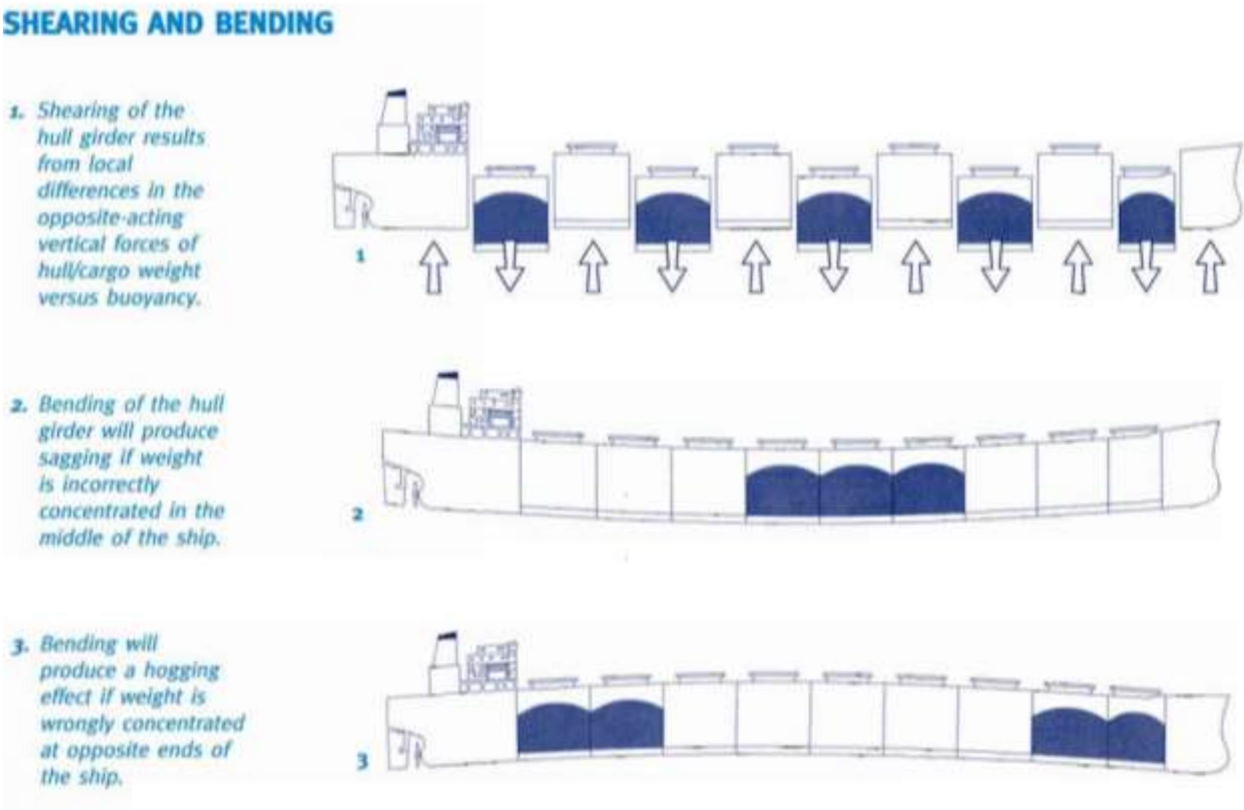
Shear forces and bending moments:

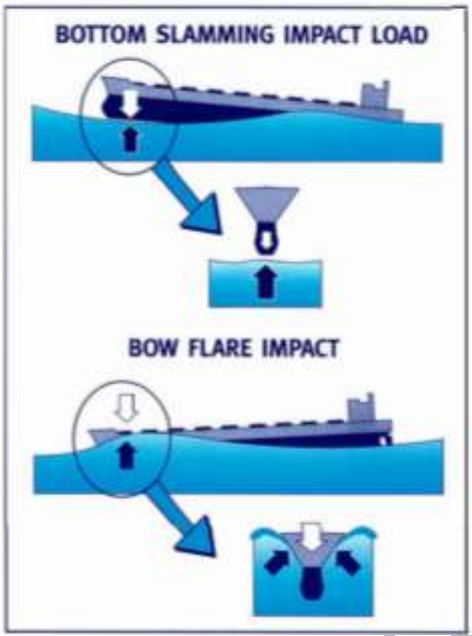
A ship floating in still water is subject to buoyancy upthrust acting on the hull. Local differences in the opposite-acting vertical forces of weight and buoyancy will cause the hull to shear and to bend. Continuous, but varying wave action at sea brings an additional dynamic component to these forces.

