EFFICIENT DECKHAND COURSE (EDH)

MCA COURSE NOTES

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MCA Efficient Deckhand Syllabus including skills and competency requirements/outcomes

PART I – Theory

1. Nautical Knowledge

a) Know the meaning of the common nautical terms.
b) Know the names and functions of various parts of the ship for example, decks, compartments, ballast tanks, air pipes, pipeline systems including bilge and ballast suctions, strum boxes and wells.
c) Knowledge of the correct use of ensigns, courtesy flags and international single letter flags.
d) Knowledge of the compass card in 360 degree notation and the ability to report the approximate bearings of an object or light in degrees or points on the bow.
e) Understanding helm orders and the ability to communicate with the officer of the watch on matters relevant to watch-keeping duties.
f) Procedures for the relief, maintenance and handover of a watch and the information needed to maintain a safe watch.
g) Knowledge of the use of lifesaving and fire-fighting appliances as follows:

    i. Understand the importance of musters and drills and know what action to take on hearing alarm signals.
    ii. Understand the general arrangements and dangers of fixed smothering systems;
    iii. Understand the correct operation, precautions and dangers of lifeboat release gear.
    iv. Understand the procedures for boat preparation and launching.
    v. Understand the precautions to be observed when maintaining lifeboats and davits.
    vi. Understand the importance of fire and watertight doors.

2. Code of Safe Working Practices for Merchant Seamen (COSWP) (1998) **2015 edition – Incorporating Amendment 1, October 2016**

In each of the sections below, the candidate will be expected to have a good working knowledge of the COSWP relevant to seamen's duties and responsibilities as follows:

	Duty and responsibility	Relevant chapter of COSWP Section
1	Protective clothing and equipment	8
2	Safety signs and to include standard signs and colours for dangerous goods, pipelines, fire extinguishers and gas cylinders.	9
3	Safety induction	2
4	Fire precautions	5
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3. Shipboard maintenance

Practical knowledge of general shipboard maintenance including:

i. The use of painting, lubrication and cleaning materials and equipment and understand routine maintenance and repair procedures.
ii. Knowledge of surface preparation techniques.
iii. Knowledge of manufacturer's safety guidelines, shipboard instructions and the requirements for the safe disposal of waste materials.
iv. Knowledge of the application, maintenance and use of hand and power tools.

4. Apply precautions and contribute to the prevention of pollution of the marine environment.

Basic knowledge of marine environmental issues including:

i. The precautions to be taken to prevent pollution of the marine environment.
ii. The use and operation of anti-pollution equipment.
iii. The approved methods for disposal of marine pollutants.

PART II - Practical work

Testing by practical demonstration

1. Knots, Bends and Hitches

Common knots bends and hitches including:

i. Reef knot
ii. Timber hitch
iii. Cove hitch
iv. Rolling hitch
v. Figure of 8 knot
vi. Wall and crown knot
vii. Bowline and bowline on the bight
viii. Sheet bend and double sheet bend
ix. Sheepshank
x. Fishermen's bend
xi. Monkey's fist
xii. Round turn and two half hitches
xiii. Marlinspike hitch

2. Splicing and whipping

Common splicing and whipping including:

i. Eye splice in eight-stranded plaited rope
ii. Eye back and short splice in three-stranded rope
iii. Eye splice with locking tuck in wire rope.
iv. Parcel and serve a splice.
v. Whip a rope's end using plain and palm and needle whippings.
vi. Put a seizing on a rope and wire.

3. Rope work and rigging

General deck work including:

i. Care use and storage of fibre and wire ropes, cables and chains, including their construction, use, marking, maintenance and proper stowage.
ii. Slinging and rigging a stage and bosun's chair.
iii. Rigging a pilot ladder or hoists, gangway and accommodation ladder.
iv. Rigging rat guards
v. Rigging a derrick or crane.
vi. Use and selection of stoppers for wires and ropes
vii. Open and closing hatches and watertight doors including bow, stern and other shell doors.
viii. Driving a winch and the general precautions to be taken before and during the operation of a winch whether used for working cargo or warping.
ix. Securing the deck for heavy weather.
x. Rigging a hydrostatic release unit.
xi. The correct fitting of wire grips (e.g. 'Bulldog' grips).

4. Mooring

General understanding of mooring operations including:

i. The functions of mooring and tug lines and how each line functions as part of the overall system.
ii. Safe handling of moorings with particular reference to synthetic-fibre ropes and self-tensioning winches.
iii. The procedures and order of events for making fast and letting go mooring and tug lines and wires, including towing lines.
iv. Working knowledge of the procedures and order of events associated with mooring to a buoy or buoys.

5. Anchoring

General understanding of anchoring operations including:

i. The use and operation of a windlass in anchor work such as anchoring, weighing anchor, securing for sea and warping.
ii. The use of anchors in emergencies.
iii. The precautions to be taken in the stowage of chain cable and securing the anchors at sea.
iv. The marking of the anchor cable.
v. The procedures and order of events for the use of anchors in various operations.

6. Cargo work

a) General understanding of cargo operations including:

i. The gear used in cargo work and an understanding of its uses.
ii. General maintenance with particular reference to wires, blocks and shackles.
iii. The capacities, safe working loads and breaking strengths of mooring and cargo equipment including mooring wires, synthetic and fibre lines, winches, anchors windlasses, capstans, bitts, chocks and bollards.
iv. The procedures for safe handling, stowage and securing of cargo and stores, including dangerous, hazardous and harmful substances and liquids.
v. The ability to use and understand basic signals for the operation of equipment, including winches, windlasses, cranes, and hoists.
vi. Basic knowledge of and precautions to observe in connection with particular types of cargo and identification of IMDG labelling. (Marking and Labelling of Dangerous Goods)

INTRODUCTION

The Efficient Deck Hand Course is required by all candidates for the Maritime and Coastguard Agency (MCA) Officer of the Watch Certificate.

From January 2017 an EDH certificate must be issued 18 months prior to the issue of the OOW Certificate of Competency. Although candidates may sit the OOW oral before, no COC will be issued prior to the 18 months

Mandatory requirements for an Efficient Deck hand Certificate:

- You must be at least 17 years of age
- MCA accepted Yachtmaster Offshore, or
- Yacht Rating with at least 6 months seagoing service and steering certificate, or
- A Navigational Watch Rating Certificate, or
- A Boat Master Licence tier1 or 2 certificate, or
- A Tug Rating with at least 6 months seagoing service and a steering certificate or a NWR

BEFORE AN EDH CERTYIFICATE CAN BE ISSUED, A MINIMUM OF 6 MONTHS SEAGOING SERVICE IN VESSELS OF 15 M OR MORE IS REQUIRED.

The course consists of 5 days of theory and practical training covering basic seamanship, nautical knowledge, safety and the Code of Safe Working Practices for Merchant Seamen (COSWP), with practical assessment and examination on the final day.

Assessment will be in the form of daily test where a pass mark of 70% is required and by means of a practical assessment conducted by an approved MCA Examiner.

On successful completion a certificate will be awarded – there is no expiration on the certificate.

The EDH course forms part of the education and training required to obtain a UK Yacht Certificate of Competency. It provides an understanding of safe working practices with regard to seamanship, cargo work, anchor procedures, pilot ladders and means of access, shipboard organisation and associated topics. Further information about the course requirements can be found in MSN 1862.

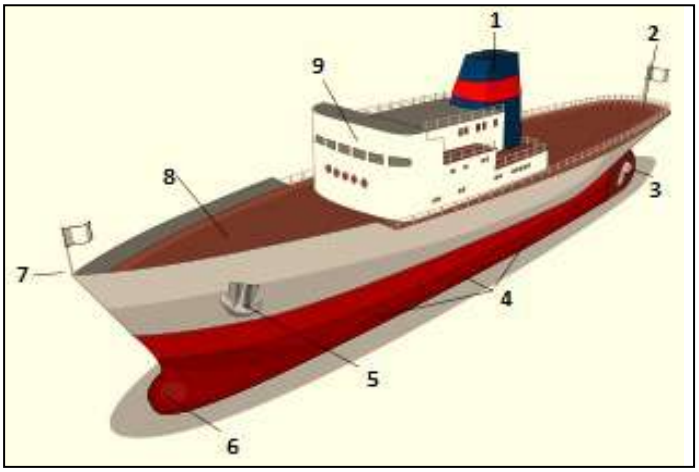
CHAPTER ONE
NAUTICAL KNOWLEDGE AND TERMINOLOGY

Nautical Knowledge

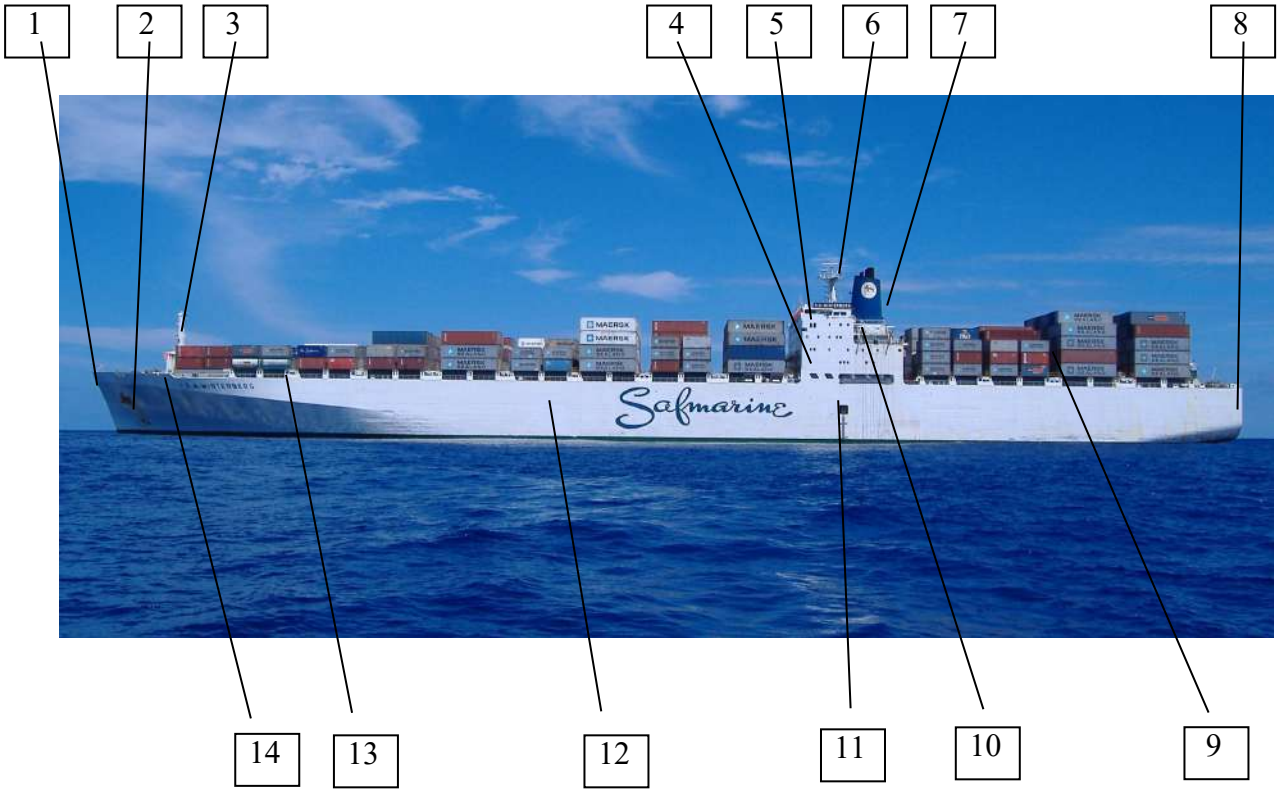
As with all industries and professions the sea has its own language and everyone who works at sea must be familiar with these terms. The language of the sea has been developed over hundreds of years and still retains some of the words that were used when ships were made of wood and sails were their only means of propulsion.

General Parts of the Vessel

Key	
1	Funnel
2	Stern/aft
3	Propeller
4	Anti-fouling/waterline
5	Anchor
6	Bulbous bow
7	Stemjack/bow/forward
8	Deck
9	Bridge/wheelhouse

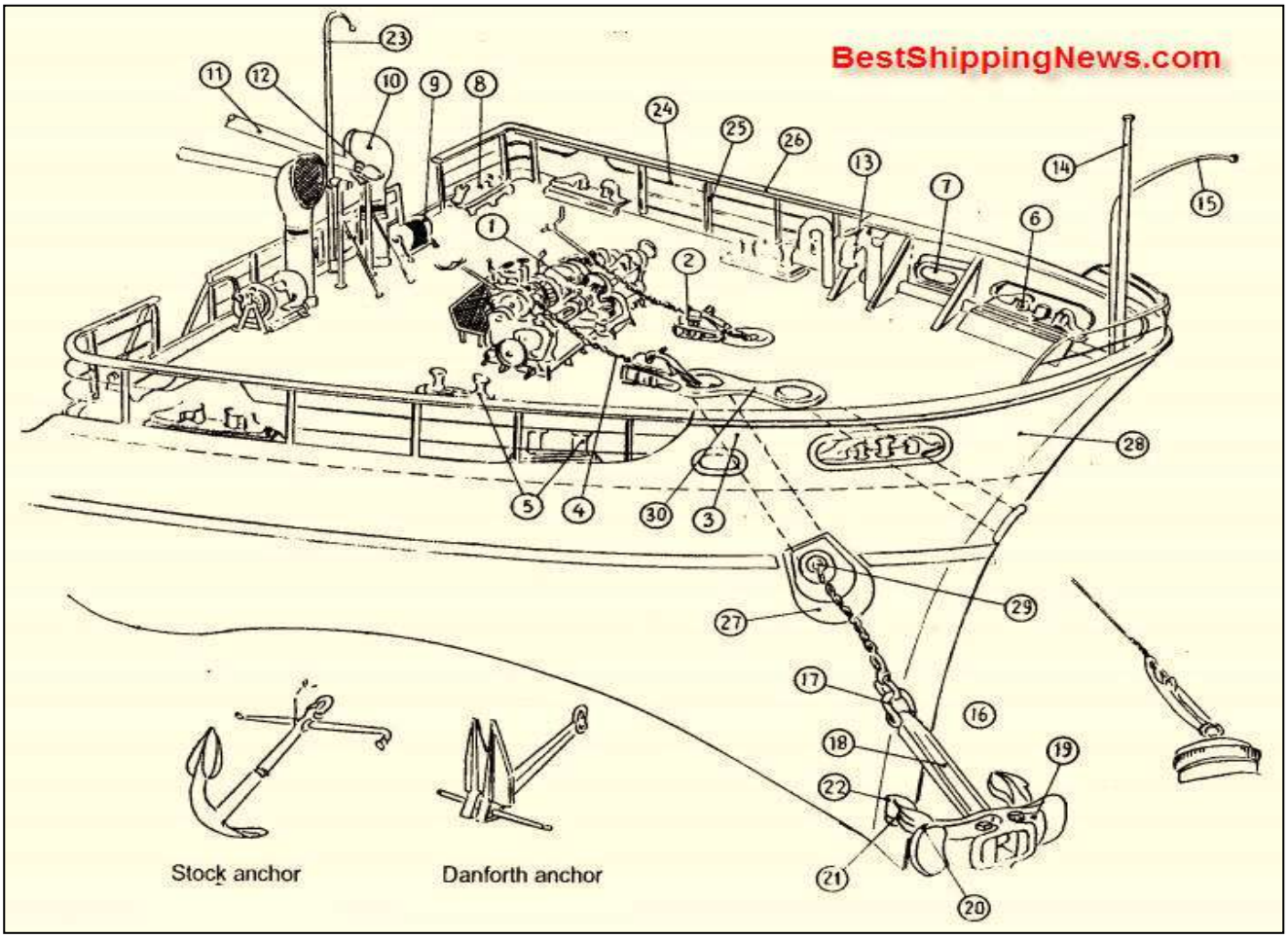


A container ship

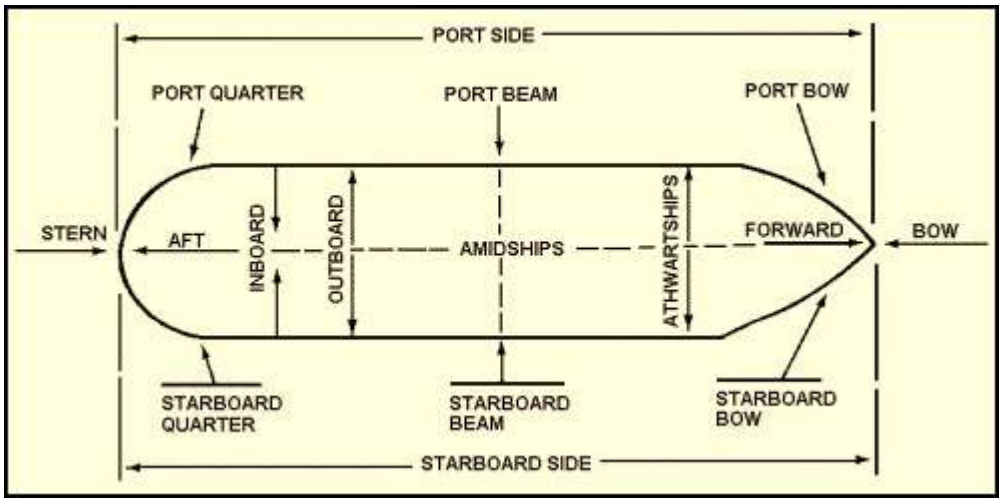


Key					
1	Bow	2	Anchor	3	Fore Mast
4	Accommodation Block	5	Bridge / Wheelhouse	6	Aft Mast
7	Funnel	8	Stern	9	Containers / Cargo
10	Lifeboat	11	Pilot Ladder	12	Hull
13	Main Deck	14	Fo'castle		

Parts of a container ship



Key					
1	Windlass	2	Anchor Pawl	3	Bulwark
4	Anchor Chain	5	Bitts	6	Fairlead
7	Panama Lead	8	Fairlead	9	Wire Drum
10	Vent Cowl	11	Purchase Derrick	12	Derrick Head
13	Vent Pipe	14	Jack Staff	15	Stem Jack
16	Bow	17	D- Shackle	18	Shank
19	Anchor Crown	20	Tipping Palm	21	Fluke
22	Pea or Bill	23	Flagstaff	24	Railing
25	Railing Support	26	Bulwark Top Rail	27	Anchor Pocket



Areas on a ship

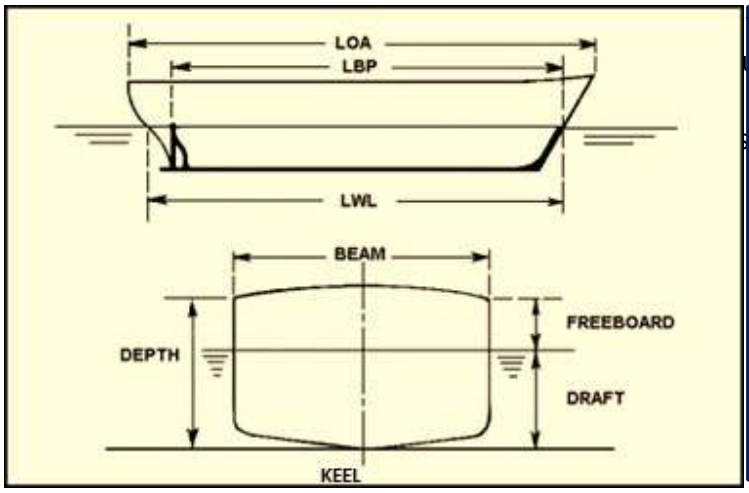
Length Overall (LOA): the length of the vessel from stem to stern.

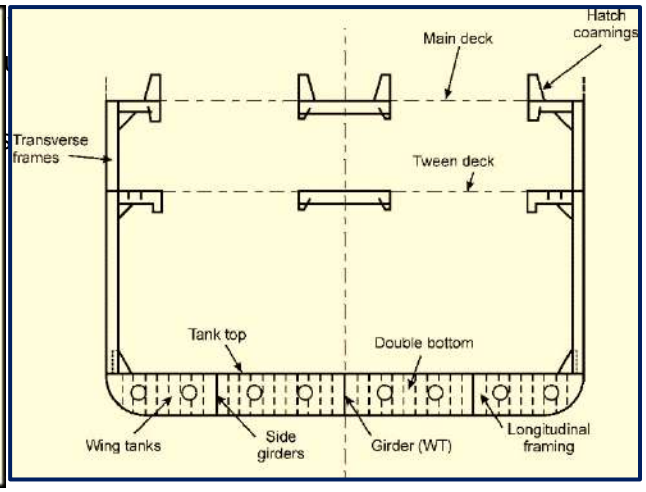
Load Waterline Length (LWL): is the fore and aft length of the hull measured at the waterline.

Length Between Perpendiculars (LBP): length from the forward part of the stem to the aft side of the rudder post at the summer load line

Waterline: the line where the water surface reaches the floating hull.

Beam: the width of a vessel at its widest point.





Glossary of terms

A	
AB	Able seaman – a rating declared competent by the administration
Abaft	Behind e.g. *abaft* the beam
Abeam	At right angles to the fore and aft line of the vessel
Aboard	On the ship; aboard or onboard the vessel
Accommodation	Living quarters; superstructure
Accommodation ladder	A portable staircase put over the shipside when the ship is at anchor or alongside; for the use of persons embarking and disembarking
Adrift	Loose/afloat without any means of propulsion; at the mercy of the sea and wind
Afloat	Lying on top of the water; not touching the bottom
Aft	Towards the stern of the vessel
After peak	Normally a tank at the most aft part of the vessel; used for ballast
Alleyway	A passage within the accommodation
Amidships	In the centre line of the vessel
Anchor	Heavy iron implement used to hold a vessel in position in shallow water
Astern	Behind the ship; or is 'moving astern' going backwards
Athwart ship	Running from port to starboard; across the vessel
Aweigh	Said of an anchor when it is broken (free) out of the ground
B	
Back spring	A mooring line which leads aft from the bow or forward from the stern
Ballast	Water or other weights carried in a vessel without profit
Batten down	Make something secure
Beam	Distance across the widest part of the vessel
Becket	Loop of rope
Below	Below deck
Bend on	Tie one rope to another
Blue Peter	International code flag 'P'
Bilge	Rounded part of the hull where the ship side meets the ship keel; also the drainage area in a hold or engine room where any excessive water or oil will collect
Bilge keel	Plate fitted at right angle to the bilge, reducing rolling of the vessel whilst at sea
Bitts	Strong twin posts for making fast mooring ropes on board the ship
Boat deck	Deck on which the life boats are located
Bollard	Single strong post on which mooring ropes are placed on the quayside
Bosun	Deck foreman
Bow	Front of the vessel
Bridge	Top deck or wheel house of the vessel; where the vessel is navigated from also known as the 'wheelhouse'
Bulkhead	A 'wall' onboard a vessel; vertical sides of a tank or cabin

Bulwark	Plating erected around the outer most edge of a vessel on the weather deck
Bunkers	Fuel for the ship's engines pumped by barges (seaside) or trucks (alongside)
Bowse-in	Bind in tightly; pull in
C	
Cabin	A room onboard where you sleep
Cable	A distance of $^{1}/_{10}$th of a nautical mile (+/- 180 metres) Also, a heavy rope or chain for mooring a ship
Capsise	Turn over
Capstan	Single vertical turning drum used for hauling ropes
Cargo	Goods carried for profit onboard
Cargo battens	Horizontal or vertical planks fixed inboard on frames to protect cargo
Catwalk	Temporary gangway laid on top of deck cargo
Chain locker	Space where the anchor chain is housed
Chartroom	Area on the bridge where the charts or kept and navigation of the vessel plotted
Chippy	Ship's carpenter
Clear	Keep a rope free of kinks and tangles
Cleat	Protrusion to which a rope can be fastened
Cells	Angle irons forming slots in the hold of a container ship to hold the containers
Coaming	Raised metal borders around hatch openings
Coaming stiffener	A bar or plate set up at right angles to the coaming to provide it strength
Cofferdam	The empty space between two bulkheads separating two adjacent compartments
Coil	Stow a rope in a circular form
Come up	Order to stop hauling on a rope and ease the strain so that it can be made fast
Course	Direction in which a vessel is travelling
Crew	All personnel onboard a vessel other than the captain
Crow's nest	A look-out position towards the bow of the vessel at the top of the foremast
D	
Davits	Structure to which lifeboats are connected; used for launching and retrieving lifeboats
Deadlight	Metal cover for glass portholes
Deck	The floors on a vessel
Deckhead	The ceilings on a vessel
Deep tank	A large ballast tank which normally covers most of the beam of a vessel horizontally and vertically, located from the weather deck down to the double bottom

Derrick	A pivoted boom capable of being raised and lowered and used for loading or discharging stores and cargo
Devils claw	Two pronged hook used for securing the anchor cable whilst the vessel is at sea
Donkeyman	The engine room crew foreman
Double bottom	Space between the bottom of the ships and the tank top; used for storing ballast, drinking water, fuel or lubrication oils
Draught	Distance measured from the water line to the keel of the vessel
Draught marks	Markings found on the vessel fore and aft as well as midships indicating the depth of water the vessel is drawing
Drumend	A drum on the side of the winch used for holding, moorings and the discharge of cargo by fibre ropes
Duct keel	A keel built of plates in a box shape; normally running fore and aft along the centre line at the keel of the vessel; pipes and electrical cables run through the duct keel
Dunnage	Loose wood placed under or between cargo when loading
E	
Even keel	When the vessel has an equal draught forward and aft
F	
Fathom	A measurement of 6 feet in length; +/- 1.83m
Fid	Wooden spike used when splicing fibre ropes
Fish plate	Vertical iron plate on the outboard side of a deck in the superstructure
Flagstaff	Pole at stern of vessel from which the vessel's national flag is flown
Floor	Vertical iron plate running transversely along bottom of the vessel between opposite frames
Fo'castle	Crew's quarter in forward part of vessel; in modern vessels used as a store room for wires, ropes and cargo equipment
Fo'castle head	Upper most deck at bow of vessel; deck above fo'castle
Fore peak	A ballast tank in the bow of the vessel
Forward	Towards the bow
Frame	Vertical angle bars running athwart ship
Freeboard	The distance measured from the water level to the top edge of the deck plate
Freeing port	Large openings in bulwarks to allow excess water to escape quickly in heavy weather
Fumigation	The disinfection of various parts of the vessel
G	
Galley	Kitchen on board a vessel
Gangway	Access ladder between the vessel and the quay; normally fixed on board the vessel on a swiveling platform
Gangplank	Portable access ladder between vessel and quay
Gooseneck	Swivel at heel of a derrick
Gooseneck vent	Inverted 'U' shape at top of a double bottom ventilator

Granny knot	Incorrectly made reef knot
Gravity davits	Two davits which support the lifeboat which, on being released, move the boat over the ship's side under gravity
Greaser	An engine room rating
Gunwale	A flat or bulb plate secured to the top of the bulwark
Gypsy	A sheave with interior lugs into which a chain will fit
H	
Halyard	A rope used to hoist flags
Hands	Members of the ship's crew
Hatch	An opening in the deck giving access to below-deck spaces for loading cargo.
Hatch batten	Steel bar used to clamp a tarpaulin down at the sides
Hatch board	One of a number of wooden or metal boards used to cover a hatch
Hatch coaming	See *coaming*
Hatch locking bar	Bar used to clamp the hatch boards in position; fitted over the tarpaulin
Haul	Pull upon
Hawse pipe	Tube through which the anchor cable passes to connect to the anchor on the outboard side of the vessel to the water
Head line	A forward mooring line on the bow leading forward
Helm	Wheel by means of which the vessel is steered; steering wheel
Hold	A large cargo space; normally the depth and width of a vessel
House flag	The flag of the shipping company
Hull	The whole of the ship's side plating together with frames and floors
I	
In ballast	A ship with no cargo, only ballast water
Inboard	Inside the ship
Inglefield clip	A patent clip used mainly for clipping flags to halyards
J	
Jackstaff	A flagpole situated on the tip of the bow
Jacobs ladder	A thin rope ladder with round rungs
Jumbo derrick	A heavy lift derrick
K	
Keel	The main centreline structural bottom plate of a ship running fore and aft
Kicking strap	A heavy prong pointing aft beneath a windlass gypsy; placed there to kick the cable out of the gypsy into the spurling pipe
Knot	Speed of one nautical mile per hour
Knock off	Done with duties
L	
Labour	Roll and pitch
Launch	A small motor boat; or to place a boat or ship in the water
Lay	The twists of the strands of a rope or wire – right/left-hand lay
Lee side	The side of a ship the wind is blowing away from

Leeward	Away from the wind
Let go	Untie or free a rope
Life boat	Small boats carried onboard used in an emergency which ship's crew must abandon the ship
Light ship	Without cargo
Light vessel	A navigational aid
Lightening holes	Circular pieces cut out of floors and intercostals to reduce the overall weight of a ship
List	The amount by which a ship is leaning over to one side
Lizard	A short piece of rope having a thimble spliced into one end
Load line marks	Vertical and horizontal lines found amidships on the ships side denoting the depth to which the ship may be loaded under varying conditions and seasons
Log	A diary of happenings onboard a ship. Also a device for measuring distance travelled
LNG	Liquid natural gas; for example: methane
LPG	Liquid petroleum gas; for example: propane and butane
Lubber line	A line drawn on the forward inner side of a compass bowl in a fore and aft direction
Lull	Temporary easing of the wind or weather
M	
Main deck	Deck up to which all watertight bulkheads reach
Make fast	To secure
Make water	To take in water through a leak
Manhole	A circular hole cut in a tank; tank top or other place through which a person can enter
Marlin spike	Metal spike used when splicing wire ropes
Mast	Vertical pole normally on the centre line of a ship
Mast house	A house at the base of a mast
Master	Legal name for the captain of a merchant ship
Mate	Deck officer
Mess	Dining room onboard a ship
Monkey island	Top of the wheelhouse
Moor	To secure a ship alongside a quay or with two anchors
Muster	Assemble in a particular place
Muster List	A notice displayed all around the ship listing the names of the crew and their duties and muster stations in case of an emergency
N	
Navigate	To proceed from one place to another
NUC	Not under command
O	
Outboard	On the outside of the ship or towards the outside
Overboard	In the water

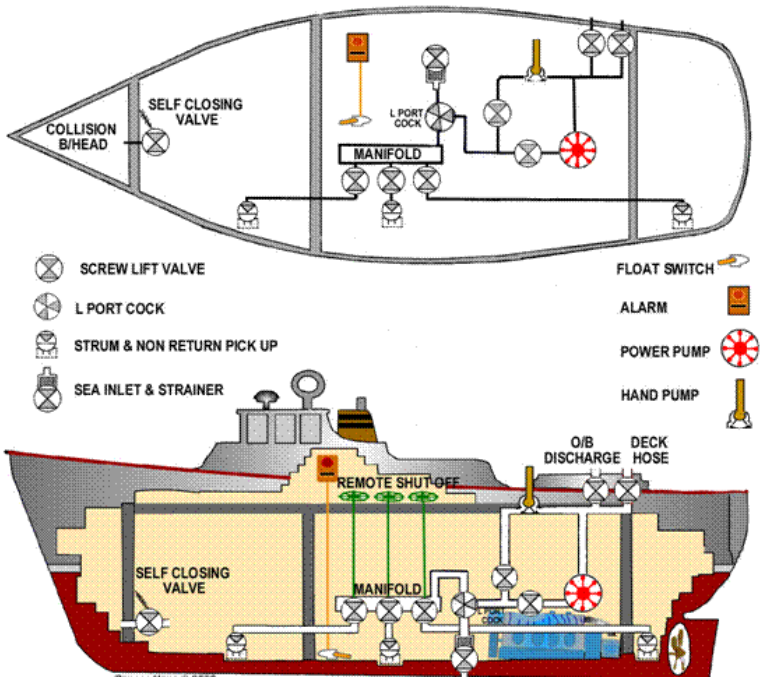
P	
Pallet	A wooden tray carrying cargo
Panama Lead	Fair lead with a closed top, used in the Panama Cannel
Part	When a rope breaks it is said to 'part'
Pay off	Discharge/sign off a crew at the end of his/her contract
Payout	To give more slack, payout a rope or anchor chain
Peggy	Crew mess steward
Plimsoll Mark	A circle with a horizontal line running through the centre, found with the load line marks; maximum depth to which a ship may be loaded in summer when floating in saltwater
Pillars	Strong vertical angle irons supporting the corners of the hatchway above the tank top
Poop	Weather deck at stern of ship
Port hole	Window on a ship
Portside	Left hand side of a ship when facing forward
Q	
Quarter	Aft part of a ship
Quartermaster	Crew man employed as a helmsman
R	
Reeve	Pass the end of a rope through an opening
Rigging	Any rope or wire attached to a mast or on the gear attached to a mast
Rudder	Means by which the directions of a ship's head is controlled; a movable flat metal plate underneath at the stern, close to propeller
S	
Saloon	Officer's dining room
Samson post	A stump mast used to support a derrick
Scotchman	Any sleeve placed on rigging to prevent chaffing
Scupper	A drain onboard a ship
Set	Direction in which a current flows
Shackle	Two piece connector made of steel
Side lights	The coloured lights at the side of a ship
Sign on	Join a ship as member of a crew
Sign off	Cease to remain a member of the crew
Skylight	Metal structure capable of opening to allow natural light below decks
Slip	Let go of
Sounding	Measurement of depth of a liquid
Spurling pipe	Tube/opening for anchor cable to run down into the chain locker
Squeegee	Rubber strip attached to a wooden handle, used as a broom for removing excess water off decks
Square up	Stow materials; pack away gear and tools
Stability	Righting force of a ship
Starboard side	Right hand side of a ship when facing forward

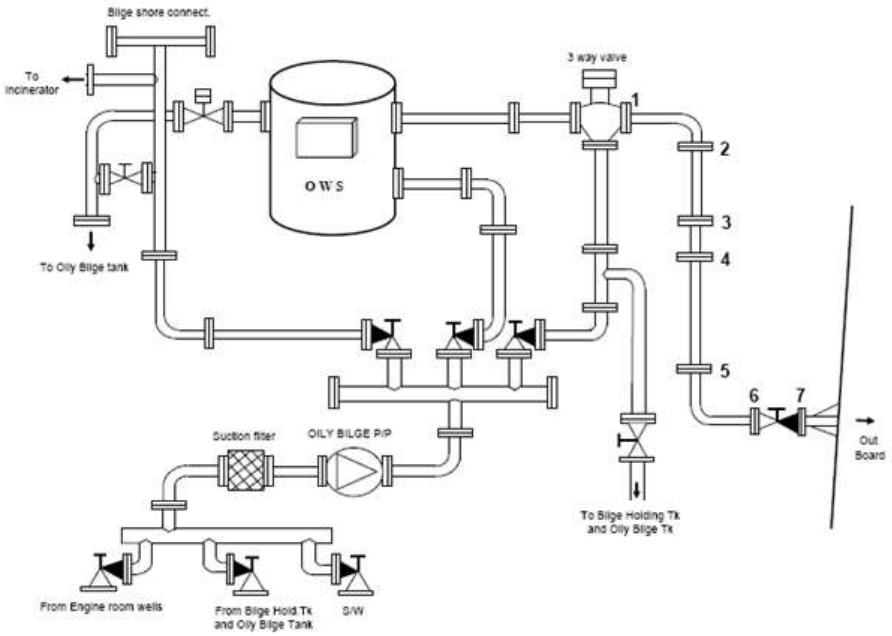
Steer	Keep the ship heading in a required direction
Stern	Rear end of a ship
Stern line	Mooring rope used aft which leads aft
Stove in	Anything broken by bad weather is said to be 'stove in'
Stow	Put an object neatly in its proper place
Strumbox	Found in bilges, a metal filter box fitted to end of bilge suction pipe to stop debris being sucked up into the pump i.e. a strainer
Sugi	Water mixed with soda used to clean/wash down a ship. (soogie)
Sweat down	Tighten a rope
T	
Tank	Usually designed to carry dry cargo, liquid cargo, ships bunkers or fresh water
Thwartship	Across the ship from one side to another
Topside	The ship's side above the loaded waterline
Trice	To bind in
Trim	Difference in the amount of water drawn by the bow and stern of a ship
Trough	Hollow between two waves
Tug	Small powerful vessel used to assist ships when entering, berthing and leaving port
Tweendeck	Any deck between the main deck and lowest deck; in a hold
Turn to	Start work
U	
Ullage	The vertical measurement between the top of a tank and the surface of the liquid in that tank
Underway	A vessel which is not at anchor, aground or made fast alongside a quay
Union plate	Triangular plate with a hole in each corner
Unship	Remove an object from its working position
V	
Ventilation	Any arrangement that allows the air in a compartment to be changed
W	
Wake	Disturbed water left astern of a moving ship
Walk back	To reverse the action of a capstan or winch so as to ease the rope around it
Warp	Move a ship by means of ropes, without using engines
Wash down	Hose the decks down
Watch	Period on duty
Water ballast	Sea water carried in tanks in order to obtain satisfactory conditions of draft, trim and stability
Watertight door	A door lined with packing and secured and found between two watertight compartments
Watertight deck	Deck which prevents water passing through
Watertight bulkhead	Vertical partitions in a ship used to separate holds or tanks

Way	Impetus of a ship through the water
Weather side	The side of the ship which has the wind blowing onto it
Weather deck	An uncovered deck exposed to the weather
Wedge	Triangular pieces of wood or metal used to keep hatches closed and watertight
Wheelhouse	Another name for the bridge
Winch	Machine having a horizontal barrel operated by either hand or mechanical power to heave on ropes and wires. Used during mooring a ship alongside
Windlass	A special form of winch fitted with a gypsy to heave up anchor chains
Windward	Towards the wind

Bilge Pumping System

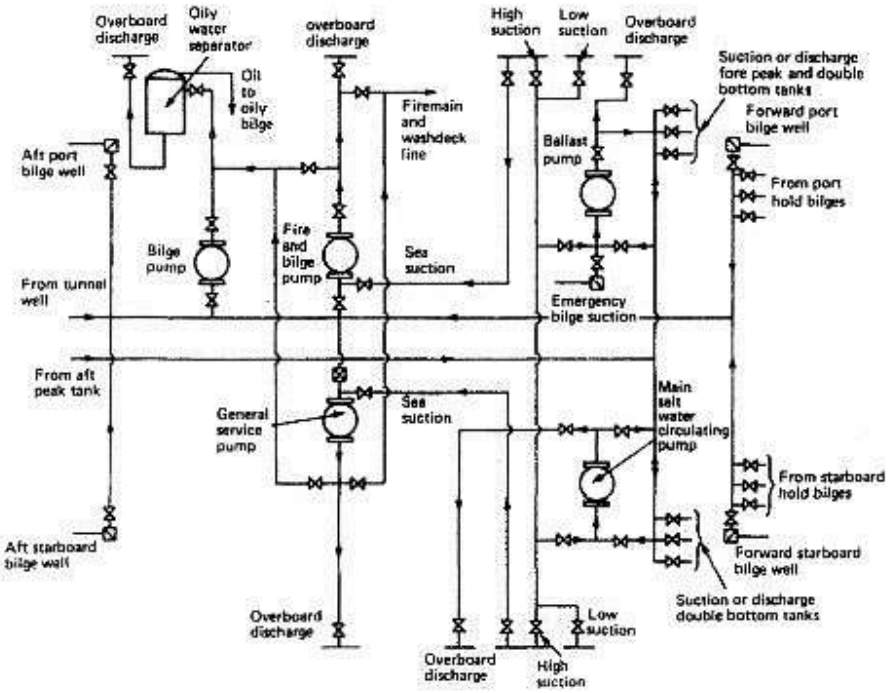
This is a system of pipes and valves which are designed to be able to pump any unwanted water out of any compartment on board a vessel and is also connected to all bilge wells found in cargo holds as well as the engine room bilges.





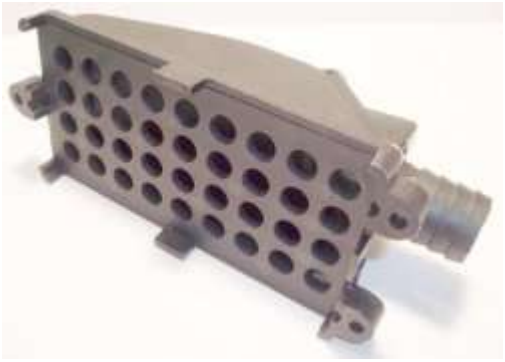
Combined Fire and Bilge Pump System

Often ballasting and sometimes bilge system pumps are connected to the firefighting system serving multiple purposes.

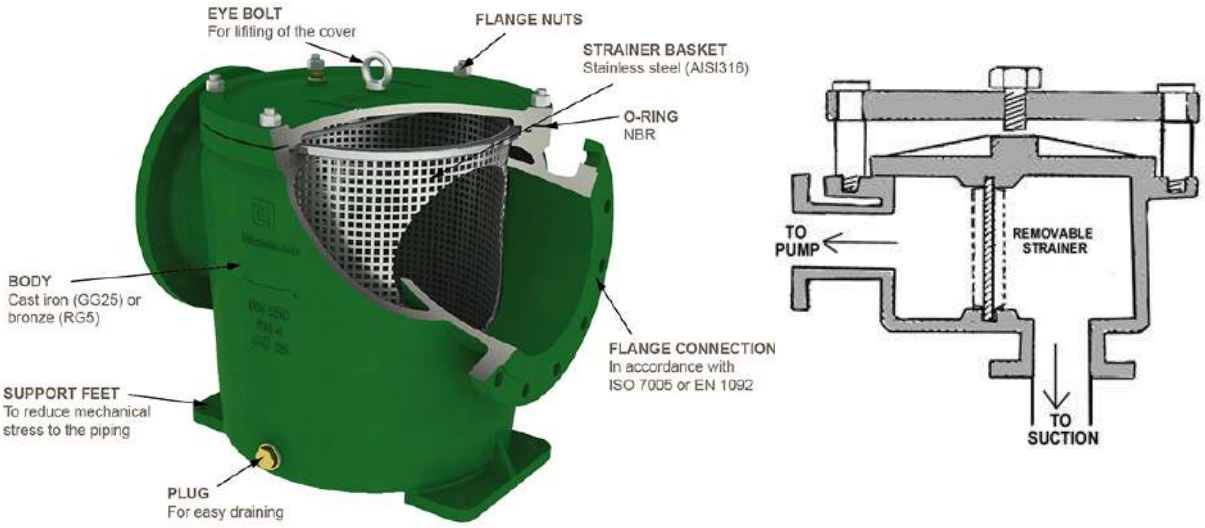


To prevent solids and other items from entering the system there will be a number of filters in place:

Strum Boxes are fitted at the intake of all bilge pipes to prevent solids etc. from being drawn into the pumps.



Mud Boxes are placed close to the salt water intakes and are designed to prevent mud and other solids from being drawn into the pumps and valves.



Manifolds is connected with many pipes and allow suctions to be selected to different bilges on the vessel.

Oily Water Separator is in the bilge system to remove oil from bilge water before it is pumped overboard.

Limber holes are holes in frames that allow water to pass through and drain into the bilge.

Ballast system is used for pumping ballast (sea water) into (ballasting) or out of (de-ballasting) dedicated tanks. The reason for doing this may be to increase or possibly decrease a ship's stability or it could be to change a vessel's trim or list.

Vessel pumping out Ballast water from tanks

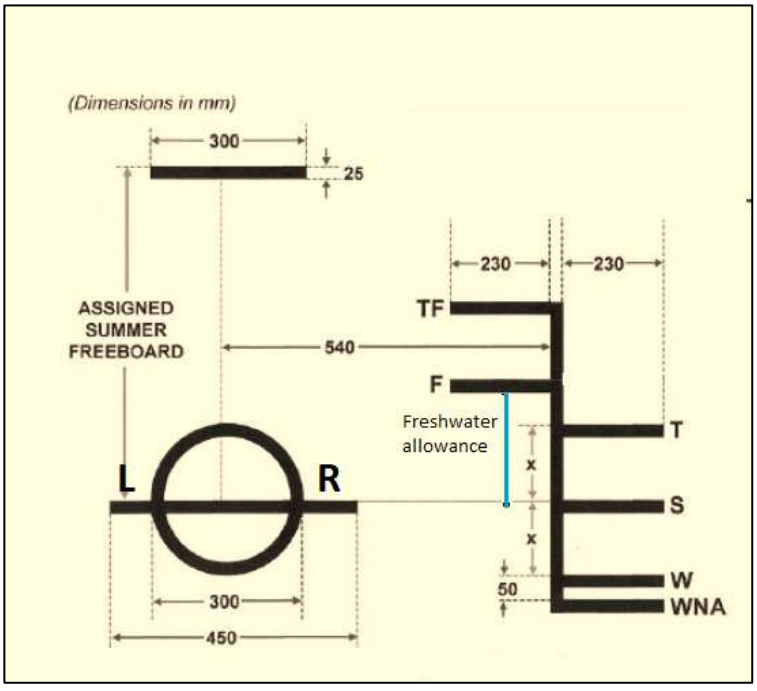
CHAPTER TWO
LOAD LINES

When a vessel loads weights of any sort (passengers, fuel, crew, stores, cargo etc) its draft increases as more buoyancy needs to be provided to support the increase in displacement (weight). Obviously, if too much weight is loaded the vessel will eventually sink; this will occur once there is no reserve buoyancy left (i.e. no enclosed volume above the waterline. To ensure a margin of safety, there should always be a certain amount of reserve buoyancy left. For this reason, vessels involved in commercial operations, and certain leisure craft, are assigned a **load line.** This is a mark made on the side of the hull which indicates the deepest draft to which a vessel may load. The load line is assigned by a government agency in terms of an international convention, and there are severe penalties imposed on vessels which are overloaded, i.e. if the load line is submerged.

The position of the load line is determined by assigning a Statutory Freeboard (also known as Assigned Freeboard or Summer Freeboard) to the vessel. This is the minimum freeboard the vessel is allowed and is found from tables, entered with the principal dimensions of the hull, and adjusted for certain features of the vessel, such as bow height, superstructure, etc. The following definitions are extracted from the Load Line Convention, and are important:

Freeboard deck is the uppermost continuous deck that can be closed weathertight
A**ssigned freeboard** the distance from the top of the deck line to top of the Summer load line.
Superstructure is a decked structure upon the freeboard deck, which either extends from side to side of the ship or nearly so.

Cargo vessels operating worldwide need to be able to maximise their earnings by loading as much as is compatible with safety. The Assigned load line is known as the Summer load line since it applies in summer in most parts of the oceans. A slightly higher freeboard applies in Winter, for which an additional mark (**W**) is made on the side. Certain areas of the world are designated Tropical as they have mostly good weather conditions, and a freeboard slightly less than the summer one is permitted. This is also marked on the side (**T**).



Many passenger and leisure vessels may opt for an 'All Seasons Load Line' when a freeboard slightly higher that the calculated Summer Freeboard is assigned. This is the suitable for all seasons in all areas of the world and is illustrated below.

When a vessel moves from salt to fresh water is assumes a slightly deeper draft since fresh water is less dense. Similarly, moving from fresh water to salt water causes the draft to decrease by the same amount. A vessel loading in fresh water is therefore allowed to submerge its Load Line by an amount known as the **Fresh Water Allowance**; **defined as the difference between draft in Salt and fresh water.** The Fresh Water load line is marked on the side of the hull (**F**) to facilitate this.

Assigning Authorities

Governments may assign load lines through their own agencies such as the MCA in the UK or USCG in USA. Frequently, however, they may delegate their powers of assigning to certain private organisations known as classification societies, who then become the assigning authority. Examples are Lloyd's Register of Shipping in the UK or the American Bureau of Shipping in the USA. The initials of the assigning authority are marked either side of the primary load line mark on the vessel's side.

Conditions of Assignment

Vessels requiring a load line may not operate without a loadline certificate. This is only issued when the relevant marks have been made on the side and provided certain conditions are met, which are designed to ensure that the vessel will continue to have adequate reserve buoyancy by excluding water from the enclosed volume. These conditions are also checked annually to ensure that the vessel continues to comply.

Conditions of assignment include the following provisions which affect the stability and seaworthiness of the ship.

1. All openings which give access to spaces below the weather deck must be designed and constructed so as to prevent the ingress of sea water.

2. Hatchways should be hinged sliding, or permanently secured by other equivalent means to the structure of the ship and be provided with at least two locking devices. In general, all hatchways should be kept closed at sea. However, hatchways which are often open at sea should be as small as possible, never more than a metre square and have a coaming or sill of at least 300 mm above the deck.

3. Doorways should have weathertight doors, open outwards and have means of closure that can be operated from either side. They should be located as close as possible to the centre line of the ship or, if on the side of the superstructure, be hinged on the forward edge and fitted with a coaming or sill at least 300 mm above the weather deck.