All bulk carries classed with IACS societies are signed maximum permissible still water shear force (SWSF) and still water bending moment (SWBM) values.

The ship's loading instrument provide a means to calculate the shear forces and bending moment in any load or ballast condition, and to assess these against the assigned maximum permissible values.

The equivalent seagoing SWSF and SWBM figures dictate the limits of shearing and bending of the main hull girder when subject to cargo loading and the continually changing wave – induced forces acting on the hull when the ship is at sea.





Capability to withstand normal dynamic loads at sea – typically from slamming and bow flare impacts – will be reduced if static stress in the hull structure has been increase by overloading.

Local strength

Some bulk carrier are provided with local loading criteria, which define the maximum cargo weight allowed in each hold – and each pair of adjacent holds – (block hold loading) for various draught conditions.

Overloading will induce grater stresses in the double bottom, transverse bulkheads, hatch coaming, hatch corners, main frames and associated brackets of individual holds.

2.2.2. METHODS TO AVOID THE DETRIMENTAL EFFECTS ON BULK CARRIERS OF CORROSION, FATGUE AND INADEQUATE CARGO HANDLING

Cargo distribution

Cargo distribution along the ship's length has a direct influence on the bending and shearing of the hull girder - and on the stresses in the local hull structure.

Common cargo distributions are:

Homogeneous hold loading:

Cargo evenly distributed in all holds. Usually adopted for low density cargoes - such as coal and grain.

Alternate hold loading

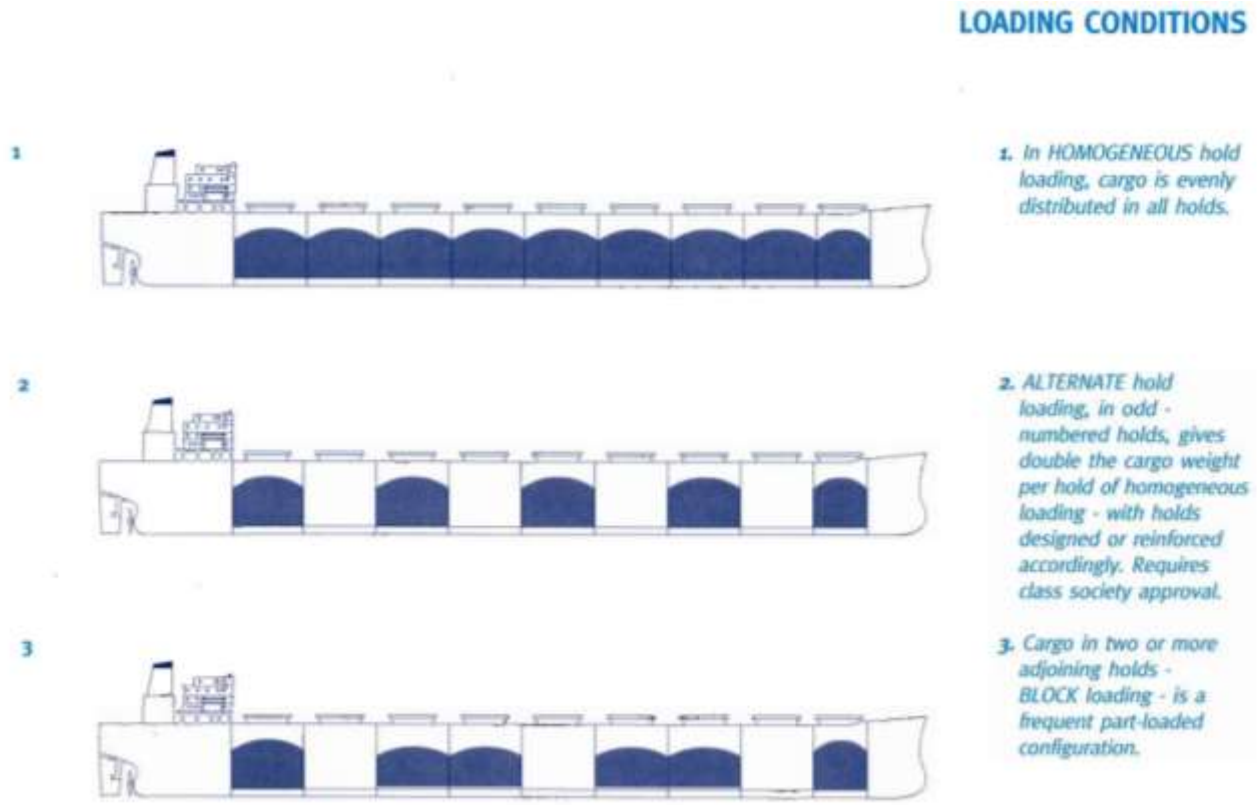
Large bulk carriers often stow high density cargo such as mineral ore - in odd-numbered holds, with the remaining holds empty.