4. Skylights, side scuttles, portholes and windows must be of equivalent strength to the structure around them and must have further means of closure in case of breakage. Those in spaces below the weather deck must have permanently attached deadlights and those above the weather deck must have portable means of closure.

5. Ventilators must be as far inboard as practicable and be of sufficient height to prevent the ready admission of water. They must also be provided with a permanently attached means of weathertight closure.

6. Air pipes greater than 10 mm in diameter should have permanently attached means of closure, be as far inboard as possible and be of sufficient height to prevent inadvertent flooding.

7. Where the deck is fitted with bulwarks such that shipped water may be temporarily trapped behind them, the bulwarks should be provided with an adequate number of freeing ports.

The **International Association of Classification Societies** (**IACS**) is a technical based organization consisting of the twelve marine classification societies headquartered in London.

The principle maritime nations (12) all have established Classification Societies:

American Bureau of Shipping (ABS)
Bureau Veritas (BV)
China Classification Society (CCS)
Croatian Register of Shipping (CRS)
Det Norske Veritas Germanischer Lloyd (DNV GL)
Indian Register of Shipping (IRS)
Korean Register of Shipping (KR)
Lloyd's Register (LR)
Nippon Kaiji Kyokai (NK/ClassNK)
Polish Register of Shipping (PRS)
Registro Italiano Navale (RINA)
Russian Maritime Register of Shipping (RS)

Symbols Used by Classification Societies
A ship built in accordance with Lloyd's Register of Shipping rules will be assigned a class and listed in Lloyd's Register Book. The characters and symbols used in the book include:

100	Considered suitable for seagoing service.
A	Built in accordance with Lloyd's class rules.
1	Anchor and mooring equipment comply with Lloyd's rules.
✠ Maltese Cross	New ship built under supervision of a society surveyor.

Other characters are used for special ship types and machinery.

The table shows the symbols used by each IACS Member to denote a ship constructed under special survey in compliance with the society's rules, suitable for unrestricted sea-going service:

Society	Symbol
ABS	✠ A1
BV	I
CCS	★ CSA
CRS	★ 100A1
DNV GL	✠ 1A
IRS	✠ SUL
KR	✠ KRS1
LR	✠ 100A1
NK	NS *
PRS	* KM
RINA	100-A-1.1 or C
RS	KM⊛

Surveys

Classification Societies carry out the following survey

Annual survey
Intermediate survey every 2 or 3 years

Special survey every 5 years

Docking survey twice within the 5-year period

Other surveys for special requirements

CHAPTER THREE
FLAGS, DISTRESS AND MORSE CODE

Flags still have a role even with modern communications. They indicate the port of registry of a vessel, sometimes identify the company or owner, membership of clubs and also are used for safety and communications.

In addition sound signals are still used based on the Morse Code.

Ensign

The national ensign worn by a vessel must be the nautical flag of her registry—it is not necessarily that of the owner or operator. It will be flown from the stern on most vessels; from dawn until dusk in harbour and at all times while at sea. For example the Red Ensign will be flown by most non state-owned UK vessels.

Courtesy Flag

This is the national maritime flag of the host country, although there are countries (such as Malta) where the national, rather than the maritime flag is correct.

It is worn on the starboard yard arm where it can be clearly seen (unless the vessel is in its own country of registry) and is hoisted once vessel is cleared into waters of the host country.

A yacht with UK ensign and French courtesy flag.

"Q" Flag

The yellow Q flag should be flown when the vessel enters a foreign countries territorial waters and remains up until the yacht is properly cleared by customs and immigration, after which the Q flag is replaced by the courtesy flag. It should be flown from the starboard side yard arm where it can be clearly seen when approaching the port of entry to a foreign country. It indicates that the vessel is newly arrived and requests "free pratique" – that is permission to use a port, given to a ship after quarantine or on showing a clean bill of health - and is requesting customs and immigration clearance. It should never be flown above the courtesy ensign and should only be removed after all clearances have been given.

Burgee

Indicates membership of a club or the owner's personal "flag". Often triangular, the burgee from the skipper's yacht club or sailing organisation is also hoisted at the starboard spreader, but below the courtesy flag. It may also be flown from the jack staff in the bows. The burgee may be flown day and night.

Signal Flags

Should be flown from the port side yard.

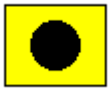
International Code of Signals

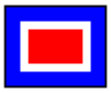
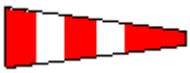
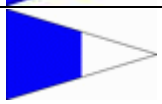
The International Code of Signals, otherwise known as ICS, enables parties to communicate, by voice, flag or lamp or sound, even though there may be no common language. It contains details of methods of signalling, the Morse Code, signal flags, radiotelephony and semaphore signalling. The book is divided into sections for emergencies, casualties, navigation, manoeuvres, weather, routing, icebreakers and medical. There is also a set of Rescue Signal tables and distress signals.

The code flags and their individual meanings are as follows:

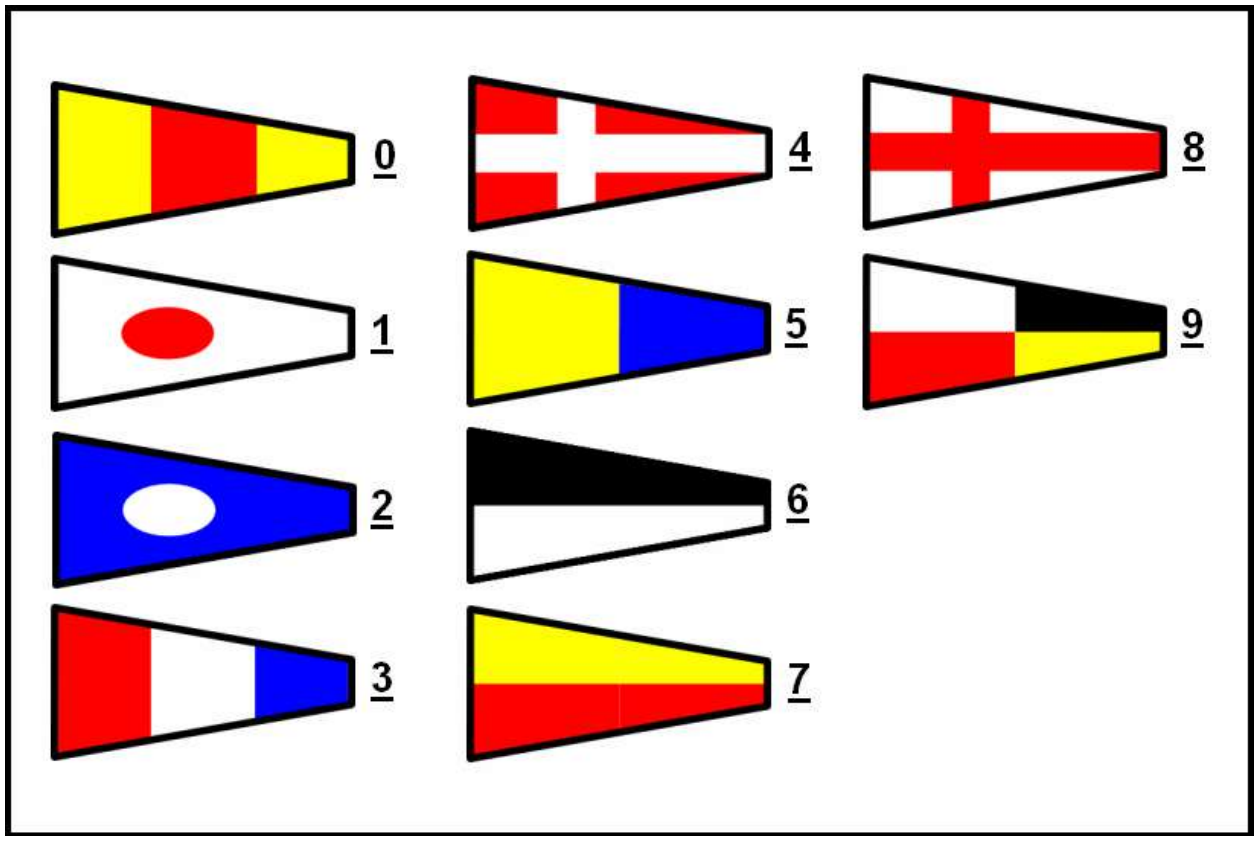
Code Flags – meaning and phonetic pronunciation

FLAG	LETTER MORSE CODE	PHONETIC	MEANING	Alternate meaning
	**A** ·–	**ALPHA**	I have a diver down; keep well clear at slow speed	Non ICS Diver Flag 
	**B** –···	**BRAVO**	I am taking in, discharging, or carrying dangerous cargo	
	**C** –·–·	**CHARLIE**	"Yes" or "affirmative"	
	**D** –··	**DELTA**	I am manoeuvring with difficulty; keep clear	
	**E** ·	**ECHO**	I am altering my course to starboard	
	**F** ··–·	**FOXTROT**	I am disabled; communicate with me	
	**G** ––·	**GOLF**	I require a pilot	When made by fishing vessels operating in close proximity on the fishing grounds it means: "I am hauling nets"

	**H**	**HOTEL**	I have a pilot on board	
	**I** . .	**INDIA**	I am altering my course to port	
	**J** . – – –	**JULIETTE**	I am on fire and have dangerous cargo; keep well clear of me	I am leaking dangerous cargo.
	**K** – . –	**KILO**	I wish to communicate with you	
	**L** . – . .	**LIMA**	You should stop your vessel immediately	In harbour: the ship is quarantined.
	**M** – –	**MIKE**	My vessel is stopped and making no way through the water	
	**N** – .	**NOVEMBER**	No or negative	
	**O** – – –	**OSCAR**	Man overboard	
	**P** . – – .	**PAPA**	In port: all persons report on board, the vessel is about to proceed to sea	At sea: used by fishing vessels to mean: "My nets have come fast upon an obstruction".
	**Q** – – . –	**QUEBEC**	My vessel is 'healthy' and I request free pratique	
	**R** . – .	**ROMEO**	No ICS meaning as single flag	
	**S** . . .	**SIERRA**	I am operating astern propulsion	
	**T** –	**TANGO**	Keep clear of me	Keep clear of me; I am engaged in pair trawling

	**U** · · _	**UNIFORM**	You are running into danger	
	**V** · · · _	**VICTOR**	I require assistance	
	**W** · _ _	**WHISKEY**	I require medical assistance	
	**X** _ · · _	**XRAY**	Stop carrying out your intentions and watch for my signals	
	**Y** _ · _ _	**YANKEE**	I am dragging anchor	
	**Z** _ _ · ·	**ZULU**	I require a tug	
	**Code/Answer**		Message is understood	Numeric decimal point
	**FIRST SUBSTITUTE**		Substitute for the first flag in this hoist.	
	**SECOND SUBSTITUTE**		Substitute for the second flag in this hoist	
	**THIRD SUBSTITUTE**		Substitute for the third flag in this hoist	
	**FOURTH SUBSTITUTE**		None	
 	**NC**	**NOVEMBER CHARLIE**	International signal for DISTRESS	

Numeral Pennants



Dressing Ship/Dressing Overall

On certain important national occasions (and for special occasions at local and personal level) it is customary to "dress ship" by stringing all the signal flags together and run them from the stem head up to the mast/s and then to the stern rail.

Practice varies from country to country as to the order in which the signal flags are placed; in some countries a specific order is laid down, in others it is left to the vessel. However the flags should be a random succession not concealing words or message and the numeral and other pennants spaced equally and regularly along the line. Custom and regulations require that national or other flags not be mixed in with the signal flags when dressing a ship overall.

ICS Distress Signals

Internationally recognized distress signals are covered by the International Regulations for the Prevention of Collisions at Sea, 1972 and the International Code of Signals.

The following signals, used or exhibited either together or separately, indicate distress and need of assistance:

a) A gun or other explosive signal fired at intervals of about one minute.
b) A continuous sounding with any fog signalling apparatus.
c) Rockets or shells, throwing red stars fired one at a time at short intervals.
d) A signal made by radiotelegraphy or by any other signalling method consisting of the group … --- … (SOS) in the Morse code.
e) A signal sent by radiotelephony consisting of the spoken word "Mayday".
f) The International Code Signal of distress indicated by N.C.
g) A signal consisting of a square flag having above or below it a ball or anything resembling a ball.
h) Flames on the vessel (as from a burning tar barrel, oil barrel, etc.).
i) A rocket parachute flare or hand flare showing a red light.
j) A smoke signal giving off orange smoke.
k) Slowly and repeatedly raising and lowering arms outstretched to each side.
l) The radiotelegraph alarm signal.
m) The radiotelephone alarm signal.
n) Signals transmitted by emergency position-indicating radio beacons.
o) Approved signals transmitted by radio communication systems, including survival craft radar transponders.

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

Also recognised are the following signals:

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

The Morse Code

This can be sent and received by sound, by light, by flags or by radio. The International Code of Signals gives all the necessary details. It is important not to send too quickly and essential to keep the proportions between dots and dashes. A dot is one unit and a dash is three units. Clarity is the most important consideration and not speed. You will never become proficient in the use of Morse without practice.

A ·–	J ·–––	S ···	1 ·————
B –···	K –·–	T –	2 ··–––
C –·–·	L ·–··	U ··–	3 ···––
D –··	M ––	V ···–	4 ····–
E ·	N –·	W ·––	5 ·····
F ··–·	O –––	X –··–	6 –····
G ––·	P ·––·	Y –·––	7 ––···
H ····	Q ––·–	Z ––··	8 –––··
I ··	R ·–·	0 —————	9 ————·

CHAPTER FOUR
NAVIGATIONAL WATCH KEEPING

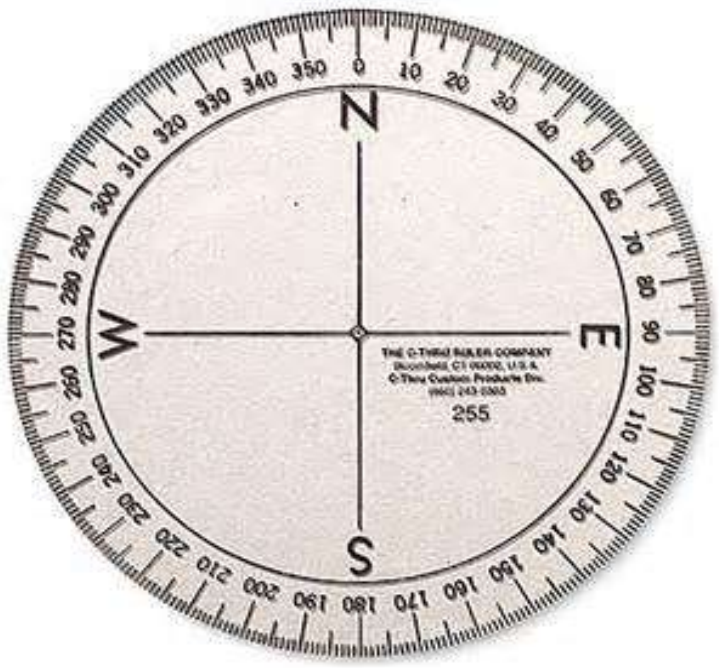
As a rating forming part of a navigational watch you must consider yourself as an integral part of the Bridge Team at all times. Your main duties when forming part of a navigational watch will be as look-out/helmsman and you can be called upon at any time to take the helm should the officer of the watch require you to do so.

While on the bridge assisting as part of a navigational watch you should not have any other duties especially during hours of darkness, restricted visibility and times of heavy traffic.

If the officer of the watch issues you an instruction or order, and you do not fully understand what he said, ask him to repeat the order or to explain what he requires before carrying out his instruction. Remember, English may not be the first language of the parties involved so you must listen closely to what is being said and when you reply speak slowly and clearly so that you both understand one another.

Compass Card and Bearings

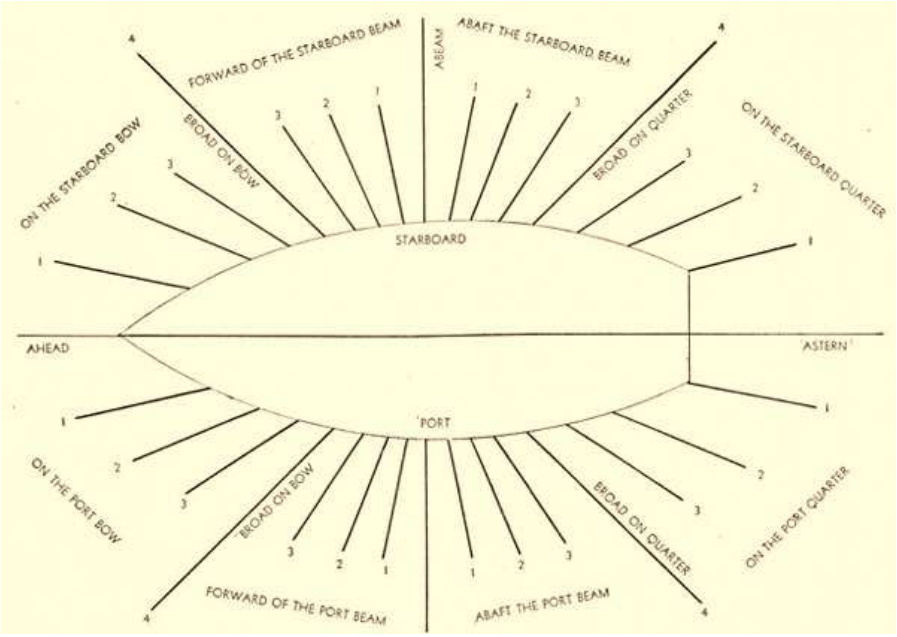
All lookouts must have the ability to report the approximate bearings of an object or light in degrees or points on the bow; it is critical that the lookout is able to accurately report ships, light, land and other objects to the officer in charge of the watch (OOW).



A typical compass in 360° notation

There are two ways to report the bearing of an object or light:

1. **Relative Bearing**, that is related to an object measured specific to a part of the vessel, i.e. “flashing white light 30° on starboard bow” or using “points” each point representing 11 ¼° this would be “flashing white light 3 points on the starboard bow.



Points system using the bow and the stern as zero

The compass is divided into 360° and also into 32 points each point being 11 ¼°. Based on the vessel rather than North, bearings can be given either in degrees or in points. With the Zero 000 of both being the ships heading of the vessel/stem head. Both too are calculated in a clockwise direction starting at 000°/360° relative bearing being at 12 o’clock and 090° relative being at 3 o’clock, 180° being 6 o’clock etc.

2. **True Bearing** is the direction of an object from the observer given in degrees measured from North. It may need to be corrected if using a magnetic compass but not if taken from a Gyro compass corrected to zero.

   True bearings can be obtained by using the ships compass and allowing for variation and deviation or by reading the true bearing from the ships Gyro compass.

Communication and helm orders

Understanding correct communications between watchkeepers on matters relevant to watch-keeping duties is critical to the safety of the vessel, crew and other vessels at sea.

From the above section it will be clear that one of the most important communications will be alerting the OOW to objects, dangers and other factors outside of the vessel. Always err on the side of caution and report what is known and if not sure exactly then note that in the report. For example in low visibility a fog signal might be heard but the exact direction may be difficult to pinpoint. Report the Sound, “2 long and one short blast heard, direction uncertain but approximately broad on the port bow”. Hopefully the position of the sound can be verified on radar.

The helmsman also will have to communicate with the OOW and instructions have to be clear to allow for no misunderstanding. A helmsman maintains a steady course, properly executes all rudder orders and communicates to the OOW using navigational terms relating to ship's heading and steering. A helmsman relies upon visual references, magnetic and/or gyro compasses and a rudder angle indicator to steer a steady course.

The officer of the watch is responsible for the safe navigation of the ship and gives orders to the helmsman. There is a set of standard steering commands and responses by the helmsman recognized in the maritime industry. The helmsman repeats any verbal commands to demonstrate that the command is heard and understood.

All orders received by the helmsman are to be repeated twice; once when the order is received and again when the order has been carried out. This is to ensure that the helmsman has both understood and has carried out the orders correctly.

When the OOW requires a course to be steered by compass, the direction in which he wants the wheel turned should be stated followed by each numeral being said separately, including zero.

Order	Course to be steered
“Port, steer one eight two”	182°
“Starboard, steer zero eight two”	082°
“Port, steer three zero five”	305°

On receipt of the order to steer, for example, 182°, the helmsman should repeat it and bring the ship round steadily to the course ordered. When the ship is steady on the course ordered, the helmsman is to call out: “Steady on one eight two” (NOT “one hundred and eighty-two!)

The person giving the order should acknowledge the helmsman’s report.

Sometimes the helmsman will be ordered to steer on a selected mark, “Steer on buoy/mark/beacon”. The helmsman should repeat the order and when steady on the mark call out: “Steady on buoy/mark/beacon”

If you are given helmsman duties then you should not be expected to be the lookout as well as these are two completely separate duties.

The following example shows the orders, replies and reports for an alteration of course from 008° to 306° degrees. Speak loudly and clearly:

DUTY OFFICER’S ORDER	HELMSMAN’S REPLY	WHEN DONE - REPORT
Midships (i.e. rudder straight ahead)	Midships	Wheel’s amidships
Port thirty (i.e. rudder 30° to port)	Port thirty	Wheel on port thirty
Ease to fifteen (i.e. rudder 15° to port)	Ease to fifteen	Wheel on port fifteen
Midships	Midships	Wheel’s amidships
Starboard ten (i.e. rudder 10° to starboard)	Starboard ten	Wheel on starboard ten
Midships	Midships	Wheel’s amidships
Steady	Steady course	Steady on three zero seven
Steer three zero six	Steer three zero six	Steering Three Zero Six (when on that course)

Examples of orders, replies and reports for an alteration of course

Safe Watch Procedures

All watchkeepers must understand the information and procedures for the relief, maintenance and hand over of a watch and the information needed to maintain a safe watch. The Bridge is the nerve centre of a ship. From this area, the ship is navigated, conned and manoeuvred

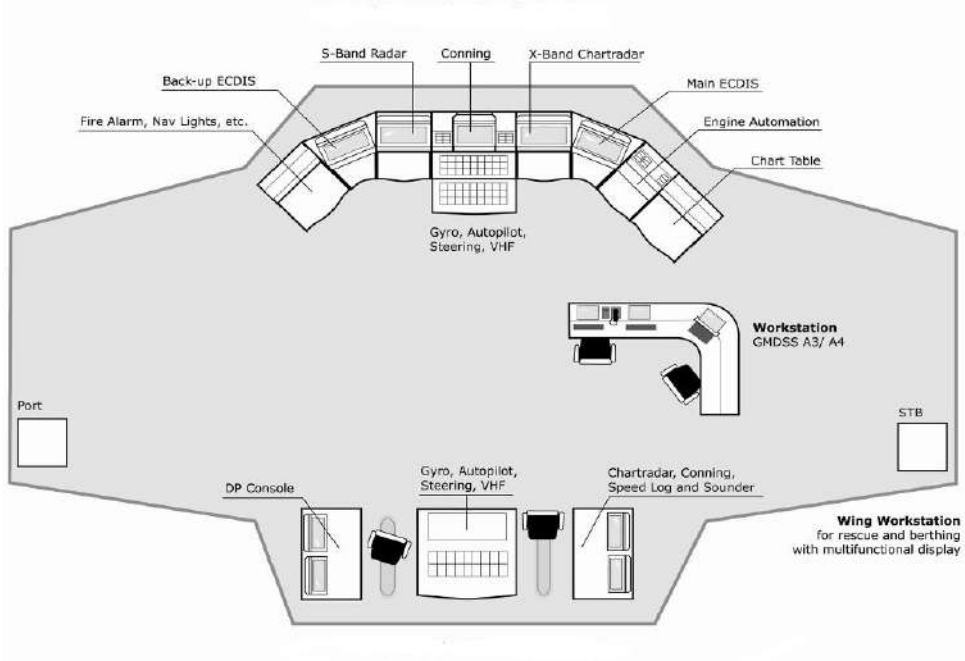
When a ship is underway the bridge is manned by an OOW aided usually by an AB (able seaman) acting as lookout. During critical manoeuvres the captain will be on the bridge supported by an OOW.

Modern advances in remote control equipment allow the actual control of the ship from the bridge. The wheel and throttles can be operated directly from the bridge, controlling often-unmanned machinery spaces. It will contain the equipment necessary to safely navigate a vessel on passage. Such equipment will vary with ship type, includes a GPS, a Navtex receiver, an ECDIS, radars, depth sounders, a communications system (GMDSS compliant devices including distress calling equipment), engine controls, a wheel/autopilot system, gyro compass, a magnetic compass (for redundancy and cross-check capability) and light/sound signalling devices.

All watchkeepers should understand the equipment and its correct use.

In addition there will be charts, navigation books, binoculars, clocks, alarm panels and systems monitoring equipment, etc.

Modern ship bridge layout



Well-thought-out bridge

Manning and Watchkeeping Requirements

The requirement for correct bridge manning are laid down in the **STCW Code** as amended and the **International Regulations for the Prevention of Collisions at Sea (IRPCS).** On the bridge, the MCA's minimum requirement is for a properly-qualified OOW and an additional properly-

qualified person. The officer in charge of the navigational watch is the master's representative and is primarily responsible at all times for the safe navigation of the ship and for complying with the **International Regulations for Preventing Collisions at Sea, 1972**, as amended.

If the Master is on the bridge his decision to take over control from the OOW must be clear and unambiguous.

Proper Lookout - STCW Sect A – VIII/2 Part 4-14 – NB

A proper lookout shall be maintained at all times in compliance with rule 5 of the International Regulations for Preventing Collisions at Sea, 1972, as amended and shall serve the purpose of:

1. Maintaining a continuous state of vigilance, by sight and hearing as well as by all other available means, with regard to any significant change in the operating environment;
2. Fully appraising the situation and the risk of collision, stranding and other dangers to navigation and
3. Detecting ships or aircraft in distress, shipwrecked persons, wrecks, debris and other hazards to safe navigation.

The lookout must be able to give full attention to the keeping of a proper lookout and no other duties shall be undertaken or assigned which could interfere with that task

The duties of the lookout and helmsperson are separate and the helmsperson shall not be considered to be the lookout while steering, except in small ships where an unobstructed all-round view is provided at the steering position and there is no impairment of night vision or other impediment to the keeping of a proper lookout.

Rule 5 International Regulations for the Prevention of Collisions at Sea (IRPCS) states:

"Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision."

This underscores that watchkeeping and the maintenance of a good lookout is a full-time task, having priority over other tasks. The lookout must step outside the bridge to achieve the "sight and sound" requirement. Bridge equipment should be considered aids and not totally relied on.

Watch Change and Handover Procedures

Handing over the watch requires that the relieving watch should be given all the information necessary to carry out their duties properly with the safety of the vessel paramount. This will require specific information and time to adjust to night vision and satisfy themselves of at least the following:

1. Standing orders and other instructions by the master relating to navigation of the ship.
2. Position, course, speed and draught of the ship.
3. Prevailing and predicted tides, currents, weather and visibility and the effect of these factors upon course and speed.
4. Procedures for the use of main engines to manoeuvre when the main engines are on bridge control, and the status of the watchkeeping arrangements in the engine room.
5. The ship security status.
6. That sufficient time has been allowed for night vision to be established and that such vision is maintained.
7. The vessel's navigational situation, including but not limited to:

- The operational condition of all navigational and safety equipment being used or likely to be used during the watch.
- The errors of the Gyro and Magnetic compasses.
- The presence and movements of ships in sight or known to be in the vicinity.
- Proximity and hazards likely to be encountered during the watch.
- The possible effects of heel, trim, water density and squat on under keel clearance.

As soon as possible after taking over the watch, the new watchkeeper should carry out performance checks on all equipment in use. This does not preclude keeping a proper lookout.

Checklists are often used, see example below:

CHANGE OF WATCH CHECK LIST		
TIME	DATE	
ITEM		
Course, Charted		
Course, True.		
Course Gyro		
Course Standard		
Compass Error	Gyro	Magnetic
Main Engine Revolutions	Port	Starboard
Main Engine Limitations	Port	Starboard
Shaft Alternator Engaged	Port	Starboard
Speed	Required	Made good
Ship's Position		
Method of Fixing		
Proximity of Land or other Hazard		
Position, Course, Speed & CPA of other Ships.		
Visibility.		
Navigation or Weather Warnings.		
Captain's Whereabouts.		
Faults with Bridge Equipment.		
Calls.		
Initials of OOW Handing Over.		
Initials of OOW Taking Over.		

CHAPTER FIVE
SAFETY AND LIFESAVING APPLIANCES

EMERGENCY SIGNALS

General alarm signal consists of seven or more short blasts followed by one long blast on the ship's whistle or siren and, in vessels where such systems are required, on an electrically operated bell or similar sounding device. On hearing the general alarm signal the crew and passengers (if any) must proceed to their assembly or muster stations and carry out the actions specified in the muster list.

Abandon ship signal is used at the Masters discretion and may be given by a signal or by word of mouth, but arrangements must be made to ensure that everyone on board, including those in emergency parties in remote locations will receive it.

Fire Alarm is a continuous ringing of ship's electrical bell or continuous sounding of ship's horn.

Man Overboard Alarm in the case that someone falls overboard, the ship's alarm bell sounds 3 long rings and/or ship whistle will blow 3 long blasts.

Gas and Smoke Alarms will depend on type etc. but cannot be confused with the above.

DRILLS AND MUSTERS

Muster Lists

A muster list is to be prepared before a ship puts to sea and maintained throughout the voyage. If any change takes place in the crew, equipment or procedures the muster list must be amended accordingly. The muster list is to give clear instructions to be followed in the event of an emergency, and it is to be displayed in conspicuous places throughout the ship, including the navigating bridge, engine control room, and crew accommodation.

Content of the Muster List

Details of the general alarm signal and actions to be taken by crew and passengers when hearing it.

How the order to abandon ship will be given.

Other emergency signals and actions to be taken by the crew on hearing such signals.

See overleaf for an example of a Muster List

EMERGENCY MUSTER LIST

This muster list must be completed in compliance with SOLAS Chapter III, Regulation 37 and the Company Safety Manual.

FIRE OR OTHER INCIDENT
Signal: *Continuous sounding of the ship's alarm system.*
Action: *Emergency parties muster at designated stations with warm protective clothing and lifejackets to hand. All non-tasked personnel collect warm clothing, don lifejackets and muster at:* _____

GENERAL EMERGENCY
Signal: *Seven or more short blasts followed by a long blast on the ship's whistle, repeated on the ship's alarm system.*
Action: *All personnel to don lifejackets and warm clothing and muster at designated stations. Reserve Team to prepare lifesaving appliances for launching.*

ABANDON SHIP
Signal: _____ *The order to abandon ship will be given* **ONLY** *by the Master or his substitute.*
Action: *Proceed in an orderly manner to your designated lifeboat or raft wearing lifejackets and warm clothing. The person in charge will take a roll call before launching.*

MAN OVERBOARD
Signal: _____
Action: *Throw Lifebuoy. Immediately inform the officer of the watch (Tel: _____) state "Man overboard" and give location. Keep the casualty in sight.*

CONTROL TEAM
Muster on Bridge

NAME	RANK	DUTIES

FIRST EMERGENCY TEAM
Muster at: _____

NAME	RANK	DUTIES

SECOND EMERGENCY TEAM
Muster at: _____

NAME	RANK	DUTIES

RESERVE TEAM
Muster at: _____

NAME	RANK	DUTIES

ENGINE ROOM SUPPORT
Muster at: _____

NAME	RANK	DUTIES

MAN OVERBOARD PARTY
Muster at: _____

NAME	RANK	DUTIES

ABANDON SHIP STATIONS *If Lifeboat not available, proceed to raft station*

NAME	RANK	BOAT	RAFT	DUTIES

GENERAL INSTRUCTIONS

1) *The person responsible for maintenance of all LSA and fire fighting equipment is:* _____
2) *In case of collision, grounding or flooding duty watch to close all watertight doors and scuttles.*
3) *In the event of fire, all automatic and manual fire doors to be closed by the reserve team.*
4) *Supernumeraries and non-tasked personnel will stay at muster stations until dismissed or ordered to abandon ship.*
5) *The Master's substitute will be:* _____
   The Chief Officer's substitute will be: _____
   The Chief Engineer's substitute will be: _____
6) *Other instructions:* _____

 Ref 1012X

Value and Need of Practice Drills and Training

Drills and training are required according the rules and guidelines of various international conventions. The various training required for personnel on board are laid down in the STCW, SOLAS and MARPOL regulations and describes various practice drills to be carried out. These drills must be recorded in the ships logbook and these entries can be verified by the authorities.

The Purposes of Practice Drills and Training

1. To know what equipment is available, where it is located, how to use it and to prove that it is in good working order.
2. To ensure that everyone know where to go and what to do. Can they actually do it, or are they limited by their own shortcomings or those of the organisation?
3. To increase and build confidence in the equipment, the organisation, the individual and others.
4. To develop appropriate responses.
5. To reduce response times through practice, training and repetition.
6. Training and practice drills seek to increase the number of those who will respond in an appropriate manner and decrease the numbers who panic, become paralysed or dazed.

Fire Fighting Appliances

There will always be a risk of accidents happening, but preparing for such eventualities can mean the difference between lives lost and lives saved. Firefighting equipment includes:

- Extinguishers
- Sprinklers
- Automated fire and smoke detectors
- Manual fire alarms
- Fire pumps and hoses
- Enclosed space fire suppressant systems which require all personnel to be out of the space before activation.

All crew should be familiar with the firefighting equipment in particular the alarm locations, the portable extinguisher locations and what each type of extinguisher should be used for different types of fire Crew must also be aware of the different warning alarms, temperature alarms, smoke detector alarms, CO, CO^2 etc. alarms. Everyone is also expected to know the locations of the manual alarms.

SYMBOLS & COLORS FOR EXTINGUISHER CLASSES BASED ON TYPE OF FIRE FUELS	INTENDED FIRE EXTINGUISHER PURPOSE	TYPE OF FIRE EXTINGUISHING AGENT(s) REQUIRED
 A Ordinary Combustibles	Class A Extinguishers – For ordinary combustibles like wood, cloth, plastic, paper, rubber etc.	Water, Foam, Dry Chemical
 B Flamable Liquids	Class B Extinguishers – For fires due to flammable liquids like oil, gasoline, oil-based paints, petrol etc.	Foam, Dry Chemical, Carbon Dioxide
 C Electrical Equipment	Class C Extinguishers – For fires generating from equipment or appliances connected to electricity.	Dry Chemical, Carbon Dioxide
 D Combustible Metals	Class D Extinguishers – For flammable metal. Needs special extinguishing agents. Found typically in factories.	-
 K Combustible Cooking	Class K Extinguishers – For combustible cooking oils like vegetable oils, fats, animal oils & more. In general meant for commercial kitchens.	Foam, Carbon Dioxide

Symbols and classes of different fires

Types of fire extinguishers and what they can be used for

MAIN FIRE SYSTEM

In an Enclosed Space System such as the engine room, a fixed smothering system may be in place. The most common is a CO^2 System which requires the engine room to be completely closed off, including fans, vents, etc. The CO^2 is then released into the space eliminating oxygen and smothering the fire. Obviously all personnel have to be evacuated prior to activation so there will normally be a sound and light alarm warning of the need to evacuate.

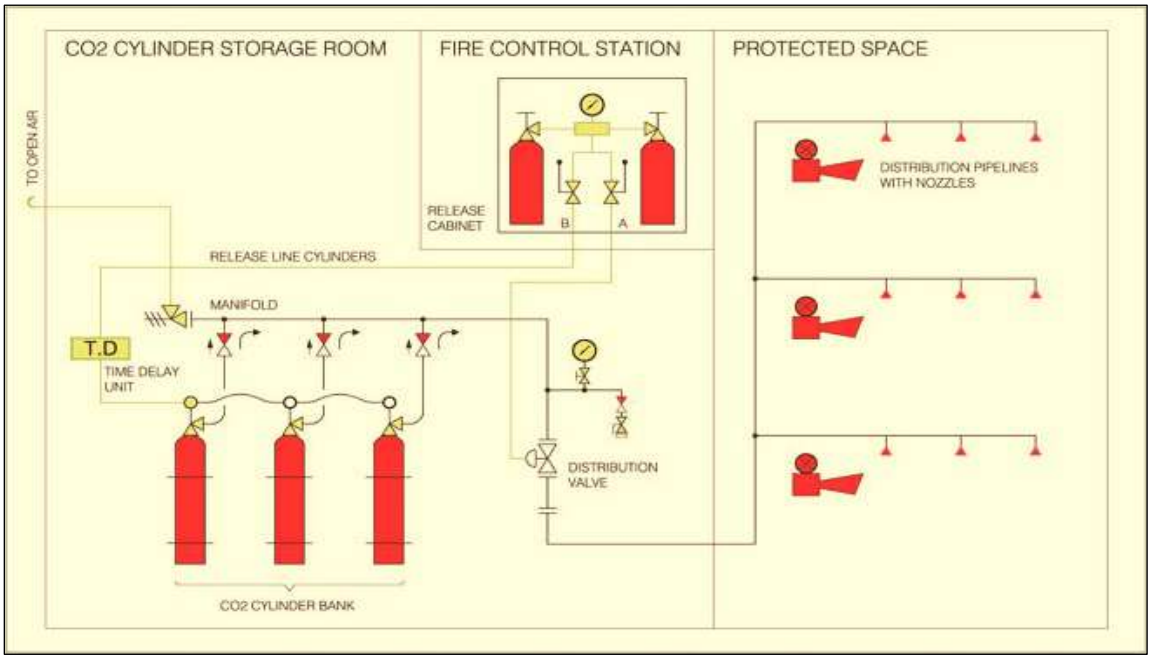


Diagram of the layout of a CO2 system in an enclosed space

Sprinkler System

The vessel may have a sprinkler system where the heat of a fire will cause the glass sprinkler heads to break which then sprays water in the area of the fire.

Hyper Mist or High-Pressure Fog Firefighting System

A high-pressure water mist/fog system provides water mist protection during emergencies to engine room areas and machinery spaces. This system is independent of any other fixed firefighting system such as foam or CO2 system. A fresh water pump takes suction from fresh water tank to supply high-pressure water to the sprinkler system. Each area is isolated by valves, which can be opened during emergency situations involving fire. The mist cools, reduces oxygen by filling the space with water droplets and helps reduce smoke by capturing solids which fall to the deck. The system can be set up to cover the whole vessel including accommodation not just machinery areas.

Hyper mist or High Pressure fog system in a machinery

Lifeboats

Lifeboats are survival craft constructed with a rigid hull. They must have ample stability in a seaway and sufficient freeboard when loaded with their full complement of persons and equipment. The Coxswain is responsible for the lifeboat during all operations

Totally enclosed lifeboats

Partially enclosed lifeboat

Open Lifeboat

Lifeboat Launching Procedure

1) Initial preparations

- Remove harbour securing pins.
- Disconnect electrical charge cable.
- Close drain plugs.
- Place EPIRB and SART in boat.
- Board when instructed and fasten seat belts.

2) Launch actions

- Release gripes/securing wires.
- Secure hatches.
- If in a safe atmosphere, open vents.
- Suitable jackets (inflatable) are to be worn by the boat crews.

3) Lower to water

- Check that it is clear below.
- Operate the brake release.
- Be aware that the boat may swing during the launch.
- Keep lowering the boat at a steady rate.

4) Entering water

- Allow boat to settle in the water.
- Keep the brake off.
- Release the falls.

If the falls do not disengage, operate emergency release as follows:

i. Break glass.
ii. Move lever to green zone.
iii. Release falls.

5) Letting go

- Start engine.
- If in a dangerous atmosphere, open air supply and water spray valves.
- Release painter when ready.
- Steer away from ship.

6) Final actions

- Rescue any swimming survivors if safe to do so.
- When clear of vessel, stream sea anchors.
- Operate EPIRB and SART.

NOTE:

- Careful attention should be paid to the releasing mechanisms of lifeboats
- All lifeboats designed with an 'on-load release' mechanism, should have a FPD (fall preventer device) fitted for safety during practice drills and training exercises.
- All moving parts of davits, wires and sheaves should be carefully inspected for wear and tear. Wires and sheaves should be greased regularly.

Liferafts

Although non-inflatable, rigid life rafts are permitted, there are very few in use; nearly all rafts in use today are of the inflatable type.

Inflatable life rafts are constructed from either a rubber compound (polyurethane) or other tough material and guaranteed to hold up to the worst weather and conditions for at least 30 days. Normally a life raft and its equipment must be able to withstand being dropped into the water from a height of 18m. If a life raft is to be stowed at more than 18m from the waterline, then it must be of a type that is approved for dropping from the increased height.

Hydrostatic release unit

Anything attached to the vessel with a Hydrostatic Release Unit (HRU) will be released automatically when the unit reaches a depth of between 1.5 and 4 metres. It is absolutely essential to attach the unit correctly so that it will function properly if needed. Most HRU's are now limited-life units; that is they are required to be replaced after 2 years. They are date stamped for this purpose. Some HRU's are permanent and must be serviced annually.

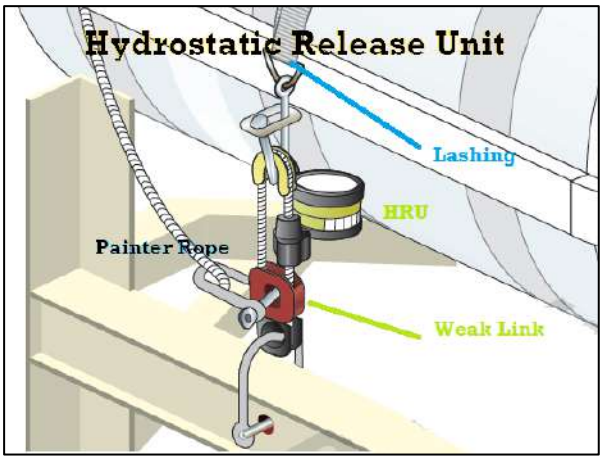
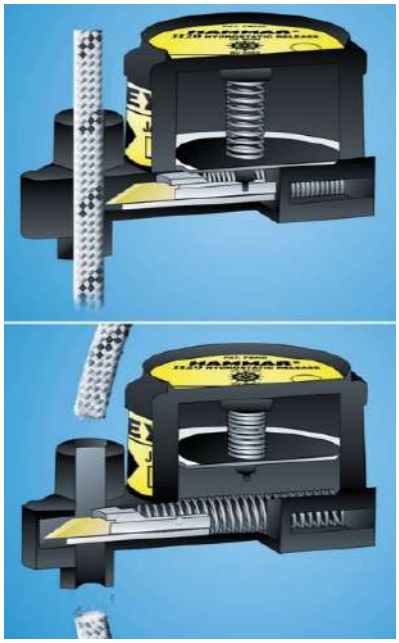


Diagram showing correct setup of HRU

HRU used on a liferaft

The limited life unit illustrated is activated by water pressure which acts on a diaphragm to release a spring-loaded guillotine which cuts the securing line.



Spring-loaded guillotine

Lifejackets (Personal Flotation Devices)

These devices provide face-up flotation with levels of support sufficient for various open and rough water uses. PFD's have a buoyancy distribution sufficient to turn users, when tested on users wearing swimming costumes according to ISO 12402, to a position where the mouth has a defined freeboard above the water's surface, even when the user is unconscious

Lifebuoys

Lifebuoys are to be distributed so that they are readily available on both sides of the ship and, as far as practicable, on the upper deck. At least one lifebuoy must be placed near the stern of the vessel. They must not be permanently secured, but must be capable of being rapidly deployed

Line-throwing Apparatus

Line-throwers are self-contained units that are able to project a line up to 250 meters in calm conditions. They use a rocket which is only able to be used once, thereafter the rocket needs to be replaced. Care should be taken to replace the rocket correctly.

Emergency Position Indicating Radio Beacons- EPIRB

These operate on 406 MHz via the global coverage of the SARSAT and COSPAS polar orbiting satellite communications systems. To assist with location in search and rescue operations the units also transmit a signal on 121.5 MHz, the civil aviation distress frequency.

When activated the EPIRB will transmit a signal encoded with the identity of the vessel. When this is received by satellites in displaced orbital planes Doppler shift measurements allow the position of the beacon to be found. The appropriate Rescue Co-ordination Centre is notified and the rescue operation commences in an average notification time of 90 minutes

Search and Rescue Transponders

Upon activation a SART will remain in standby condition in which the battery will last for 96 hours. As soon as the instrument detects a radar signal it switches to active mode and the battery will last 8 hours while being “interrogated” by radar.

In active mode the SART will “paint” a series of twelve dots in line outwards from the blip on the operating radar screen of any vessel in range. They are more effective if placed high up and should not be used in conjunction with a radar reflector.

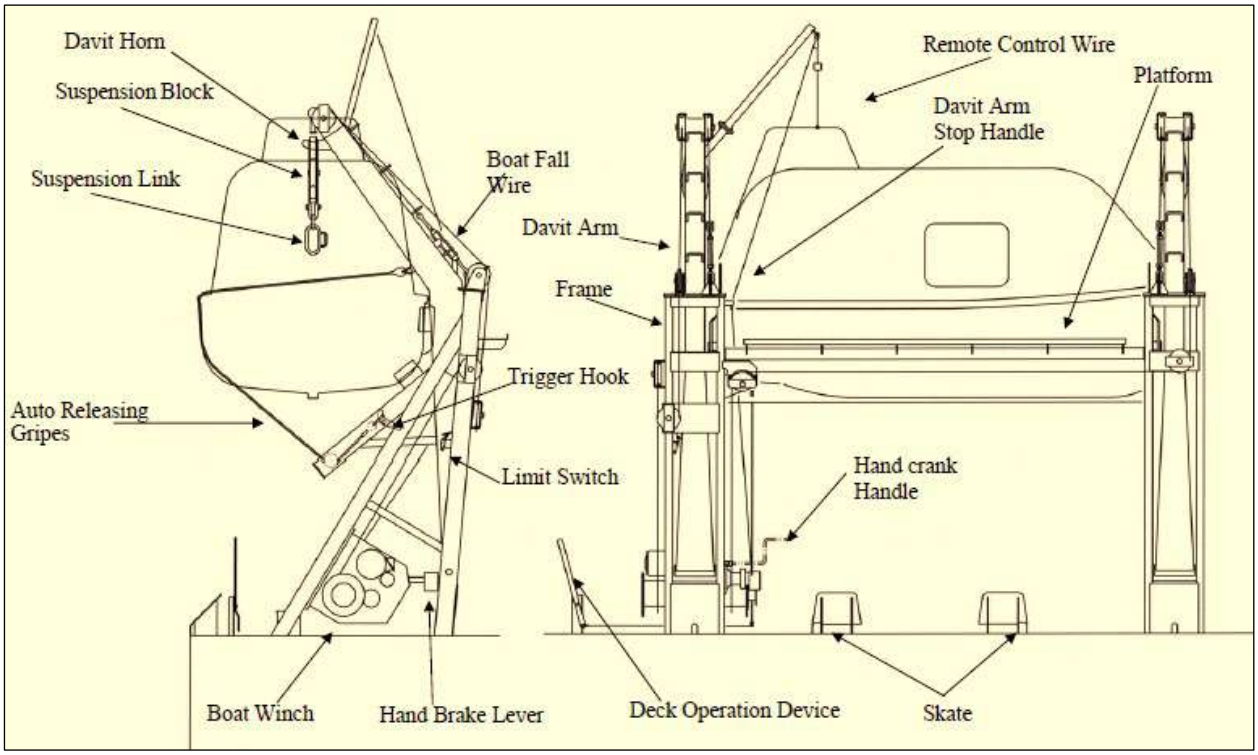
CHAPTER SIX
LIFEBOAT RELEASE, DAVITS AND WATERTIGHT DOORS

Lifeboat Release Gear

There are a number of different types of lifeboats which may be used on a vessel and the type of vessel and its operation area will dictate the type. There are also different methods of storing and launching as well as the type of release mechanism; not all the lifeboats have the same type.

Gravity Davits

Have multiple working parts and are complicated to operate. Complying with the Launch and recovery procedure (see below) will ensure the safe operation. The falls are wire, a requirement for all launching mechanisms, but the launch is by gravity with a hand brake.



Single-Arm Davits

Single-arm davits are mechanically controlled and must be fitted with wire rope falls. The type of ship dictates where they are sited; also davit launched are small rescue boats and davit-launched liferafts, the rescue boat will be "griped" down into chocks. According to how the davit is sited the boat may be launched on one side of the ship only, or on either side.

Beam Davits

Typical on many yachts and some cruise ships these provide stowage out of view. The davit is extended by means of a hydraulic motor and the boat launched by gravity. There is a motor for recovery of the boat.