Cargo weight per laden hold is approximately double that of homogeneous load distribution, with alternate holds designed/ reinforced accordingly. Requires classification society approval.

Block hold loading /part loaded conditions.

Block hold loading refers to stowage of cargo in a block of two or more adjoining holds – with holds adjacent to such blocks remaining empty.

The configuration is often adopted when the ship is only part loaded. However, to avoid over-stressing the hull structure in the part loaded condition, careful consideration must be given to the amount of cargo in each laden hold and the anticipated sailing draught.



Planning and control of cargo handling

Advance planning, exchange of information and continuous ship-to-shore communication are all critical. Key factors will include:

- Terminal / cargo data for the ship
- Stowage and loading / unlading plans
- Communication before and during cargo operations
- Monitoring of stevedoring
- Monitoring of stevedoring
- Monitoring the ship's condition and
- Checking for hull damage

Preparation for cargo operations

Cargo and port information:

To plan stowing, loading and discharge, the cargo terminal should provide the ship's staff well in advance with:

- Cargo characteristics, amount and properties
- Availability and any special sequence requirements
- Characteristics of loading / unloading equipment: number, range of movement and loading / unloading rates

- Depth of water alongside and in fairway
- Water density at berth and any air draught restrictions
- Maximum sailing draught and minimum draught for safe manoevring
- Conveyor belt delivery amount beyond ship's stoppage signal
- Terminal requirements / procedures for moving ship
- Relevant local port restrictions (bunkering, de-ballasting etc.)

To minimize the risk of cargo shift, IACS recommends that cargo in all holds be trimmed. The ship's master should be aware of the possibly harmful effect of corrosive and high temperature cargoes, and cargoes which may liquefy if the moisture content exceeds a certain limit.

Cargo stowage and loading /unloading plans:

The amount and type of cargo and intended voyage will dictate the proposed cargo and/or ballast stowage plan for departure. The officer in charge should always refer to the ship's approved loading manual to determine a cargo load distribution consistent with the structural loading limits imposed.

- If cargo needs to be distributed differently from the loading manual, calculations must always be mad to determine, for any part of the voyage that SWSF, SWBM, block loaded cargo weights and local loading limits are not exceeded.
- Ballasting must be considered to ensure: correct synchronization with cargo operations; rates consistent with loading rates and imposed structural / operational limits; simultaneous ballasting / de-ballasting of symmetrical port / starboard tanks.
- Stress and displacement calculations must be commensurate with the number of cargo pours and loading sequence to ensure that SWSF/SWBM, cargo weights and tanktop / local loading limits remain within limits.

At all times, hull stress limits should be kept below permissible limits.

For each step of the cargo operation, the cargo loading / unloading plan should give a clear indication of:

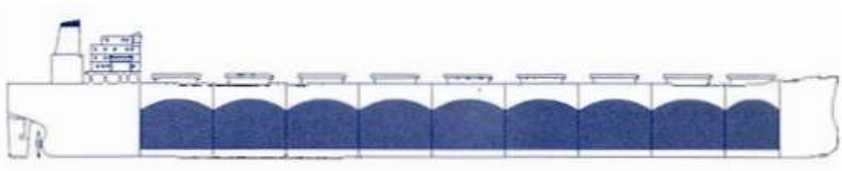
- Cargo quantity and corresponding hold numbers(s)
- Amount of water ballast and corresponding tank/hold to be discharged / loaded
- Ship's draught and trim at completion of each cargo stage
- Calculated SWSF and SWBM at completion of each cargo stage
- Estimated time for completion of each cargo loading / discharge stage
- Assumed rate (s) loading / unloading equipment
- Assumed ballasting / de – ballasting rates
- Allowances for any necessary cargo loading / discharge stoppages

Ship- shore communication

The ship's officer responsible for the cargo operation plan should submit the proposed loading/unloading plan to the cargo terminal representative at the earliest opportunity. The ship's officer should be familiar with the IMO ship /shore safety checklist, developed in conjunction with the industry.