Free – Fall

A free-fall lifeboat it is launched from the stowed position by operating a lever located inside the boat which releases a hook (the launching mechanism is similar to an on-load release hook) allowing the boat to slide down a tilted ramp into the water. Clearly there must be safeguards to prevent a premature launch.

SOLAS requires that each free-fall lifeboat shall be fitted with a release system which shall:

- Have two independent activation systems for the release mechanisms which may only be operated from inside the lifeboat and be marked in a colour that contrasts with its surroundings.
- Be so arranged as to release the boat under any condition of loading from no load up to at least 200 % of the normal load.
- Be adequately protected against accidental or premature use.
- Be designed to be able to test the release system without launching the lifeboat.
- Be designed with a factor of safety in strength of the materials used
- Be capable of being safely launched under all conditions of trim of the ship up to 10° and a list up to 20° either way from the certification height when fully equipped and loaded,

Davit Maintenance

The following items should be examined for satisfactory condition and operation:

a) Davit structure, with particular regard to corrosion, particularly behind head sheaves and in other hard-to-paint places, misalignments, deformations and excessive free play in bearings or track rollers;
b) Wires and sheaves, possible damage such as kinks and corrosion;
c) Lubrication of wires, sheaves and moving parts;
d) Functioning of all limit switches;
e) Stored power systems including a check on capacity and hydraulic systems;
f) Inspection for correct termination of fall wire ends;
g) Verification of fall wire end for ending or replacement of wire;
h) Condition and reaves of remote control wires, pulleys etc.

Winch Maintenance

The following items should be examined for satisfactory condition and operation:

a) Open and inspect brake mechanism;
b) Replace brake pads, if necessary;
c) Remote control system;
d) Power supply system;
e) Winch foundation;
f) Winch crank handle interlocks and
g) The angles/clearances of "dead mans" brake levers to be checked upon reassembly.

Lifeboat Release Gear

Used to release the lifeboat from the davit falls, there are two types of lifeboat releasing mechanisms: **on-load and off-load**. These mechanisms release the boat from the falls by means of the release of a hook thus allowing the lifeboat to move away from the ship.

Off-Load Mechanism

This release mechanism requires the weight (load) of the lifeboat to not be on the hook when it is released. The off load mechanism releases the boat after the load of the boat is transferred when the boat has been lowered fully into the sea. This releases the hook, the weight having held the mechanism of the hook in place. It can be unhooked manually if the mechanism does not operate.

On-Load Mechanism

This mechanism allows the lifeboat to be released from the falls at any point, with the lifeboat above the water and with all the crew members inside the boat. This type of system allows a lifeboat to be released when it is not in the water, whether this is because of the emergency or an accident. Clearly extreme care must be taken during an evacuation to ensure that the release mechanism is not activated accidentally.

A lever is provided inside the boat to operate this mechanism.

Opening the hook on load is achieved by operating the remote release lever or, alternatively, this can be done manually at the hook.

All hook handling can be done by one person.

Operational Test of On-load Release Function

a) Position the lifeboat partially into the water such that the mass of the boat is substantially supported by the falls and the hydrostatic interlock system, where fitted, is not triggered;
b) Operate the on-load release gear;
c) Reset the on-load release gear; and
d) Examine the release gear and hook fastening to ensure that the hook is completely reset and no damage has occurred.

Operational Test of Off-Load Release Function

a) Position the lifeboat fully waterborne;
b) Operate the off-load release gear;
c) Reset the on-load release gear; and
d) Recover the lifeboat to the stowed position and verified ready for launching in an emergency

Watertight Doors

Watertight doors found on ships prevent the ingress of water from one compartment to another during flooding or accidents. These doors are used on board in areas where chances of flooding are high, e.g. engine room compartments and shaft tunnel.

Requirements for watertight doors

SOLAS Regulations Regarding Closure of Watertight Doors (chapter II-1, Regs 14 to 25)

Type A may be left open and are to be closed only during an emergency.

Type B watertight doors should be closed and are made to remain open only when personnel are working in the adjacent compartment.

Type C watertight doors must be kept closed all the time. They may be opened only for sufficient time when personnel are passing through the door compartment.

Doors to stairways and egress as well as door to Engine and machinery spaces must be gas/smoke tight.

Doors should be closed:

- When there is restricted visibility.
- In compulsory pilotage limits.
- When the depth of water is less than 3 times the draught.
- In high traffic density.
- Whenever the master feels that conditions are dangerous.

Watertight Door Drills

1. Practice drills for operation of watertight doors shall take place every week and before leaving the port.
2. All watertight doors, manual and power-operated should be tested daily during the rounds.
3. Each door should be able to operate from both locally and by remote i.e. from the bridge.
4. If a door is operated by remote location, there should be an audio and visual alarm during closing.
5. There should be indication of the status of doors at the remote place of operation.

Further Requirements

1. All power-operated doors must be capable of being closed simultaneously from bridge and Ship Control Centre (SCC) in not more than 60 seconds when the ship is in an upright condition.
2. The door shall have an approximate uniform rate of closure under power. The closure time, from the time the door begins to close to the time it closes completely shall be in no case less than 20 seconds or more than 40 seconds with the ship in an upright condition.
3. In the case of hand operation during power failure, the door must be able to be closed within 90 seconds.

Weather tight doors are found at various points on the superstructure. They are secured with levers called **'dogs'**

Watertight doors are found between watertight compartments in the hull.

Hatches and Watertight Doors

Watertight doors found on ships prevent the ingress of water from one compartment to another during flooding or accidents. There are other watertight doors that give access through the sides of a vessel and these obviously must be kept closed at sea and also have a complete watertight integrity.

Watertight doors on a ferry

In addition some vehicle ferries and car transporters have bow and stern door mechanisms. These also have an inner door which adds to the integrity in the event of an outer door failure.

All automatic doors have light and alarms when being operated, they can also be manually operated and their status will be shown a display on the bridge.

Mega yachts with watertight doors

CHAPTER SEVEN
LEGISLATION

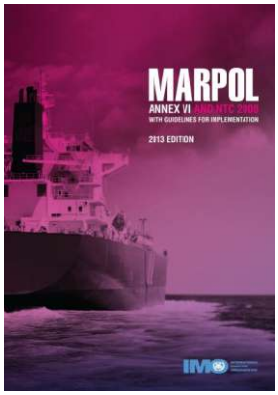
IMO - International Maritime Organisation

This is the international body responsible for all things maritime. It is an autonomous organisation within the United Nations. It is the IMO who, through discussions and debates with all members, decides on new rules and regulations for the Maritime industry. These rules and regulations are known as 'Conventions'.

There are 6 international maritime conventions covered in this EDH Course:

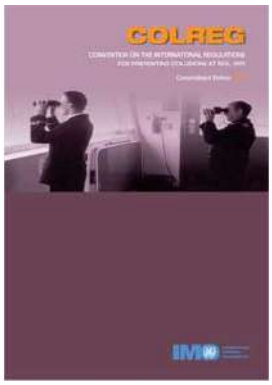
1.STCW - The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers is the international standard (minimum requirements) to which the various watch keepers on board a vessel must be trained. STCW sets the minimum standard/criteria to which each seafarer must be trained in for his/her respective rank.

2. **SOLAS - The International Convention for the Safety of Life at Sea** is an international maritime treaty which sets minimum safety standards in the construction, equipment and operation of various types of ships.



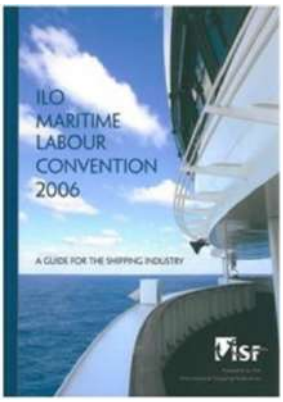
3. MARPOL - The International Convention for the Prevention of Pollution from Ships is one of the most important international conventions. MARPOL is short for *Marine Pollution.*

4. **COLREGS - The International Regulations for Preventing Collisions at Sea** set out, among other things, the "rules of the road" or navigation rules to be followed by ships and other vessels at sea to prevent collisions between two or more vessels.



5. **CLL – The International Convention on Load Lines** provides for the terms of ship's surveys, issuance, duration, validity and acceptance of International Load Line Certificates, as well as relevant State control measures, agreed exemptions and exceptions.

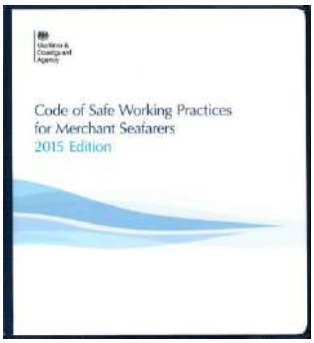
6. **MLC – The Maritime Labour Convention** consists of 16 articles containing general provisions as well as a *Code* consisting of five Titles laying out specific provisions:



- Title 1: Minimum requirements for seafarers to work on a ship
- Title 2: Conditions of employment
- Title 3: Accommodation, recreational facilities, food and catering
- Title 4: Health protection, medical care, welfare and social security protection
- Title 5: Compliance and enforcement

THE MARITIME AND COASTGUARD AGENCY

The Maritime and Coastguard Agency is the UK Government body responsible for all maritime issues including licensing of seafarers, safety of vessels and their crews, search and rescue and Ships Registry. Legislation and guidance is generated and promulgated by the MCA in various forms:

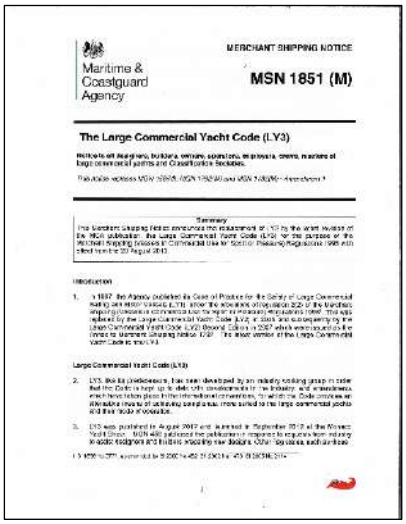


The Code of Safe Working Practices for Merchant Seafarers -
COSWP provides guidance for improving health and safety on board UK-registered ships.

Marine Shipping Notices

There are three different types of Notice which publicise to the shipping and fishing industries important safety, pollution prevention and other relevant information.

1. **Merchant Shipping Notices (MSN)** Are used to convey mandatory information that must be complied with under UK legislation. These MSNs relate to Statutory Instruments and contain the technical detail of such regulations.

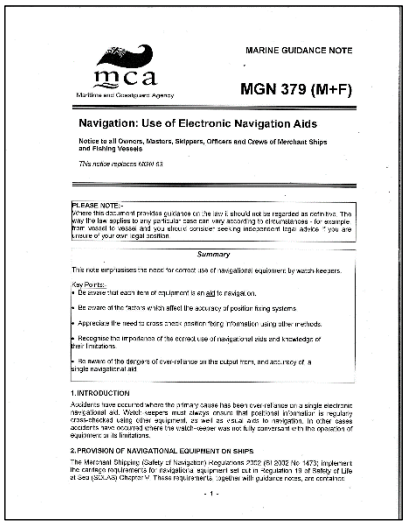

MERCHANT SHIPPING NOTICE

Maritime & Coastguard Agency

MSN 1851 (M)

The Large Commercial Yacht Code (LY3)

2. **Marine Guidance Notices (MGN)** Give significant advice and guidance relating to the improvement of the safety of shipping and of life at sea and to prevent or minimise pollution from shipping.



MARINE GUIDANCE NOTE

MGN 379 (M+F)

Navigation: Use of Electronic Navigation Aids

Notice to all Owners, Masters, Skippers, Officers and Crews of Merchant Ships and Fishing Vessels

This notice replaces MGN 63

PLEASE NOTE:-
Where this document provides guidance on the law it should not be regarded as definitive. The way the law applies to any particular case can vary according to circumstances - for example from vessel to vessel and you should consider seeking independent legal advice if you are unsure of your own legal position.

Summary

This note emphasises the need for correct use of navigational equipment by watch keepers.

Key Points:

- Be aware that each item of equipment is an aid to navigation.
- Be aware of the factors which affect the accuracy of position fixing systems.
- Appreciate the need to cross check position fixing information using other methods.
- Recognise the importance of the correct use of navigational aids and knowledge of their limitations.
- Be aware of the dangers of over-reliance on the output from, and accuracy of, a single navigational aid.

1. INTRODUCTION

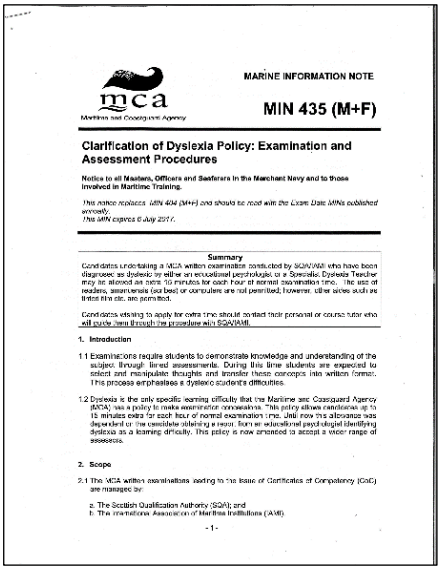
Accidents have occurred where the primary cause has been over-reliance on a single electronic navigational aid. Watch keepers must always ensure that positional information is regularly cross-checked using other equipment, as well as visual aids to navigation. In other cases accidents have occurred where the watch-keeper was not fully conversant with the operation of equipment or its limitations.

2. PROVISION OF NAVIGATIONAL EQUIPMENT ON SHIPS

The Merchant Shipping (Safety of Navigation) Regulations 2002 (SI 2002 No. 1473) implement the carriage requirements for navigational equipment set out in regulation 19 of Safety of Life at Sea (SOLAS) Chapter V. These requirements, together with guidance notes, are contained

- 1 -

1. **Marine Information Notice (MIN)** Are intended for a more limited audience e.g. training establishments or equipment manufacturers, or contain information which will only be of use for a short period of time, such as timetables for MCA examinations. MINs are numbered in sequence and have a cancellation date which will typically be no more than twelve months after publication.



MARINE INFORMATION NOTE

MIN 435 (M+F)

Clarification of Dyslexia Policy: Examination and Assessment Procedures

Notice to all Masters, Officers and Seafarers in the Merchant Navy and to those involved in Maritime Training.

This notice replaces MIN 404 (M+F) and should be read with the Exam Date MINs published annually.
This MIN expires 6 July 2011.

Summary

Candidates undertaking a MCA written examination conducted by SQA/AMI who have been diagnosed as dyslexic by either an educational psychologist or a Specialist Dyslexia Teacher may be allowed an extra 10 minutes for each hour of normal examination time. The use of readers, amanuensis (scribe) or computers are not permitted; however, other aides such as tinted lenses etc. are permitted.

Candidates wishing to apply for extra time should contact their personal or course tutor who will guide them through the procedure with SQA/AMI.

1. Introduction

1.1 Examinations require students to demonstrate knowledge and understanding of the subject through timed assessments. During this time students are expected to select and manipulate thoughts and transfer these concepts into written format. This process emphasises a dyslexic student's difficulties.

1.2 Dyslexia is the only specific learning difficulty that the Maritime and Coastguard Agency (MCA) has a policy to make examination concessions. This policy allows candidates up to 15 minutes extra for each hour of normal examination time. Until now this allowance was dependent on the candidate obtaining a report, from an educational psychologist identifying dyslexia as a learning difficulty. This policy is now amended to accept a wider range of assessors.

2. Scope

2.1 The MCA written examinations leading to the issue of Certificates of Competency (CoC) are managed by:

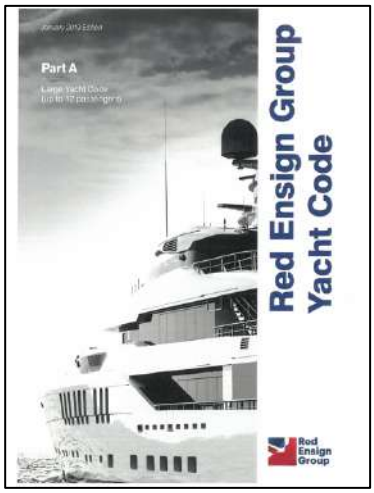
a. The Scottish Qualification Authority (SQA); and
b. The International Association of Maritime Institutions (AMI).

- 1 -

Within each series of Marine Notices, suffixes are used to indicate whether documents relate to merchant ships or fishing vessels, or to both. The suffixes following the number are:

(**M**) for merchant ships
(**F**) for fishing vessels
(**M+F**) for both merchant ships and fishing vessels

Red Ensign Group Yacht Code (January 2019) was previously known as The Large Yacht Code and has two parts to it.



Part A applies to vessels in the commercial use for sport or pleasure, which are 24m in “load line” length and do not carry any more than 12 passengers, such vessels are not permitted to carry cargo.

Part B applies to vessels pleasure yachts of any size, in private use or engaged in trade, which carry more than 12 but not more than 36 passengers and which do not carry cargo.

THE INTERNATIONAL MARITIME DANGEROUS GOODS CODE

The IMDG Code is accepted as an international guideline for the safe carriage of dangerous goods or hazardous materials on vessels. It gives a uniform international code of dangerous goods, methods of packing in packets or in containers as well as stowage and segregation of incompatible substances. In addition, it gives guidance for the protection of crewmembers and the prevention of marine pollution in the event of an emergency.

The implementation of the Code is mandatory under the International Convention for the Safety of Life at Sea (SOLAS) and the International Convention for the Prevention of Pollution from Ships (MARPOL). It is recommended to governments for use as the basis for national regulations.

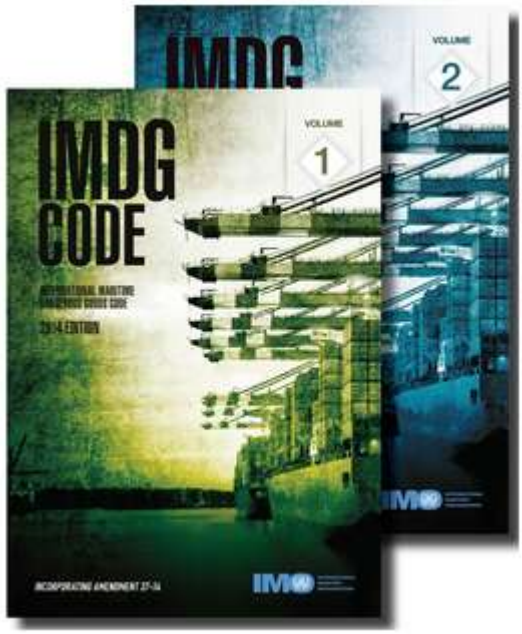
The Code is intended for use not only by the mariner but also by all those involved in industries and services connected with shipping. It contains advice on terminology, packaging, labeling, placarding, markings, stowage, segregation, handling, and emergency response. It generally applies to passenger ships and cargo ships constructed after 1 July 2002 although there are some additional applications listed in the Code.

Publication

The Code is published, updated and maintained by the Carriage of Cargoes and Containers (CCC) Sub-Committee of the International Maritime Organization which meets every two years. At the time of writing the current edition of the IMDG Code is the 2014 Edition which applies for two years from 1 January 2016. The 2016 Edition comes into force for two years from 1 January 2018 for two years and may be applied voluntarily from 1 January 2017.

Structure

The IMDG Code consists of three publications:
Volume 1, Volume 2 and Supplement



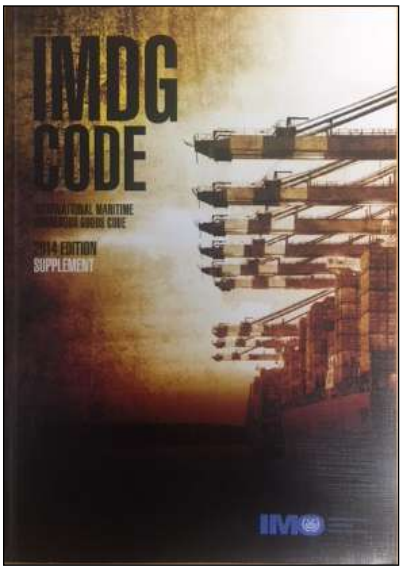
Volume 1

Part 1 General provision, definitions and training
Part 2 Classification
Part 4 Packing and tank provision
Part 5 Consignment procedures
Part 6 Construction and testing of containers
Part 7 Provision concerning transport operations

Volume 2

Part 3 Dangerous goods list, special provisions and exceptions

The Dangerous Goods List is the central core of the IMDG Code and presents information on the transport requirements for all dangerous goods in a coded form.



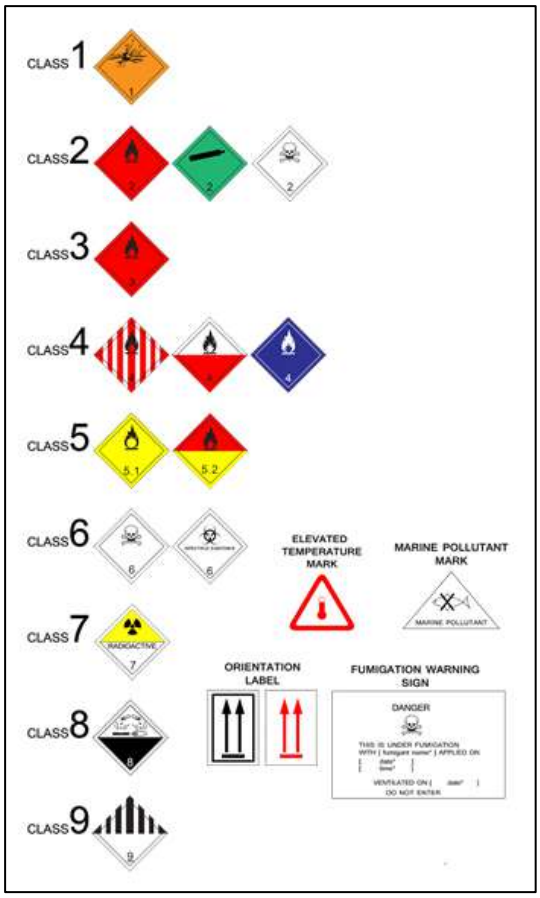
Supplement

This gives guidance for emergencies involving packaged dangerous goods where the master and crew have to respond to a spillage and fire without external help. Separate advice is given for fire and spillage emergencies in the following categories:

- Emergency response procedures
- Medical first aid guide
- Reporting procedures
- Recommendations on safe use of pesticides on ships

Nine hazard classes have been established internationally by a United Nations (UN) committee to ensure that all modes of transport (road, rail, air and sea) classify dangerous goods in the same way.

Class 1	Explosives
Class 2	Gases
Class 3	Flammable liquids
Class 4	Flammable solids
Class 5	Oxidizing substances and organic peroxides
Class 6	Toxic and infectious substances
Class 7	Radioactive material
Class 8	Corrosive substances
Class 9	Miscellaneous dangerous substances and articles



CHAPTER EIGHT
CODE OF SAFE WORKING PRACTICES FOR MERCHANT SEAMAN

This very comprehensive publication of the British Maritime and Coastguard Agency (MCA) is specifically aimed at seamen on merchant vessels but the general principles are applicable to anyone at sea, yachts being no exception. It is concerned with improving health and safety on board ship. ***The notes below refer to the specific sections and chapters in the COSWP.***

General

This Code is concerned with improving health and safety on board ship. In the United Kingdom, the Merchant Shipping Act allows the Secretary of State to make regulations, sometimes implementing international standards, to secure the safety of ships and those on them. Much of the Code relates to matters, which are the subject of such regulations. In such cases the Code is intended to give guidance as to how the statutory obligations should be fulfilled. However, the guidance should never be regarded as superseding or amending regulations.

The COSWP acts as a guide to all aspects of safety and incorporates the ISM Code and other safety legislation. It lays down the responsibilities of owners/managers, masters and crew. Compliance with this code will normally be taken as satisfactory compliance with relevant safety regulations.

The International Safety Management Code (ISM) Code is compulsory for all ships over 500Gross Tonnes (but recommended for all vessels).