Effective communication must be established and maintain between the ship's deck officers and the terminal throughout cargo operations. The link should establish.

- Agreed procedure to stop cargo operations
- Personnel responsible for terminal cargo operations
- Ship's officer responsible for loading / unloading plan
- Ship's officer responsible for on – deck cargo operation
- Confirmation of information received in advance
- Agreed procedure for terminal to provide ship's officer in charge with loaded cargo weight at frequent intervals and at the end of each pour
- Agreed procedure for fraught checking
- Reporting of any ship damage from cargo operations



The terminal should not commence cargo operations until the loading / unloading plan and all relevant procedures are agreed and the ship's master has, where necessary, received a certificate of readiness issued by the respective maritime authorities.

After 1 july 1998, it will be a mandatory SOLAS requirement (Under SOLAS VI Part B, regulation 7) that the plan – and any subsequent amendments – be lodged with the appropriate authority of the port state. It will also be mandatory for the ship's master and terminal representative to ensure that cargo operations are conducted in accordance with the agreed plan.

The master will have the right to suspend operations if he is not satisfied with the manner of working:

Before cargo operations are commenced, it should be determined that no structural damage exists and that if noted, it is reported to the appropriate classification society. No cargo operations should be undertaken until the damage has been assessed and repairs carried out as found necessary - and that bilge and ballast systems determined to be in satisfactory, working condition.

Monitoring / controlling cargo operations

Monitoring of stevedoring

The ship's officer in charge and monitoring stevedoring should ensure that:

- The terminal is following the agreed loading / unloading sequence
- Any damage to the ship is reported
- Where possible loading is symmetrical in each hold and where necessary the cargo is trimmed
- Effective communication with the terminal is maintained
- Pour completions and shore side equipment moves in accordance with an agreed plan are advised.
- Loading rate is not increase beyond the agreed rate for the loading plan

Any changes to previously agreed plans should have the mutual agreement of both the terminal and ship before implementation.

Monitoring the ship's loaded condition:

The officer in charge should closely monitor the ship's condition during cargo operations, to ensure that all cargo and ballast operation are STOPPED if there is any significant deviation from the agreed plan:

The officer in charge should ensure that:

- Cargo operations and ballast procedure are synchronized
- Draught surveys verify ship's loading condition versus the loading plan
- Ballast tanks sounded to verify content and ballasting / de-ballasting rate
- Cargo load agrees with terminal's figures
- SWSF, SWBM and – where appropriate – hold cargo weight / draught calculations are performed at intermediate stages, and recorded on the loading plan

If there is deviation from the loading plan, the officer in charge should take corrective action to:

- Restore the ship to the original loading / unloading plan or
- Replan the balance of the loading / unloading operation – ensuring that the stress and operational limits of the ship are not exceeded at any intermediate stage
- Cargo operations should not be resumed until the modified loading / unloading plan is agreed between the ship's officer responsible and the terminal representative – and the ship's officer has given a clear indication of his readiness to proceed.

Hull damage from cargo operations

A general inspection of the cargo spaces, hatch covers and deck is recommended. Any structural damage is to be reported to the classification society. In the event of major damage, cargo operations are not be undertaken.

All damage is to be reported to the ship's master. Where any hull damage is identified which may affect the integrity of the hull, its machinery systems or equipment, the ship's owner and classification society must be informed.

Bad cargo handling practice can over-stress and damage a ship, lowering safety margins and increasing risk to the ship and its crew. By understanding bulk carrier design and operating limits – and working closely together – ship and ashore personnel become key partners for safer shipping.

2.3. CARRIAGE OF DANGEROUS GOODS

2.3.1. CARRIAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES; PRECAUTIONS DURING LOADING AND UNLOADING AND CARE DURING THE VOYAGE OF DANGEROUS, HAZARDOUS AND HARMFUL CARGOES

Dangerous goods in packages

Packing groups indicate the level of danger and thus assist in selecting correct type of package for Dangerous Goods

There are three packing groups assigned in IMDG Code as below

Packing group I: substances presenting high danger;

Packing group II: substances presenting medium danger; and

Packing group III: substances presenting low danger

Classes 1, 2, 5.2, 6.2 and 7, and self-reactive substances of class 4.1 are not assigned with packing groups