The Code is intended primarily for merchant seamen on United Kingdom registered vessels and is published by the MCA as best practice and guidance for improving health and safety on board ships. It is required to be carried by all British flag ships, yachts over 24 metres in length and under 24 metres in length commercially operated. Copies must be available to all the crew and provided in appropriate formats (electronic and hard copy) and in sufficient quantity to ensure easy access

Occupational Health and Safety

By its very nature, living on board a vessel will result in occupational health and safety risks which may lead to death, permanent disability, temporary disability or reduced work capability. Occupational health and safety risks may arise from work-related hazards or from the general living and working conditions on board, sometimes referred to as ambient factors. In cases where some risks are unavoidable, appropriate control measures should be implemented to minimise exposure to hazards that may cause injury, disease or death. Harmful exposure may have short-term or long- term adverse health effects.
Risks inherent in the working environment must be identified and evaluated (‘risk assessment’), and measures must be taken to remove or minimise those risks, to protect seafarers and others from harm, so far as is reasonably practicable

These risks include but are not limited to the following:

- Ambient factors, such as noise, vibration, lighting, ultra-violet light, non-ionising radiation and extreme temperatures
- Inherent hazards, such as the vessel's structure, means of access, ergonomic hazards and hazardous materials such as asbestos
- Hazards arising from work activities, such as work in enclosed spaces, use of equipment and machinery, working on and below deck in adverse weather, dangerous cargo and ballast operations, and exposure to biological hazards or chemicals
- Health risks, such as fatigue and impacts on mental occupational health
- Emergency and accident response

In addition, there are risks from violence in the workplace, tobacco smoking, drug abuse, alcohol misuse and drug or alcohol dependence. Each of these risks is covered in this Code.

Everyone has a duty to ensure that risk is eliminated and the interested parties are:

1. The ship owner
2. The company
3. The master
4. The seafarer

Duties of the Ship Owner

- To protect the health and safety of seafarers
- Avoidance of risks, the replacement of dangerous practices and equipment
- Actions must be taken to reduce unavoidable risks
- Work patterns and procedures that take account the individuals abilities and the design of the workplace
- The adaptation of procedures to take into account of new technology and other changes in working practices, equipment and the working environment
- Taking into account and understanding the management of the vessel
- Giving collective protective measures priority over individual protective measures
- The provision of appropriate and relevant information and instruction for workers

Duties of the Company

- Ensuring that seafarers have the appropriate information, training and instruction to enable them to work safely
- Consulting with seafarers about health and safety matters
- Recording and investigating safety incidents and accidents on board

Duties of the Master

- Representing the company aboard the vessel

Duties of the Seafarer

- Take reasonable care for their own health and safety and that of others on board
- Cooperate with anyone else carrying out health and safety duties
- Compliance with control measures identified during risk assessment
- Report any identified serious hazards or deficiencies immediately
- Make proper use of plant and machinery, and treat any hazard with due caution.

Safety Officials

Election of Safety Representatives

On every ship on which more than five workers are employed, the Company must make arrangements for the election of safety representatives.

Appointment of Safety Officers

The Company is required to appoint a safety officer. The master must record the appointment of a safety officer - this should be in the official logbook. The safety officer is the safety adviser aboard the ship and can provide valuable assistance to the Company and to individual employers in meeting the statutory responsibilities for health and safety. He should have attended a suitable Safety Officer's training course.

Safety Committees

Once safety representatives have been elected, the Company must appoint a safety committee. The committee must be chaired by the master and members will include, as a minimum, the safety officer and all elected safety representatives.

Chapters in the Code of Safe Working Practices for Merchant Seafarers

The chapters included in the syllabus for this course are highlighted in YELLOW

Chapter 1	Managing Occupational Health and Safety
Chapter 2	Safety Induction
Chapter 3	Living Aboard
Chapter 4	Emergency Drills and Procedures
Chapter 5	Fire Precautions
Chapter 6	Security on Board
Chapter 7	Health Surveillance
Chapter 8	Personal Protective Equipment
Chapter 9	Safety Signs and their Use
Chapter 10	Manual Handling
Chapter 11	Safe Movement on board ship
Chapter 12	Noise, Vibration and other physical agents
Chapter 13	Safety Officials
Chapter 14	Permit to Work system
Chapter 15	Entering dangerous spaces (enclosed)
Chapter 16	Hatch covers and access lids
Chapter 17	Working at Height
Chapter 18	Provision, care and use of work equipment
Chapter 19	Lifting plant and operations
Chapter 20	Work on Machinery and Power systems
Chapter 21	Hazardous substances and mixture
Chapter 22	Boarding arrangements
Chapter 23	Food preparation and handling in the catering department
Chapter 24	Hot Work
Chapter 25	Painting
Chapter 26	Anchoring, mooring and towing operations
Chapter 27	Roll-on/roll-off ferries
Chapter 28	Dry cargo
Chapter 29	Tankers and other ships carrying bulk liquid cargoes
Chapter 30	Port Towage industry
Chapter 31	Ships serving offshore oil and gas installations
Chapter 32	Ships serving offshore renewables installations
Chapter 33	Ergonomics

COSWOP Chapter 1: MANAGING OCCUPATIONAL HEALTH AND SAFETY

The Ten Safety Leadership Qualities

1. **Instil respect and command authority**
   Leaders get respect and command authority when crews believe that they:

   - Are willing to exercise the power vested in their position
   - Possess the necessary knowledge and competence
   - Understand their situation and care about their welfare
   - Are able to communicate clearly
   - Are prepared to act confidently and decisively
   - Are willing to listen

2. **Lead the team by example**
   Be seen to be complying with the safety procedures, and working as a key part of the team, including being willing to get involved in subordinates' tasks.

3. **Draw on knowledge and experience**
   Adequate knowledge and experience are prerequisites for effective leadership:

   - Good knowledge of safety-related regulations, codes and standards
   - Experience and skills, but also in people management

4. **Remain calm in a crisis**
   People need strong, clear leadership in a crisis and rely more on their leaders than would otherwise be the case.

5. **Practise 'tough empathy'**
   Good leaders empathise realistically with seafarers and care intensely about the work they do but this doesn't mean that they always agree with them or join in with concerns and grumbles. Instead they practise 'tough empathy', which means giving people what they **need**, rather than necessarily what they **want**.

6. **Be sensitive to different cultures**
   Good leaders are sensitive to differences in the social and behavioural norms of national cultures, yet at the same time value all seafarers equally irrespective of their nationality.

7. **Recognise seafarers' limitations**
   Good leaders have a clear understanding of how operational and other demands can be realistically met by seafarers, and are able to judge whether fatigue levels are such that action should be taken.

8. **Motivate a sense of community**
   Creating the conditions for encouragement and maintain these 'healthy' motivators. Demonstrating respect for staff is often an essential part of this. Meeting someone's basic needs is often the key to keeping their motivation high.

9. **Place the safety of crew and passengers above everything**
   Leaders need to demonstrate this commitment clearly to their staff through their actions, rather than just through formal declarations or policy statements. In practice, this means showing that the safety of the crew and passengers is placed above everything else – 'nothing we do is worth getting hurt for'.

10. **Communicate clearly**
    The ability to communicate clearly is important at all levels in an organisation. For a master, the key issue is most often how to encourage better two-way rather than one-way communication, balancing authority and approachability. Being open to criticism is a part of this.

RISK AWARENESS AND RISK ASSESSMENT

Risk Awareness

If seafarers are fully informed and aware of the risks to their health, safety and welfare, they are much more likely to ensure they avoid the risks and remain safe. This knowledge is attained through risk assessment and in other ways throughout our lives including training in theory and practical application, information, observation, instructions, supervision and personal experience.

A hazard is a source of potential injury, harm or damage. It may come from many sources, e.g. situations, the environment or a human element.
Risk has two elements:

1. The likelihood that harm or damage may occur
2. The potential severity of the harm or damage.

Risk Assessment

The risk assessment process identifies hazards present in a work undertaking, analyses the level of risk, considers those in danger and evaluates whether hazards are adequately controlled, taking into account any measures already in place.

Effective risk assessments:

- Correctly and accurately identify **all** hazards
- Identify who may be harmed and how
- Determine the likelihood of harm arising
- Quantify the severity of the harm
- Identify and disregard inconsequential risks
- Record the significant findings
- Provide the basis for implementing or improving control measures
- Provide a basis for regular review and updating.

Five Steps to Risk Assessment

Step 1: identify the hazards
Step 2: decide who might be harmed and how
Step 3: evaluate the risks and decide on precautions
Step 4: record your findings and implement them
Step 5: review your risk assessment and update if necessary

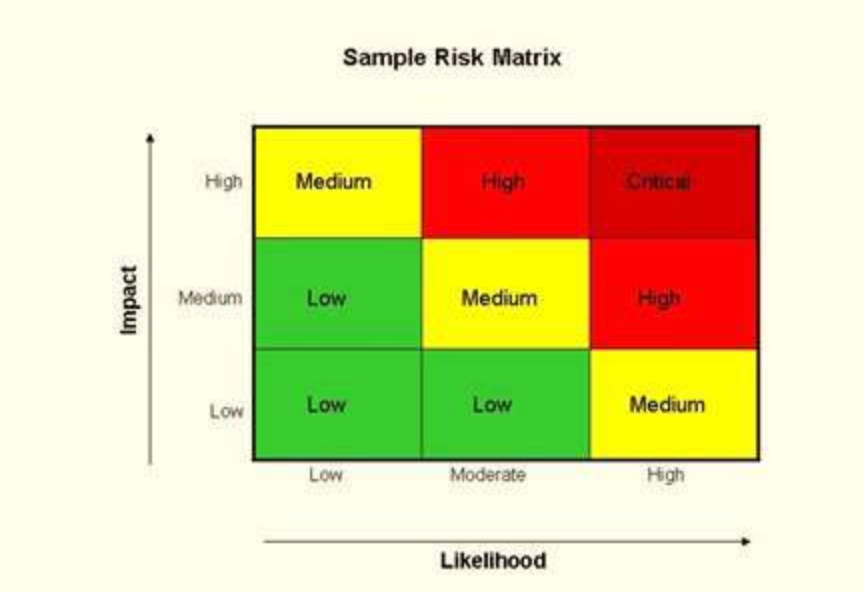
The main elements of a risk assessment are:

1. Classify Task/Activity

You need to classify the job or task at hand. You must understand what the job or task is that you are expected to or intend completing. You must also have an understanding of what the desired outcome of this task should be. If you do not then you won't be able to complete an effective risk assessment. It is also at this stage that you can identify the personnel who should make up the team to complete the risk assessment.

2. Identify Hazards and Risks

Identify what hazards exist, be they physical or environmental. You should also identify personnel at risk. These could be personnel involved in the task at hand or possibly personnel who may be affected by the task or working in close proximity. During this phase of the assessment you also decide on the probable **likelihood** of the identified hazard as well as the **impact**. These two factors multiplied together give you the risk factor, sometimes called 'severity' of the identified hazard. This is done by entering these two factors into the risk assessment matrix and should the result be a **RED** block then this hazard is immediately classified as unacceptable and further action is required to reduce the risk of this hazard occurring. The ideal situation is to have all hazards identified, reduced so that when entering them into the risk assessment matrix the result is a **GREEN** block. To help you identify hazards ask yourself, '**What could possibly go wrong when I do something?' and "What would happen if....?"**



Risk assessment matrix

3. Identify Control Measures

Move on to what are known as control measures. These are actions, devices or procedures which, if put in place and utilised correctly, will reduce the risk of an identified hazard to an acceptable limit or possibly even completely eliminate the hazard. One identified hazard can have numerous control measures put in place so as to reduce the risk to an acceptable level. It is important to ensure that the control measures you use are realistic and achievable otherwise there will be no effect in reducing the risk. To help you identify control measures ask yourself, '**What can I do to make this task safer?**' and '**What can I do to ensure that X is not damaged?'**

4. Review and Record

Once you have completed the first three steps you must review the risk assessment to ensure that it will have the desired effect. For example: Make the task at hand safe whilst also ensuring there is no damage to equipment, property or the environment. All formalised risk assessments must be recorded, and if this was not done during the first three steps then you are to record it now. There should also be general consensus between all members of the team completing the risk assessment. We say consensus, not agreement. The reason for this is the larger the team involved, the more difficult it is to have agreement. This is because we are all human and therefore we tend to be subjective, having our own views and opinions, rather than objective, not being affected by personal feelings or opinions.

5. Tool Box Talk

A risk assessment need not necessarily be done on the day that a task is to be undertaken or just before beginning a task. Risk assessments can be completed days before a task is to be completed. This means that on-board personnel can complete a number of risk assessments for basic tasks well in advance so as to save time at a later stage. For example: You may decide that

on a certain day because of weather conditions no work on deck can be undertaken so you can use that day to complete numerous risk assessments which may be used in the future. Because of this fact it is vitally important to review risk assessments before utilising them. As it is highly likely that time has elapsed between completion of the risk assessment and the task being undertaken, a 'Tool Box Talk' should be conducted just prior to the undertaking of any task. Everyone who is going to be involved with the task at hand is to be present during this tool box talk.

During this tool box talk the following should be discussed and understood by all:

- What the task is
- What outcome is expected
- Hazards identified by the risk assessment
- Control measures identified by the risk assessment
- Responsibilities of each member who shall be involved in the task
- Have any conditions changed since the risk assessment was completed and therefore may be required to be addressed further?
- It is vitally important that everyone knows and understands what is expected of them. Never assume anything.

Remember

When you **assume** something, it makes an **ASS** of **U** and **ME**
Always ask if you are unsure about anything
There is no such thing as a stupid or silly question

Remember that during the 'Tool Box Talk' you must satisfy yourselves that conditions have not changed and that the Risk Assessment is still valid.

The information from your Risk Assessment will then be used for your Permit to Work which will be covered in **Chapter 14** of this section

COSWOP Chapter 2: SAFETY INDUCTION

In addition to any appropriate mandatory STCW-approved courses, before being assigned to shipboard duties, all persons employed or engaged on a ship, other than passengers, shall receive familiarisation training on board and receive sufficient information and instruction to be able to:

- Communicate with other persons on board on elementary safety matters and understand safety information symbols, signs and alarm signals

- Know what to do if:

    - A person falls overboard;
    - Fire or smoke is detected; or
    - The fire or abandon ship alarm is sounded

- Identify alarm points, muster and embarkation stations, and emergency escape routes
- Locate and don lifejackets
- Have knowledge of the use of portable fire extinguishers
- Take immediate action upon encountering an accident or other medical emergency before seeking further medical assistance on board
- Close and open the fire, weathertight and watertight doors

On completion of the standard safety induction, the new personnel should receive the appropriate security training and departmental induction covering safe working practices, areas of responsibility, departmental standing orders, and training/certification requirements to operate specific machinery or undertake specific tasks.

In addition, anyone employed or engaged on board a vessel in any capacity with designated safety or pollution-prevention duties should, before being assigned to any of those duties, receive appropriate basic training as listed below (in the tables from the STCW Code) relevant to those duties, and relevant refresher training as required:

- Personal survival techniques as set out in Table A-VI/1-1
- Fire prevention and firefighting as set out in Table A-VI/1-2
- Elementary first aid as set out in Table A-VI/1-3
- Personal safety and social responsibilities as set out in Table A-VI/1-4.

COSWOP Chapter 4: EMERGENCY DRILLS AND PROCEDURES

Musters and Drills

Musters and drills are required to be carried out regularly in accordance with merchant shipping regulations. Musters and drills are designed to prepare a trained and organised response to dangerous situations, which may unexpectedly threaten loss of life and property at sea and are also for protection of the marine environment. It is important that they should be carried out realistically, approaching emergency conditions as closely as possible while ensuring the safety of personnel. Changes in a ship's function and personnel from time to time should be reflected in corresponding changes in the muster arrangements.

The muster list must be conspicuously posted before the ship sails. These instructions should describe the allocated assembly station, survival craft station and emergency duty, and all emergency signals and action, if any, to be taken on hearing such signals.

An abandon ship drill and a fire drill shall be held within 24 hours of leaving port if more than 25% of the crew have not taken part in drills on board the ship in the previous month.

As soon as possible after joining the ship, on-board training in the use of the ship's life-saving appliances, including survival craft and evacuation systems, must be given to seafarers. Seafarers should also familiarise themselves with their emergency duties, the significance of the various alarm systems and the locations of their lifeboat station and of all life-saving and firefighting equipment. When a ship enters service for the first time after major modifications or when a new crew is engaged, these drills shall be held before sailing.

All the ship's personnel concerned should muster at a drill wearing lifejackets that are properly secured. The lifejackets should continue to be worn during lifeboat drills and launchings but in other cases may be subsequently removed at the master's discretion if they would impede or make unduly onerous the ensuing practice, provided they are kept ready to hand. The timing of emergency drills should vary so that personnel who have not participated in a particular drill may take part in the next.

Fire Drills

Training in firefighting procedures and maintenance of equipment should be carried out by participating in regular drills in accordance with regulatory requirements. Access to firefighting equipment should be kept clear at all times and emergency escapes and passageways should never be obstructed.

A fire drill should be held simultaneously with the first stage of the abandon ship drill. Firefighting parties should assemble at their designated stations. Engine room personnel should start the fire pumps in machinery spaces and see that full pressure is put on fire mains. Any emergency fire pump situated outside machinery spaces should also be started; all nominated seafarers should know how to start and operate the emergency fire pumps.

The fire parties should be sent from their designated stations to the location of the supposed fire, taking with them emergency equipment such as radios, axes, lamps and breathing apparatus. The locations should be changed in successive drills to give practice in differing conditions and in dealing with different types of fire so that accommodation, machinery spaces, store rooms, galleys and cargo holds and high-risk fire areas are all covered at regular intervals. Fixed fire-extinguishing installations should be tested to the extent practicable.

Portable fire extinguishers should be available for demonstration of their use. This should include different types applicable to different kinds of fire. At each drill, one extinguisher or more should be operated by a member of the fire party, a different member on each occasion. As far as practicable, different types of extinguishers available on board should be used on a rotational basis. The operation of extinguishers that cannot be charged on board should be explained. Extinguishers so used should be recharged before being returned to their normal location or sufficient spares should otherwise be carried for demonstration purposes.

Each member of the firefighting party should be trained in the use of breathing apparatus as part of the drill. Search and rescue exercises should be undertaken in various parts of the ship. The apparatus should be cleaned and verified to be in good order before it is stowed. Cylinders of self-contained breathing apparatus should be recharged and seafarers should be trained in this procedure. Otherwise, sufficient spare cylinders should be carried for this purpose.

Fire appliances, fire and watertight doors, other closing appliances and fire detection and alarm systems that have not been used in the drill should be inspected in accordance with the ship's safety management system.

Action in the Event of Fire

The risk of fire breaking out on board a ship cannot be eliminated but its effects will be much reduced if the following advice is followed:

- A fire can usually be extinguished most easily in its first few minutes. Prompt and correct action is essential.
- The alarm should be raised and the bridge informed immediately.
- If the ship is in port, the local fire authority should be called.
- If possible, an attempt should be made if safe and practicable to extinguish the fire
- The ship's personnel should be aware of the use of different types of fire extinguisher.
- Openings to the space should be shut
- Any fuel lines feeding the fire or threatened by it should be isolated.
- Combustible materials adjacent to the fire should be removed

Seafarers should not re-enter a space in which a fire has occurred without wearing breathing apparatus until it has been fully ventilated.

Abandon Ship Drills

Arrangements for drills should take account of prevailing weather conditions. Seafarers taking part in life raft or lifeboat drills should muster wearing warm outer clothing and lifejackets that have been properly secured. In addition to the statutory inspection, an opportunity should be taken to ensure all wires are in good condition and sheaths and working parts are operational and well lubricated.

The engines on motor lifeboats should be started and run ahead and astern. All seafarers should be familiar with the engine-starting procedure. Radio life-saving appliances should be examined and tested, and seafarers instructed in their use.

When a drill is held in port, as many lifeboats as possible should be cleared and swung out. Each lifeboat should be launched and manoeuvred in the water at **least once every three months**. Personnel should avoid being in the boat when it is lowered or raised from the water. However, the launching crew may need to be on board.

The **monthly** drills with free-fall lifeboats should be carried out according to the manufacturer's instructions, so that those who are to enter the boat in an emergency are trained to embark the boat, to take their seats in a correct way and to use the safety harnesses; and are also instructed on how to act during launching into the sea.

Where fast-rescue boats/rescue boats are carried that are not lifeboats, they should be launched and manoeuvred in the water every month as far as is reasonable and practicable. The interval between such drills must not exceed three months.

Where simultaneous off-load/on-load release arrangements are provided, great care should be taken to ensure that the hooks are fully engaged prior to launching, before recovery and after stowage.

On-board training in the use of davit-launched life rafts shall take place at intervals of not more than four months on every ship fitted with such appliances. Whenever practicable, this shall include the inflation and lowering of a life raft. This life raft may be a special life raft intended for training purposes only, which is not part of the ship's life-saving equipment; such a special life raft shall be conspicuously marked.

During drills, lifebuoys and lines should be readily available at the point of embarkation.

Where life rafts are carried, instruction should be given to seafarers in their launching, handling and operation. Methods of boarding life rafts and the disposition of equipment and stores on them should be explained.

Life-saving appliances must be maintained at all times. If the use of a life raft for practice would bring equipment below the specified scale, a replacement must first be made available

Man Overboard Drills

As far as reasonably practicable, man overboard (MOB) drills involving the manoeuvring of the vessel should be conducted at regular intervals. Where a fast-rescue craft (FRC) is carried, so far as is reasonably practicable, this should be launched each month and tested in the water in a harbour or safe anchorage.

In addition to the statutory inspection, an opportunity should be taken to:

- Ensure all wires are in good condition, and sheaths and working parts are operational and well lubricated.
- A safety harness should be worn if there is any risk of falling.
- Prior to the launching of the rescue boat, communications with the deck and bridge should be checked.
- There should be no more than two persons in the boat when being launched and

recovered.

- Working lifejackets that do not restrict free movement should be worn.
- Survival suits should be worn where there is a risk of hypothermia
- Other protective clothing should be worn including helmet, gloves, safety shoes and suitable clothing.

Action in the Event of Man Overboard

1. Where a person is seen to fall over the ship's side, immediate action should be taken by the officer of the watch and bridge team
2. The master, on taking charge, should consider all options for the recovery of the person including directly from the sea via a bunker or pilot door; ladder or gangway; crane or davit; FRC or other boat.
3. The master should ensure that all preparations are made for receiving the casualty

Fast rescue boat being used for MOB

COSWOP Chapter 5: FIRE PRECAUTIONS

General

The prevention of fire on board ship is of utmost importance. Some important organisational measures that can be taken to reduce the risk of fire.

Yacht on fire in St Thomas

Mega Yacht on fire 2016

Smoking

Conspicuous warning notices should be displayed in any part of the ship where smoking is forbidden (permanently or temporarily) and observance of them should be strictly enforced. Ashtrays or other suitable containers should be provided and used at designated places. E-cigarettes are a source of ignition and should not be used in hazardous areas.

Electrical Fittings

All electrical appliances should be firmly secured and served by permanent connections whenever possible. All electric wiring should be well maintained and kept clean and dry. The rated load capacity of the wires and fuses should never be exceeded.

Flexible leads should be as short as practicable and so arranged as to prevent their being chafed or cut in service. Makeshift plugs, sockets and fuses should not be used. Circuits should not be overloaded because this causes the wires to overheat, destroying insulation and thus resulting in a possible short-circuit, which could start a fire. Notices should be displayed warning that approval should be obtained from a responsible officer to connect any personal electrical appliances to the ship's supply.

All portable electrical appliances, lights, etc. should have insulation readings taken before use and should be isolated from the mains after use. It is important that all fixed electric heaters are fitted with suitable guards securely attached to the heater and that the guards are maintained in position at all times. Drying clothing on or above the heaters should not be permitted and suitably designed equipment should be supplied, or areas designated.

The use of portable heaters should be avoided wherever possible. However, if they are required while the ship is in port (as temporary heating during repairs or as additional heating during inclement weather), a protective sheet of a non-combustible material should be provided to stand them on to protect wooden floors or bulkheads, carpets or linoleum. Portable heaters should be provided with suitable guards and should not be positioned close to furniture or other fittings. These heaters should never be used for drying clothes, etc. unless that is the purpose for which they were designed, e.g. a heated towel rail. Personal portable space-heating appliances of any sort should not be used at sea. The installation of electric heaters should always be carried out in accordance with the relevant regulations and instructions or guidance supplied by the manufacturer.