Some hazard classes also require a Packing Group to indicate degree of hazard "Packing Group" is usually shortened to "PG". If a PG is required, it must be included on the shipper‟s declaration

- PG I Great danger
- PG II Medium danger
- PG III Low danger

Marine Pollutant

These are substances that bio-accumulate in the marine food chain or are highly destructive to the marine environment

Marine pollutants must be identified on documents and by the marine pollutant mark (below) on packages and cargo transport units

Flashpoint
The flashpoint must be provided only for:

- Class 3 substances (Flammable Liquids)
- Or any substance with a class 3 sub-risk

CLASS 3 - flammable liquids are liquids that have a flashpoint of less than 60°C.

Less common variable details

There are other less common conditional classification details that may be required eg:

- Solid or liquid
- Control & emergency temperature
- Radioactivity details
- Explosives details

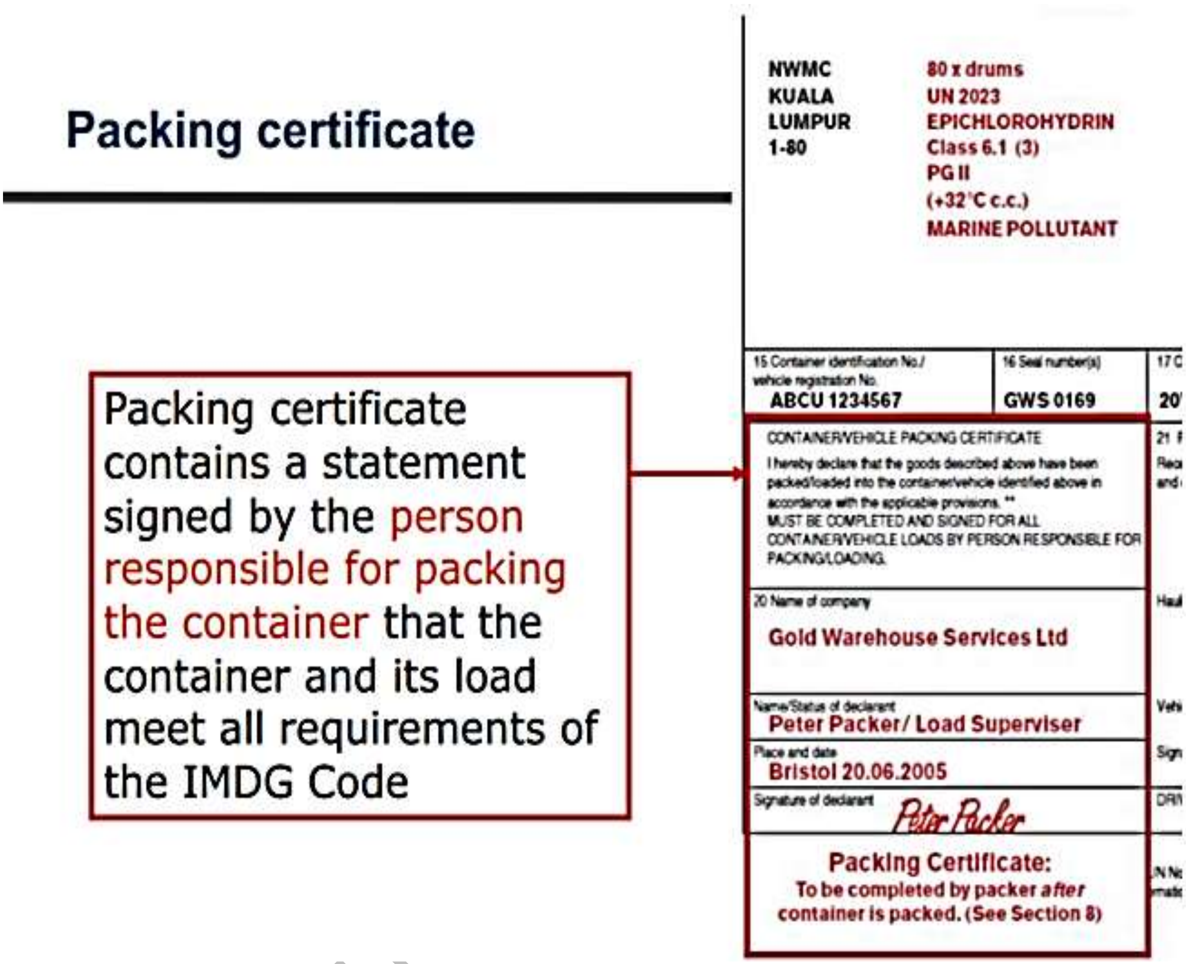
Refer to the substance entry in the Dangerous Goods List and IMDG 5.4 to see what details may be requied.

How to find classification details

All classification details are found in the various columns of the Dangerous Goods List in Part 3.2 of the IMDG Code.

When taking bookings, check that all the required classification details for the particular substance or article have been provided by the shipper.

Packing certificates



The packing certificate is a signed statement by the person packing the container that goods are:

- correctly packaged, marked & labelled
- not damaged or leaking
- properly braced and secured for sea transport
- in a container that is in good condition, that is correctly marked and placarded
- in compliance with all aspects of the IMDG Code
- accompanied by a shipper's declaration that accurately describes the goods

All consignments of dangerous goods that are packed in a freight container or a vehicle must be accompanied by a packing certificate.

Consignments without packing certificates should not be shipped.

Potential additional documentation

Booking staff should recognise that supplementary documents may be submitted or required:

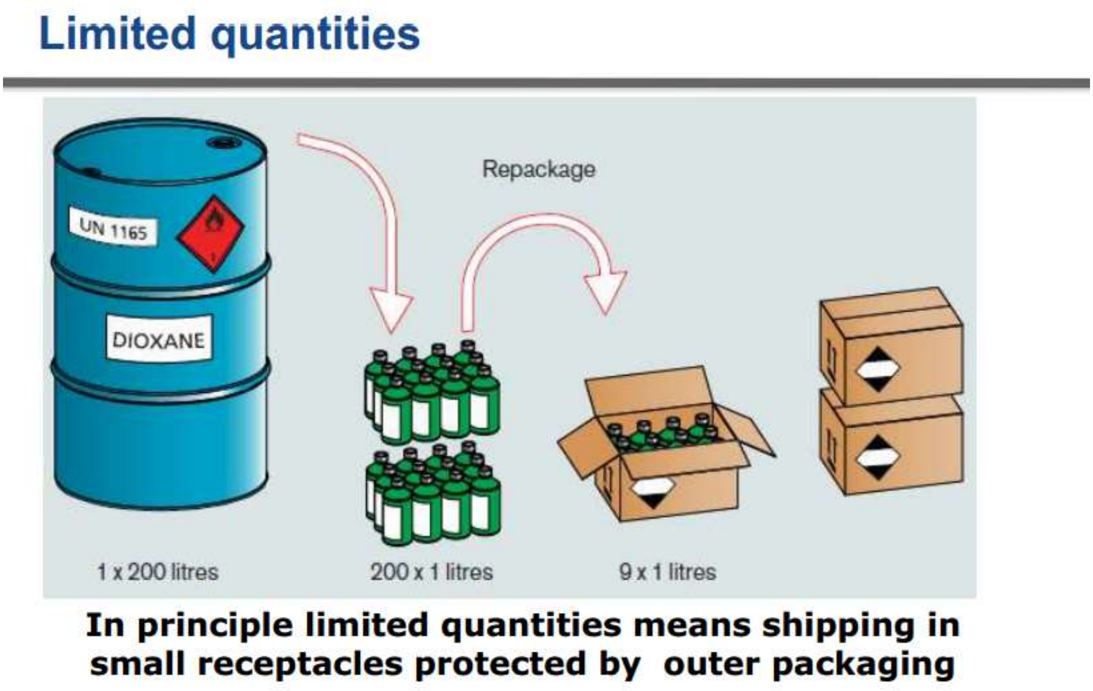
- Weathering certificate
- Exemption certificate
- Letter of indemnity
- Competent Authority Approval
- Container fumigation certificate

Limited quantities

Dangerous goods shipped as "limited quantities" have fewer land and sea transport rules.

By sea the main concession is that limited quantity goods do not require segregation from other dangerous goods.

Another concession is that UN-certified packaging is not required.



Rules for limited quantities

Packages: Maximum weight/capacity of the inner receptacles is specified in column 7 of the Dangerous Goods List for individual substance.

The shipper's declaration must state "LIMITED QUANTITIES".

Packages must bear the limited quantities mark instead of the normal label and marks.

Segregation: Rules for controlling mixed hazard loads

Mixed loading“ means loading different types of dangerous goods together in the same container.