Spontaneous Combustion

Dirty or damp waste, rags, sawdust and other rubbish – especially if contaminated with oil – may generate heat spontaneously, which may be sufficient to ignite flammable mixtures or set the rubbish itself on fire. Such waste and rubbish should therefore be properly stored until it can be safely disposed of. Materials in ships' stores, including linen, blankets and similar absorbent materials, are also liable to ignite by spontaneous combustion if damp or contaminated by oil. Strict vigilance, careful stowage and suitable ventilation are necessary to guard against such a possibility. If such materials become damp, they should be dried before being stowed away. If oil has soaked into them, they should be cleaned and dried, or destroyed. They should not be stowed in close proximity to oil or paints, or on or near to steam pipes

Machinery Spaces

All personnel should be made fully aware of the precautions necessary to prevent fire in machinery spaces – in particular, the maintenance of clean conditions, the prevention of oil leakage and the removal of all combustible materials from vulnerable positions.

Suitable metal containers with an integral cover should be provided for the storage of cotton waste, cleaning rags or similar materials after use. Such containers should be emptied at frequent intervals and the contents disposed of safely. Wood, paints, solvents, oil and other flammable materials should not be stored in boiler rooms or machinery spaces including steering gear compartments.

Galleys

Galleys and pantries present particular fire risks. Care should be taken in particular to avoid overheating or spilling fat or oil and to ensure that burners or heating plates are shut off when cooking is finished. Extractor flues and ranges, etc. should always be kept clean. The means to smother fat or cooking oil fires, such as a fire blanket, should be readily available close to stoves. Remote cut-offs and stops should be conspicuously marked and galley staff should be thoroughly familiar with their location and operation.

Laundry

When using drying cabinets or similar appliances, the ventilation apertures should not be obscured by overfilling of the drying space. Any screens or fine mesh covers around the ventilation apertures should be regularly inspected and cleaned, so that they do not become blocked by accumulated fluff from clothing

COSWOP Chapter 8: PERSONAL PROTECTIVE EQUIPMENT AND CLOTHING (PPE)

The responsibility for compliance with these guidelines lies with the individual. However, the responsibility for compliance checks, to ensure proper utilization, lies with the individual's supervisor. Therefore, each supervisor is required to train employees and ensure the proper required use of PPE for the specific job, and inspect (as needed) their employees' PPE.

All PPE must be properly maintained. No damaged, non-functional, or excessively torn PPE will be allowed. Therefore, it is the responsibility of each employee to inspect his or her PPE on a daily basis to ensure proper compliance. Equipment that no longer provides adequate protection should be repaired or replaced immediately. Unusable equipment should be destroyed. Personal protective equipment is vital to safety in the work location. The equipment should be properly cleaned, inspected after use, and stored in clearly marked and properly designated areas.

Personal protective equipment can be classified as follows:

Head protection	Safety helmets, bump caps, hair protection
Hearing protection	Ear muffs, ear plugs
Face and eye protection	Goggles and spectacles, facial shields
Respiratory protective	Dust masks, respirators, breathing equipment apparatus
Hand and foot protection	Gloves, safety boots and shoes
Body protection	Safety suits, safety belts, harnesses, aprons, high visibility clothing
Protection against drowning	Lifejackets, buoyancy aids and lifebuoys
Protection against hypothermia	Immersion suits and anti-exposure suits

Head Protection. Safety hats must fit properly to provide maximum protection and they must be maintained to ensure their protective qualities. Safety hats must not be painted or modified in any way.

Hair long enough to constitute a hazard while a person is working, such as near moving machinery, must be secured by a net or tied back. Hairstyles that make it impossible for a person to properly wear a safety hat are not permitted.

When head protection is desired but not required, Bump Caps reduce exposure to lacerations and abrasions caused by minor bumps to the head.

Hearing Protection. All personnel in areas where signs are posted warning of excessive noise levels must wear appropriate hearing protection. Radios and headsets are not allowed on the work site unless being used for work related communications.

In the event that an employee cannot wear plugs for medical reasons, a written reason, signed by a medical doctor, must be furnished. Another type of hearing protection should be used.

Face and Eye Protection. All personnel must wear approved safety glasses at all times while in any location where the potential for eye injury exists, except when special purpose eye protection is needed, e.g. welding.

When contact lenses are worn, goggles or special safety glasses with side shields must be worn for additional protection where eye protection is required.

Contact lenses should not be worn where there is a risk of liquid spray from hydrocarbons, chemicals, acids, caustics or any liquid substances that can bum or be corrosive to the eye. Wearers of contact lenses must inform their supervisor and crew that they wear lenses so that proper emergency treatment can be given if necessary.

Impact-type goggles must be worn and a face shield should be worn when engaging in any activity that involves hazards to the unprotected eye from chipped or flying particles. Some examples are chipping, scraping, buffing, grinding, etc.

- Complete-coverage eye protection must when dust hazards exist and when using any type of pneumatic tool.
- Splash-proof goggles must be worn when handling, or in the immediate vicinity of, hazardous chemical liquids, powders or vapours.
- To ensure maximum protection and comfort, eye protection should be adjusted to the face.
- A person in the immediate vicinity of other persons doing work requiring the use of safety goggles must also wear goggles.
- Welding must not be directly watched without proper eye protection.
- Goggles with approved protective lenses must be worn when material is cut with cutting gases.
- Electric arc welding requires the use of welding helmets or hand shields fitted with No. 10 or darker shade lenses.

- Cover glasses must be used with all welding goggles, helmets and shields.
- Suitable goggles must be worn when inspecting tubing under hydraulic pressure.

Respiratory Protection. Specific training requirements vary for respirator types and must be conducted in accordance with applicable regulations. This training will identify individuals who, because of their physical conditions, cannot use the equipment.

Respirators must be worn when personnel are working in an atmosphere contaminated with harmful mists, fogs, gases, dust, fumes, smoke, chemicals, sprays or vapours.

Dust respirators are used to protect from nuisance and toxic dusts. Not to be used for vapours, mists or fumes unless specified by the manufacturer or supplier.

Chemical cartridge respirators are used to protect from mists or vapours, such as paint spray. Not to be used for dusts or fumes unless specified by the manufacturer or supplier.

Canister gas masks—Used for specific gases based on canister type. Not to be used for dusts, mists or vapours unless specifically approved by the manufacturer or supplier.

Supplied air breathing airline apparatus is used in almost all hazardous situations. Not to be used in environments considered immediately dangerous to life. An escape bottle must also be included when used in a confined space.

Self-contained Breathing Apparatus (SCBA) is for use in high concentrations of toxic gases, in oxygen-deficient atmospheres or in any environment considered immediately hazardous to life.

Respirators must be regularly cleaned, disinfected and properly stored after each use.

Connections on the airlines, which supply breathing air to respiratory equipment, must be inspected frequently and maintained to ensure their integrity.

Any employee working in an area where routine or emergency use of a self-contained breathing apparatus must not have facial hair that could interfere with the function of the mask.

Hand Protection. Wearing gloves prevents many minor injuries resulting from rough materials or irritating substances. Wear gloves whenever possible.

Leather or leather-palm gloves should be worn when wire rope is being handled. Cloth gloves afford adequate protection when pipe is handled.

Appropriate gloves must be worn when acids, caustic soda and soda ash are handled.

Appropriate gloves are also necessary in certain situations that involve electrical work.

Insulated or heat-resistant gloves must be worn when regular work gloves cannot adequately protect against bums.

Standard welding gloves are to be worm while performing all types of hot work.

Foot Protection. All employees are required to use protective steel-toe footwear when required.

Exposed steel caps on safety-toe footwear must be kept Insulated. An exposed steel cap is a good conductor of electricity if it comes in contact with uninsulated live wire.

Body Protection

Protective clothing should be used when appropriate. Conditions that typically necessitate body protection include:

- Exposure to sharp knives or power cutting tools
- Exposure to temperature extremes i.e. intense summer heat or winter cold, working in walk-in freezers/coolers etc.
- Contact with intense heat, including molten metals and other hot materials e.g. steam, sparks etc.
- Contact with pesticides and other chemicals
- Working with radioactive materials

- Contact with infectious materials, including blood and body fluids
- Contact with rough or abrasive surfaces

Fall Protection. A full body safety harness is required with double hook-up capability at all times while personnel are working 6 feet (2 metres)or more above ground level, unless other adequate protection against falling is provided or the employee is inside a designated handrail system.

The safety harness should fit snugly and comfortably. The wearer should allow no more slack in the line than is necessary to safely perform the work at hand.

All safety harnesses should be regularly inspected for excessive wear and damage that could cause them to fail. Harnesses worn or damaged to the extent that they could fail should be destroyed, not discarded.

Protection against Drowning. All personnel who are suspended over the water in a personnel basket or working on the water, such as a barge tender or dock where the danger of falling into the water exists, must wear approved flotation devices.

Thermal Protection. Immersion suits and anti-exposure suits must be available to crew and meet the administration requirements.

COSWOP Chapter 9: SAFETY SIGNS AND THEIR USE

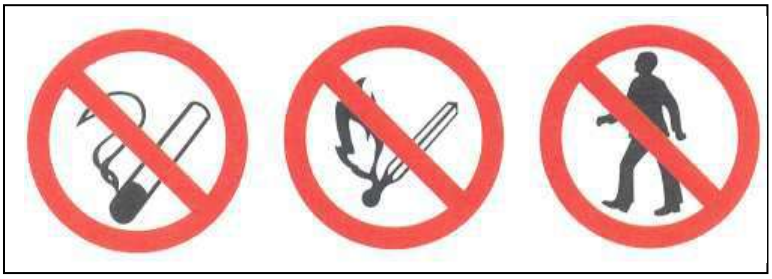
Any safety signs permanently erected on board UK ships for the purpose of giving health and safety information or instruction shall comply with the regulations and merchant shipping notices (MSNs). Other national and international standards providing an equivalent level of safety will be accepted. All seafarers should ensure that they understand the meaning of signs and any colour-coding system in use on their ship and follow the relevant safety procedures.

Those aware of any deficiency in their colour vision should tell their supervisor, so that adequate provision can be made where necessary.

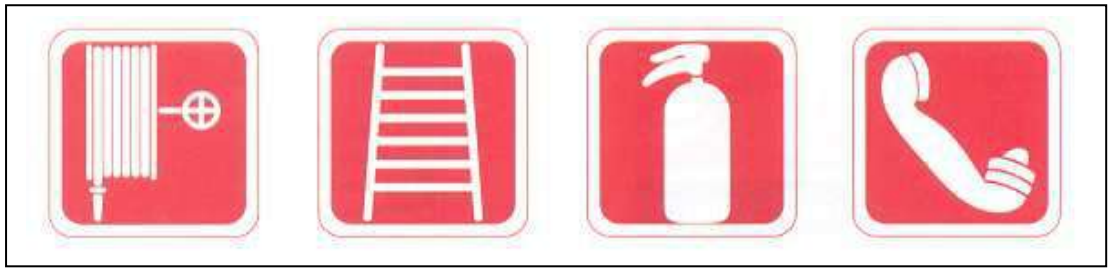
Colours and symbols, when used appropriately, can provide information and warnings of hazards that can be understood by anyone, regardless of what language they speak.

Symbols relating to life-saving appliances are mandatory and are governed by international standards. Those relating to fire control plans are recommended international standards.

Signs of prohibition are based on a red circle with a red diagonal bar and white backing. The symbol for the prohibited action is shown in black e.g. 'No smoking', with a cigarette depicted.



Firefighting equipment is a red square or rectangle, with information given in words or by a symbol in white. Alternatively, an IMO sign is a square or rectangle, with information given in words or by a symbol in red.



Yellow signs are **ADVISORY** and mean be careful or take precautions. They are based on a yellow triangle with a black border. The symbol for the hazard is shown in black, e.g. poisoning risk with black skull and crossbones on a yellow background.

Blue signs are MANDATORY and mean take a specific action. They are based on a blue disc with the symbol for the precaution to be taken shown in white e.g. 'Goggles to be worn' a person's head with goggles depicted.

Green signs mean EMERGENCY EQUIPMENT. The sign is a green square or rectangle, with safety information shown by words or a symbol in white.

Gas Cylinders There are a variety of standards for the marking of gas cylinders in use globally. It is essential that seafarers are made aware of the standard in use on board. Each cylinder should be clearly marked with the name of the gas and its chemical formula or symbol. Under British standards, the cylinder body should be coloured according to the contents with, where necessary, a secondary colour band painted around the neck of the cylinder to denote the

Example of a typical gas cylinder label

A Hazards and precautions, B Name of product, C Hazard diamond(s), D Filled pressure, E Gross weight, F Cylinder size, G Contact information, H Unique cylinder serial number, I Additional company information

Gas cylinder colours

Colours and codes are for guidance and illustrative purposes only. Please always read the label.

Name of gas	Chemical formula or symbol	Old colour before 2010	New colour of the cylinder after 2010
Oxygen	O_2	Black	Pure white RAL 9010
Carbon dioxide	CO_2	Black	Dusty grey RAL 7037
Compressed air	None – mixed gases	French grey	Grey on cylinder and green on shoulder
Nitrogen	N_2	French grey	Jet black RAL 9005
Acetylene	C_2H_2	Maroon colour BS 541 (Black red RAL 3007)	Maroon colour BS 541 (Black red RAL 3007)
Propane	C_3H_8	Signal red RAL 3001	Signal red RAL 3001
Butane	C_4H_{10}	Not specified	Not specified
Helium	He	Brown	Olive brown RAL 8008

particular hazards of the gas (flammability, toxicity, etc.). Examples of such colour coding on gas cylinders commonly used on board ship are as follows:

Medical gas cylinders

The body of the cylinder is to be coloured white (RAL 9010).

Name of gas	Chemical formula or symbol	Old colour before 2010	New colour on the shoulder of the cylinder after 2010
Oxygen	O_2	White on shoulder and black on cylinder body 	Pure white RAL 9010 on both shoulder and cylinder 
Medical oxygen	O_2	White on shoulder and black on cylinder body 	Pure white RAL 9010 on both shoulder and cylinder 
Medical nitrous oxide	N_2O_2	Blue 	Pure white (RAL 9010) on cylinder. Blue RAL 5010 on shoulder 
Compressed air (for breathing apparatus)	None (mixed gases)	French grey BS381 680 	Pure white (RAL 9010) on cylinder. Jet black (RAL 9005) on shoulder 

Pipelines

Pipe contents	Basic identification colour	BS colour reference BS 4800	Colour code band	BS colour reference BS 4800
Water (fresh)	Green	12D 45	Blue	18E 53
Water (salt)	Green	12D 45	None	
Water (fire extinguishing)	Green	12D 45	Safety red	04E 53
Compressed air	Light blue	20E 51	None	
Steam	Silver grey	10A 03	None	
Oil (diesel fuel)	Brown	06C 39	White	
Oil (furnace fuel)	Brown	06C 39	None	
Oil (lubricating)	Brown	06C 39	Emerald green	14E 53

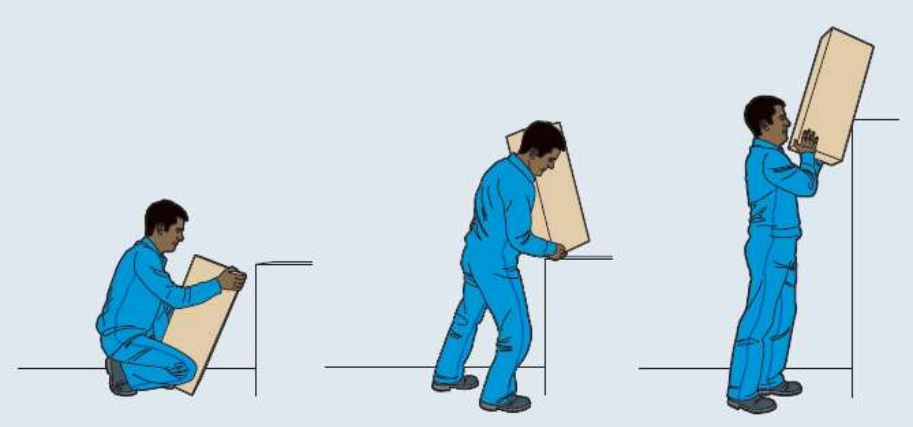
COSWOP Chapter 10: MANUAL HANDLING

The term 'manual handling' is used to describe any operation that includes any transporting or supporting of a load, lifting, putting down, pushing, pulling, carrying or moving by hand or bodily force. This guidance is generally concerned with preventing musculoskeletal injury.

Advice to Seafarers
You should:

- Use any mechanical aids provided.
- Follow appropriate systems of work laid down for your health and safety.
- Take sensible precautions to ensure that you are aware of any risk of injury from a load before picking it up.
- Cooperate on all health and safety matters.
- Inform your line manager if you identify hazardous handling activities.
- Plan the lift – where is the load to be placed?
- Consider whether you need any help with the load. Some loads require two or more people to lift safely.
- Are there appropriate handling aids you could use?
- For a long lift, such as deck to shoulder height, consider resting the load midway in order to change grip.
- Assess the load to be lifted, taking account of any information provided.
- Look for sharp edges, protruding nails or splinters, surfaces that are greasy or otherwise difficult to grip and for any other features that may prove awkward or dangerous, e.g. sacks of ship's stores may be difficult to get off the deck.
- Ensure that the deck or area over which the load is to be moved is free from obstructions, especially in narrow accesses, and is not slippery.
- Check the final stowage location to ensure that it is clear and suitable for the load.

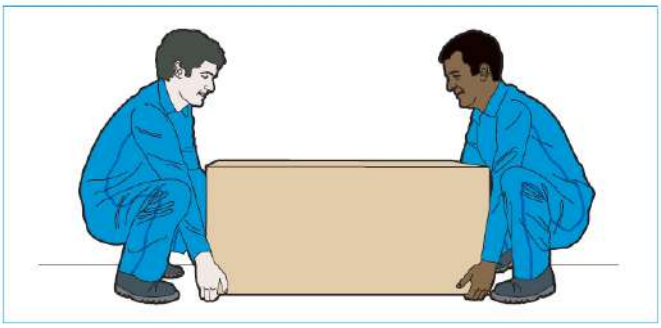
Good Manual-Handing Techniques
The diagram illustrates some important points in lifting techniques:

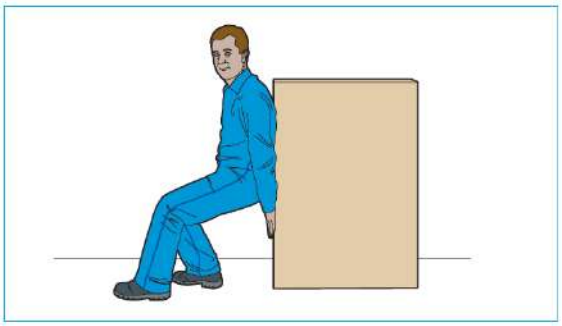


The load and the lift should be assessed before lifting.
A firm, stable and balanced stance should be taken, close to the load with the feet apart but not too wide, with one leg slightly forward to maintain balance, so that the lift is as straight as possible.
At the start of the lift and when lifting from a low level or deck, a crouching position should be adopted, with knees and hips bent, whilst maintaining the natural curve of the back to ensure that the legs do the work. It helps to tuck in the chin while gripping the load and then raise the chin as the lift begins.

The load should be gripped with the whole of the hand, not fingers only. If there is insufficient room under a heavy load to do this, a piece of wood should be put underneath first. A hook grip is less tiring than keeping the fingers straight. If the grip needs to be varied as the lift proceeds, this should be done as smoothly as possible.

The load should be lifted by straightening the legs, keeping it close to the body. The heaviest side should be kept closest to the trunk. The shoulders should be kept level and facing the same direction as the hips. Turning by moving the feet is better than twisting and lifting at the same time. Look ahead, not down at the load, once it is held securely.





Factors to be Considered

Factors	Questions
1. The tasks	Do they involve: ● activity that is too strenuous? ● holding or manipulating loads at distance from trunk? ● unsatisfactory or unstable bodily movement or posture, especially: – twisting the trunk? – stooping? – reaching upward? ● excessive movement of loads, especially: – excessive lifting or lowering distances? – excessive carrying distances? ● risk of sudden movement of loads? ● frequent or prolonged physical effort, particularly affecting the spine? ● insufficient rest or recovery periods? ● a rate of work imposed by a process? ● *climbing up or down stairs?* ● *handling while seated?* ● *use of special equipment?* ● *team handling?*
2. The loads	Are they: ● heavy? ● bulky or unwieldy, or difficult to grasp? ● unstable or with contents that are likely to shift? ● likely, because of the contours and/or consistency, to injure workers, particularly if the individual collides with

	someone or something? • *wet, slippery, very cold or hot and, therefore, difficult to hold?* • *sharp?* • *potentially damaging/dangerous if dropped?*
3. The working environment	• Are there space constraints preventing the handling of loads at a safe height or with good posture? • Is there an uneven, slippery or unstable deck surface? • Are there variations in level of deck surfaces (e.g. door sills) or work surfaces? • Are there extremes of temperature or humidity? • *Has account been taken of the sea state, wind speed and the unpredictable movement of the deck?* • *Are there steps, stairs or ladders or self-closing doors to be negotiated?* • *Is the area adequately lit?* • *Is movement or posture hindered by personal protective equipment or by clothing?*
4. Individual capability	Is the individual: • physically unsuited to carrying out the task, either because of the nature of the task or because of a need to protect an individual from a danger that specifically affects them? – *i.e. does the job require unusual strength, height, etc.?* – *is there a hazard to those who might reasonably be considered unsuited to the task?* – *does it pose a risk to those who are pregnant or have a health problem?* • wearing unsuitable clothing, footwear or other personal effects? • inadequately experienced or trained? • inadequately equipped?

COSWOP Chapter 11: SAFE MOVEMENT ON BOARD SHIP

General principles

All deck surfaces used for transit about the ship and all passageways, walkways and stairs should be properly maintained and kept free from substances liable to cause a person to slip or fall. For areas used for transit, loading or unloading of cargo or for other work processes, adequate lighting should be provided.

The Company, employer and master are also responsible for ensuring that any permanent safety signs providing information for those moving around the ship comply with the regulations and merchant shipping notice.

Any opening, open hatchway or dangerous edge into, through or over which a person may fall should be fitted with secure guards or fencing of adequate design and construction.

The ship's powered vehicles may only be driven by a competent, authorised person who is able to ensure that they are used safely. Such vehicles must be properly maintained.

Drainage

Decks that need to be washed down frequently, or are liable to become wet and slippery, should be provided with an effective means of draining water away. Apart from any open deck, these places include the galley, the ship's laundry and the washing and toilet accommodation.

- Drains and scuppers should be regularly inspected and properly maintained.
- Where drainage is by way of channels in the deck, these should be suitably covered.
- Duck boards, where used, should be soundly constructed and designed and maintained so as to prevent accidental tripping.

Transit areas

Where necessary for safety, walkways on decks should be clearly marked. Where a normal transit area becomes unsafe to use for any reason, the area should be closed until it can be made safe again

Transit areas should where practicable have slip-resistant surfaces. Spillages of oil or grease, etc. should be cleaned up as soon as possible.

When rough weather is expected:

- Lifelines should be rigged securely across open decks.
- Gratings in the deck should be properly maintained and kept closed.
- Permanent fittings that may cause hazards to movement should be made conspicuous by the use of contrasting coloured, marking, lighting or signage.
- Litter and loose objects should not be left lying around.
- Wires and ropes should be stowed and coiled so as to cause the least obstruction.

Lighting

The level of lighting should be such as to enable obvious damage to, or leakage from, packages to be seen:

- Lighting should be reasonably constant and arranged to minimise glare and dazzle
- Where visibility is poor the level of lighting should be increased above the recommended minimum to prevent collisions
- Lighting facilities should be properly maintained. Broken or defective lights should be repaired as soon as practicable.

General Advice

Seafarers and others on board must take care of their own health and safety in moving around the ship, and in particular must cooperate with any measures put in place for their safety. The following list is not exhaustive but identifies points which are all too often overlooked:

- Seafarers should watch out for tripping hazards.
- Be aware of the possibility of a sudden or heavy roll of the ship.
- Suitable footwear should be worn that will protect toes.
- It is dangerous to swing on or vault over stair rails, guardrails or pipes.
- Injuries are often caused by jumping off hatches.
- Manholes and other deck accesses should be kept closed when not being used.
- Spillage of oil, grease, soapy water, etc. should be cleaned up as soon as practicable.
- The presence of temporary obstacles should be indicated by warning signs.
- Litter and loose objects (e.g. tools) should be cleared up.
- Wires and ropes should be coiled and stowed.
- Lifelines should be rigged securely across open decks in rough weather.
- Stairways and ladders are usually at a steeper angle than is normal ashore.
- Ladders should be secured and ladder steps kept in good condition
- The means of access to firefighting equipment, emergency escape routes and watertight doors should never be obstructed

COSWOP Chapter 14: THE PERMIT TO WORK

Based on the findings of the risk assessment, appropriate control measures should be put in place to protect those who may be affected. Permits to Work are formal records to confirm that control measures are in place when particular operations are being carried out.