Mixed loading creates the possibility of dangerous chemical reaction

Mixed loading is prohibited unless permitted by the IMDG Code segregation rules in IMDG section 7.2The rules of segregation are complex - see IMDG chapter 7.2.

Be aware that different types of dangerous goods may have to be packed into different containers

Calculation and checking of mixed load segregation

You may be required to advise shippers or packers on load segregation at the booking stage, or check mixed hazard loads prior to loading the ship.

To calculate segregation you will need all the classification details from the shipper’s declaration.

Checking segregation

When taking booking for multi-hazard consignments ensure that any segregation requirement is identified to the shipper

Inform shipper if IMDG code rules prohibit co-loading of a particular hazard combination offered for shipment in the same container.

Methods of checking segregation

Segregation checks can be carried out:

1. Manually using the IMDG rules in section 7.2 (This method is explained in Guidebook 3 for Consolidators section 12)
2. Electronically using an in-house electronic system supplied by the shipping line
3. Electronically using an independent commercial checking system accessed via the internet such as HAZCHECK

Solid bulk cargoes

General requirements for carrying solid bulk cargoes

No matter what solid bulk cargo you are carrying, the same general requirements apply for accepting them for shipment and loading them.

Accepting cargoes for shipment

Information required from the shipper

Before you can accept a cargo for shipment, the shipper must provide the Master

with valid, up-to-date information about the cargo's physical and chemical properties. The exact information and documentation they must provide is listed in the Code under 'Assessment of acceptability of consignments for safe shipment; Provision of Information', and includes the correct Bulk Cargo Shipping Name and a declaration that the cargo information is correct.

Checking the cargo schedule

Individual cargoes are listed in 'schedules' which are contained in Appendix 1 of the Code. These describe each cargo's properties and detail the requirements for handling, stowing and carrying it safely. You must always consult the relevant schedule in the Code to find out what hazards the cargo presents.

Cargo being worked

Accepting cargoes not listed in the IMSBC Code

The list of individual cargoes contained in the Code is not exhaustive. If a cargo not listed in the Code is presented for shipment, the shipper and the appropriate competent authorities must follow this process:

1. Before loading, the shipper must provide details of the characteristics and properties of the cargo to the competent authority of the port of loading.
2. Based on this information the competent authority of the port of loading will assess the acceptability of the cargo for shipment.

– If the assessment defines the cargo as Group A or B, the competent authorities will set the preliminary suitable conditions for carriage.

– If the cargo is Group C then carriage can be authorized by the port of loading and the competent authorities of the unloading port and flag state will be informed of the authorization.

3. In both cases, the competent authority of the port of loading will give the Master a certificate stating the characteristics of the cargo and the required conditions for carriage and handling. The competent authority of the port of loading will also provide the same information to the IMO.

Exemptions

Under section 1.5 of the Code, a competent authority (or authorities) can grant an exemption which allows ships to carry a cargo outside the requirements specified in its schedule, provided that equivalent provisions have been put in place.

Agreement of all three competent authorities is required to ship a cargo under an exemption. Acceptance of an exemption by authorities not party to it is discretionary: i.e., if the loading port authority issues an exemption, the unloading port and flag state authorities can choose to accept it or reject it.

An exemption can be valid for up to five years and does not necessarily lead to the creation of a new or revised schedule.

Loading

<u>Inspecting and preparing cargo spaces</u>

In general, before loading a cargo you must inspect and prepare the cargo spaces, checking that:

- bilge wells and strainer plates are prepared to facilitate drainage and prevent
- cargo entering the bilge system
- bilge lines, sounding pipes and other service lines are in good order
- cargo space fittings are protected from damage, and
- measures are in place to minimise dust entering living quarters or other interior spaces, or coming into contact with moving parts of deck machinery and external navigational aids.

Distribution and stability

The cargoes are properly distributed throughout the ship's holds to provide adequate stability and ensure that the ship's structure is never overstressed. Information can be found in the ship's stability information booklet or you can use loading calculators if they are available. The Master will need to calculate the stability for the anticipated worst conditions during the voyage as well as for departure and demonstrate that the stability is adequate.

Loading Plan

Before loading or unloading, the Master and the terminal representative must agree a Loading Plan to ensure that the permissible forces and moments on the ship are not exceeded. What this Plan should include is detailed in the Code of Practice for the Safe Loading and Unloading of Bulk Carriers (the BLU Code).