Competent person (CP) means a person designated and authorised for the task covered by a permit to work under the safety management system
Authorised officer (AO) means a person designated and authorised for the purposes of issuing and closing permits to work under the safety management system.

Permit to Work Systems

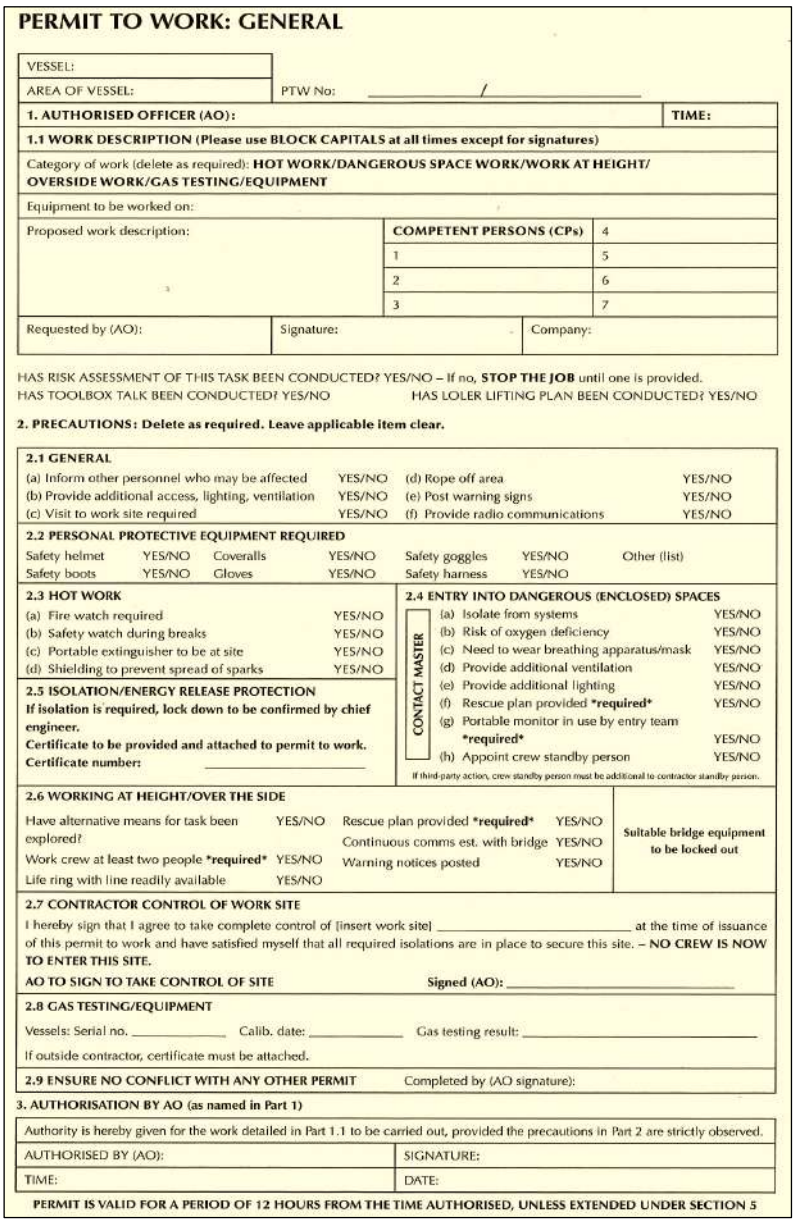
There are many types of operation on board ship when the routine actions of one person may inadvertently endanger another, or when a series of action steps needs to be taken to ensure the safety of those engaged in a specific operation. In all instances, it is necessary, before the work is done, to identify the hazards and then to ensure that they are eliminated or effectively controlled. It consists of an organised and predefined safety procedure. **A permit to work does not in itself make the job safe, but contributes to measures for safe working**.

In using a permit to work, the following principles apply:

- The permit should be relevant and as accurate as possible. It should state the location and details of the work to be done, the measures undertaken to make the job safe and the safeguards that need to be taken during the operation.
- The permit should specify the period of its validity (which should not exceed 24 hours) and any time limits applicable.
- Only the work specified on the permit should be undertaken.
- Before signing the permit, the **AO** should ensure that all measures specified as necessary have in fact been taken, or procedures are in place.
- The **AO** retains responsibility for the work until they have either closed the permit or formally transferred it to another AO who should be made fully conversant with the situation.
- The **CP** responsible for carrying out the specified work should countersign the permit to indicate their understanding of the safety precautions to be observed.
- On completion of the work, the **CP** should notify the **AO** and get the permit closed.
- The **CP** carrying out the specified work should not be the same person as the **AO.**

Permits to work would normally be required for the following categories of work:

1. Entry into dangerous (enclosed) space
2. Gas testing/equipment
3. Hot work
4. Working at height/over the side
5. General electrical (under 1000 volts)
6. Electrical high voltage (over 1000 volts)
7. Working on deck during adverse weather
8. Lifts, lift trunks and machinery



PERMIT TO WORK: GENERAL

VESSEL:

AREA OF VESSEL: PTW No: _____/_____

1. AUTHORISED OFFICER (AO): **TIME:**

1.1 WORK DESCRIPTION (Please use BLOCK CAPITALS at all times except for signatures)

Category of work (delete as required): **HOT WORK/DANGEROUS SPACE WORK/WORK AT HEIGHT/ OVERSIDE WORK/GAS TESTING/EQUIPMENT**

Equipment to be worked on:

Proposed work description:

COMPETENT PERSONS (CPs)	
1	5
2	6
3	7
4	

Requested by (AO): Signature: Company:

HAS RISK ASSESSMENT OF THIS TASK BEEN CONDUCTED? YES/NO – If no, **STOP THE JOB** until one is provided.
HAS TOOLBOX TALK BEEN CONDUCTED? YES/NO HAS LOLER LIFTING PLAN BEEN CONDUCTED? YES/NO

2. PRECAUTIONS: Delete as required. Leave applicable item clear.

2.1 GENERAL

(a) Inform other personnel who may be affected YES/NO
(b) Provide additional access, lighting, ventilation YES/NO
(c) Visit to work site required YES/NO
(d) Rope off area YES/NO
(e) Post warning signs YES/NO
(f) Provide radio communications YES/NO

2.2 PERSONAL PROTECTIVE EQUIPMENT REQUIRED

Safety helmet YES/NO Coveralls YES/NO Safety goggles YES/NO Other (list)
Safety boots YES/NO Gloves YES/NO Safety harness YES/NO

2.3 HOT WORK

(a) Fire watch required YES/NO
(b) Safety watch during breaks YES/NO
(c) Portable extinguisher to be at site YES/NO
(d) Shielding to prevent spread of sparks YES/NO

2.4 ENTRY INTO DANGEROUS (ENCLOSED) SPACES

CONTACT MASTER

(a) Isolate from systems YES/NO
(b) Risk of oxygen deficiency YES/NO
(c) Need to wear breathing apparatus/mask YES/NO
(d) Provide additional ventilation YES/NO
(e) Provide additional lighting YES/NO
(f) Rescue plan provided ***required*** YES/NO
(g) Portable monitor in use by entry team ***required*** YES/NO
(h) Appoint crew standby person YES/NO

If third-party action, crew standby person must be additional to contractor standby person.

2.5 ISOLATION/ENERGY RELEASE PROTECTION

If isolation is required, lock down to be confirmed by chief engineer.
Certificate to be provided and attached to permit to work.
Certificate number: _____

2.6 WORKING AT HEIGHT/OVER THE SIDE

Have alternative means for task been explored? YES/NO
Work crew at least two people ***required*** YES/NO
Life ring with line readily available YES/NO
Rescue plan provided ***required*** YES/NO
Continuous comms est. with bridge YES/NO
Warning notices posted YES/NO

Suitable bridge equipment to be locked out

2.7 CONTRACTOR CONTROL OF WORK SITE

I hereby sign that I agree to take complete control of [insert work site] _____ at the time of issuance of this permit to work and have satisfied myself that all required isolations are in place to secure this site. – **NO CREW IS NOW TO ENTER THIS SITE.**

AO TO SIGN TO TAKE CONTROL OF SITE **Signed (AO):** _____

2.8 GAS TESTING/EQUIPMENT

Vessels: Serial no. _____ Calib. date: _____ Gas testing result: _____

If outside contractor, certificate must be attached.

2.9 ENSURE NO CONFLICT WITH ANY OTHER PERMIT Completed by (AO signature):

3. AUTHORISATION BY AO (as named in Part 1)

Authority is hereby given for the work detailed in Part 1.1 to be carried out, provided the precautions in Part 2 are strictly observed.

AUTHORISED BY (AO): SIGNATURE:
TIME: DATE:

PERMIT IS VALID FOR A PERIOD OF 12 HOURS FROM THE TIME AUTHORISED, UNLESS EXTENDED UNDER SECTION 5

Example of a permit to work

4. ACCEPTANCE

We accept the conditions of the permit as stated above and will inform all competent persons involved in the work of the precautions to be taken. We will display a copy of the permit at the work site at all times during the task.	
ACCEPTED BY CP:	SIGNATURE:
ACCEPTED BY AO:	SIGNATURE:
TIME:	DATE:

5. EXTENSION (Site should be inspected prior to extension being granted)

Permit must not exceed 24 hrs		Signature
First extension granted at:	6hrs on:	
Second extension granted at:	6hrs on:	

6. COMPLETION (Delete as required for 6.1)

6.1 Work is complete YES/NO		All tools/apparatus have been removed and secured YES/NO	
Site is in a safe condition YES/NO		Normal operations may be resumed YES/NO	
Name (AO):	Signature:	Date:	Time:
6.2 The worksite has been inspected; I accept that all equipment is operational, the site is safe, and that I take back full control of this site.			
CLOSED BY (AO):	Signature:	Date:	Time:

Permit to work showing acceptance and time extensions

COSWOP Chapter 15: ENTERING DANGEROUS (ENCLOSED) SPACES

An enclosed space is one that:

1. Has limited openings for entry and exit
2. Has inadequate ventilation
3. Is not designed for continuous worker occupation

Any enclosed space deprived of regular and constant ventilation may become a 'dangerous space', a dangerous space as: '**Any enclosed or confined space in which it is foreseeable that the atmosphere may at some stage contain toxic or flammable gases or vapours, or be deficient in oxygen, to the extent that it may endanger the life or health of any person entering that space'.**

Some spaces may be a dangerous space only temporarily, perhaps due to the type of cargo carried or work to be undertaken, e.g. a compartment during spray painting.

Any enclosed space is potentially life threatening and every precaution should be taken both prior to entry and while inside. A single inhalation with a 5% oxygen content may result in instantaneous loss of consciousness and subsequent death. Similarly, small concentrations of a toxic substance may result in loss of consciousness and subsequent death.

All necessary precautions are taken including a risk assessment and the completion of a permit to work. Based on the findings of the risk assessment, appropriate control measures should be put in place to protect anyone who may enter an enclosed space.

A ***dangerous space*** may not necessarily be enclosed on all sides, e.g. ship holds. Personnel need to exercise caution before entering any space on board a ship that has not been opened for some time.

Examples of such spaces are:

Cargo spaces	Duct keels
Double bottoms	Inter-barrier spaces
Fuel tanks	Boilers
Ballast tanks	Engine crankcases
Cargo pump rooms	Engine scavenge air receivers
Cargo compressor rooms	CO^2 rooms
Cofferdams	Battery lockers
Chain lockers	

All crew should be given on-board training and be familiar with the risks of entry into dangerous spaces on board. Training should include as a minimum:

- Identification of the hazards likely to be faced during entry into enclosed spaces
- Knowledge of the procedures for assessment of the space
- Knowledge of the procedures for safe entry
- Recognition of signs of adverse health effects caused by exposure to during entry

Duties and Responsibilities of a Competent Person and an Authorised Officer:
On the basis of their risk assessment, the authorised officer should decide the procedures to be followed for entry into a potentially dangerous space. These will depend on whether the assessment shows that:

- There is minimal risk to the person entering the space
- There is no immediate risk to health and life but a risk could arise during the course of Work in the space
- The risk to life or health is immediate

Gas detector

Precautions before entering a dangerous space
The following precautions should be taken as appropriate before entering a potentially dangerous space without breathing apparatus:

- Competent Person to make an assessment of the space
- Authorised Officer appointed to take charge of the operation
- Potential hazards identified

- Space prepared, vented and secured for entry
- Atmosphere of the space tested
- Permit to work system used
- Procedures for preparation and entry should be agreed
- Emergency procedures should be in place.

Preparing and securing the space for entry:

- Space thoroughly ventilated
- Space isolated and secured against the ingress of dangerous substances
- Any sludge or other deposit liable to give off fumes cleaned up
- Compressed oxygen should not be used to ventilate any space.
- Pumping operations or cargo movements suspended if possible

Ventilating an enclosed space

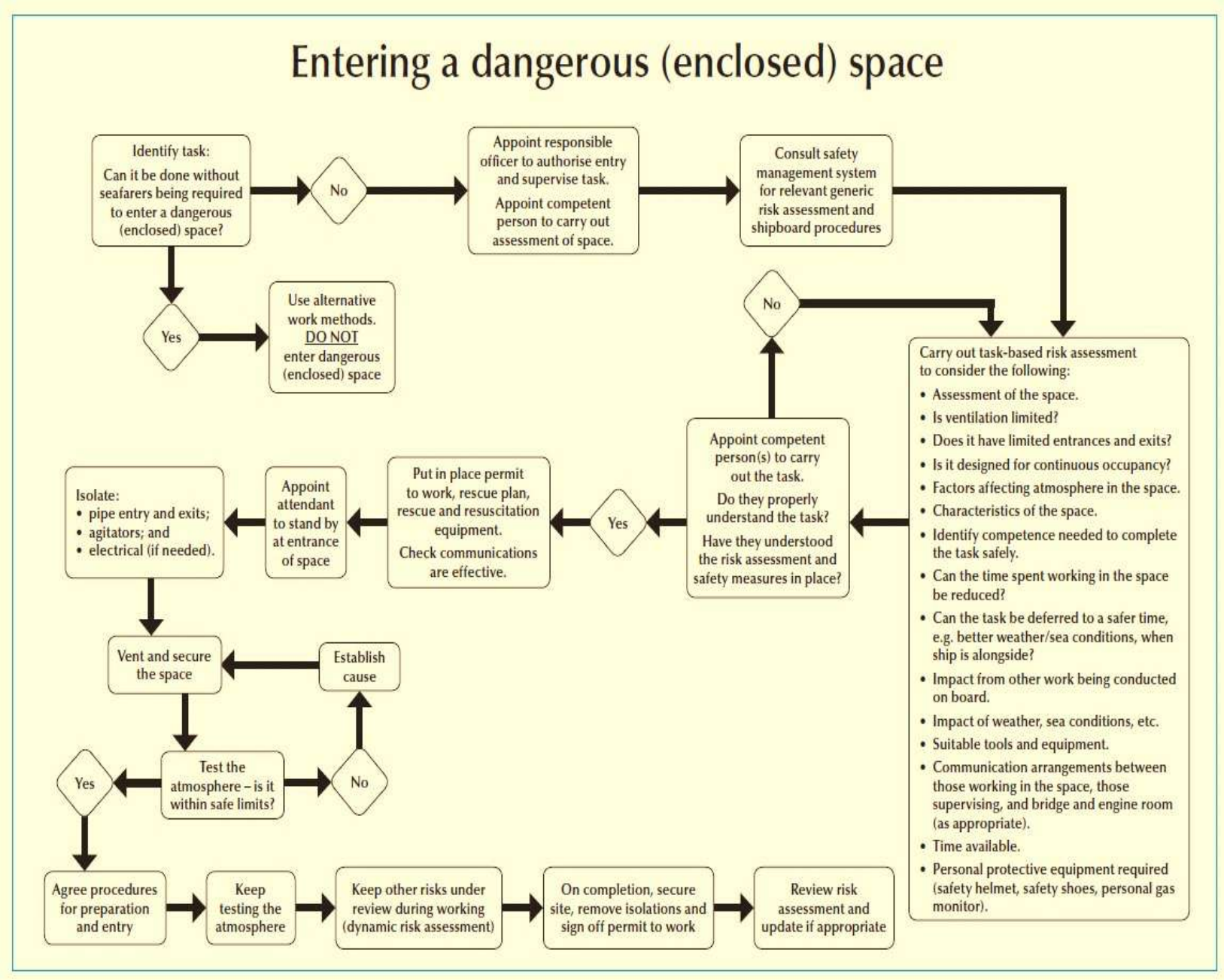
Safety precautions before entry

- The space and its access areas should be adequately illuminated.
- No source of ignition should be taken or put into the space.
- A rescue plan should be in place.
- Rescue and resuscitation equipment should be positioned at the entrance to the space.
- Lifelines should be long enough for the purpose and attached to the harness.
- A rescue harness should be close at hand.
- Hoisting equipment should be attended by personnel stationed at the entrance.
- At least one competent person posted to remain as an attendant at the entrance.
- An agreed and tested system of communication should be established:
    - Between the person entering the space and the attendant at the entrance
    - Between the attendant at the entrance and the officer on watch

Dangerous enclosure being tested

Procedures and arrangements during entry

- Ventilation should continue during the period.
- The atmosphere should be tested periodically.
- If unforeseen difficulties or hazards develop everybody should leave the space.
- If any personnel in a space feel in any way adversely affected, they should leave immediately.
- Should an emergency occur, the general (or crew) alarm should be sounded.
- **Under no circumstances should the attendant enter the space.**


Entering a dangerous (enclosed) space
Identify task:
Can it be done without seafarers being required to enter a dangerous (enclosed) space?
No
Appoint responsible officer to authorise entry and supervise task.
Appoint competent person to carry out assessment of space.
Consult safety management system for relevant generic risk assessment and shipboard procedures
Yes
Use alternative work methods. DO NOT enter dangerous (enclosed) space
No
Carry out task-based risk assessment to consider the following:
• Assessment of the space.
• Is ventilation limited?
• Does it have limited entrances and exits?
• Is it designed for continuous occupancy?
• Factors affecting atmosphere in the space.
• Characteristics of the space.
• Identify competence needed to complete the task safely.
• Can the time spent working in the space be reduced?
• Can the task be deferred to a safer time, e.g. better weather/sea conditions, when ship is alongside?
• Impact from other work being conducted on board.
• Impact of weather, sea conditions, etc.
• Suitable tools and equipment.
• Communication arrangements between those working in the space, those supervising, and bridge and engine room (as appropriate).
• Time available.
• Personal protective equipment required (safety helmet, safety shoes, personal gas monitor).
Appoint competent person(s) to carry out the task.
Do they properly understand the task?
Have they understood the risk assessment and safety measures in place?
Yes
Put in place permit to work, rescue plan, rescue and resuscitation equipment.
Check communications are effective.
Appoint attendant to stand by at entrance of space
Isolate:
• pipe entry and exits;
• agitators; and
• electrical (if needed).
Vent and secure the space
Establish cause
Yes
Test the atmosphere – is it within safe limits?
No
Agree procedures for preparation and entry
Keep testing the atmosphere
Keep other risks under review during working (dynamic risk assessment)
On completion, secure site, remove isolations and sign off permit to work
Review risk assessment and update if appropriate

COSWOP Chapter 17: WORKING AT A HEIGHT

Anyone working in a location where there is a risk of falling may be regarded as working at height (Considered to be 6 feet or 1.8 meters) . This includes undertaking work inside a tank, near an opening such as a hatch or on a fixed stairway. The basic principle is if you are working at a height of greater than your own height, then precautions should be taken for working at height.

Working at height should be subject to risk assessment and suitable control measures should be taken to protect those who may be put at risk. Depending on the severity of the risk, a permit to work may be required

General Guidelines

- Work should only be carried out at height if there is no reasonably practicable alternative to doing so.
- Only competent persons should engage in any activity relating to work at height.
- Must be older than 18 years old and more than 12 months experience at sea.
- Work equipment should be selected that is fit for purpose.
- Take into account the movement of a ship in a seaway and poor weather conditions.
- A stage, ladder, scaffolding, bosun's chair or scaffold tower should be used when work is to be done beyond normal reach.
- Any equipment being used should be in a good state of repair.
- A safety harness with a lifeline or other arresting device should be worn at all times.
- A safety net should be rigged where necessary and appropriate.
- Where work is done overside, a work lifejacket should be worn.
- Personnel should be under observation from a person on deck.
- Should not work overside whilst the vessel is under way.
- Working near the ship's whistle, should ensure that it is isolated.
- Working on the funnel, ensure that steps are taken to reduce emissions.
- Working near the radar scanner, it should be isolated and tagged out.
- Care must always be taken to avoid risks to anyone working or moving below.
- Tools should be sent up and lowered by line in suitable containers.
- Tools should be secured by a lanyard.

Portable Ladders

Working with ladders should be avoided as far as possible. It is a fact that the vast majority of accidents involving ladders result from the failure to exercise care.

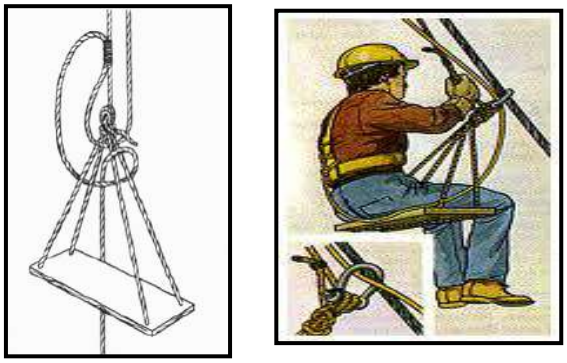
- On any job requiring a ladder, use only approved sturdy ladders that you can place on a firm base.
- Inspect the ladder prior to **every** use.
- Do not use ladders with structural defects.
- Use a ladder only for the purpose for which it was designed.
- Carry ladders parallel to the deck.
- A portable ladder should only be used where no safer means is available.
- Wooden ladders should not be painted or treated so as to hide defects and cracks.
- Portable ladders should be pitched between 60 and 75 degrees from the horizontal, on a firm base, properly secured against slipping or shifting sideways and be so placed as to afford a clearance of at least 150 mm behind the rungs. Where practicable the ladder should extend to at least 1 metre above any upper landing place unless there are other suitable handholds.
- With portable extending ladders, there should be sufficient overlap between the extensions.
- Personnel using a ladder should face the ladder and use both hands, and not attempt to carry tools or equipment in their hands.
- Planks should not be supported on rungs of ladders to be used as staging, nor should ladders be used horizontally for such purposes.
- Working from ladders should not be done, but where necessary, and for heights greater than 2 metres above base level, personnel must use a safety harness with lifeline secured above the work position.
- Carry smaller tools in pouches around the waist.

Examples of portable ladders

Bosun's Chair

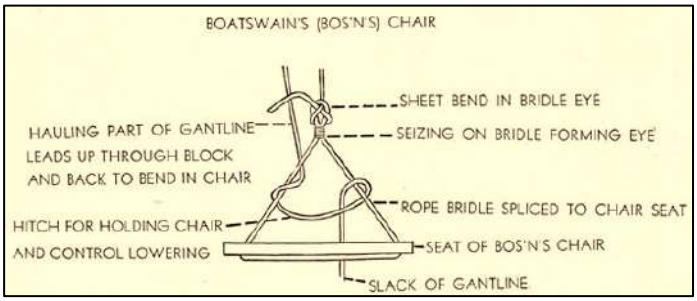
The bosun's chair is used to allow a single person to be lowered over the side of the vessel to carry out some maintenance task or when working aloft on the superstructure of the vessel.

- When used with a gantline the chair should be secured to it with a double sheet bend and the end seized to the standing part with adequate tail.
- Hooks should not be used to secure bosun's chairs unless they are of the type which, because of their special construction, cannot be accidentally dislodged and have a marked safe working load which is adequate for the purpose.
- On each occasion that a bosun's chair is rigged for use, the chair, gantlines and lizards must be thoroughly examined, and renewed if there is any sign of damage and load tested to at least 4 times the load they will be required to lift before a person is hoisted.
- When a chair is to be used for riding topping lifts or stays, it is essential that the bow of the shackle, and not the pin of the shackle, rides on the wire. The pin in any case should be seized.



Bosun's chairs

- When it is necessary to haul a person aloft in a bosun's chair it should be done only by hand; a winch should not be used.

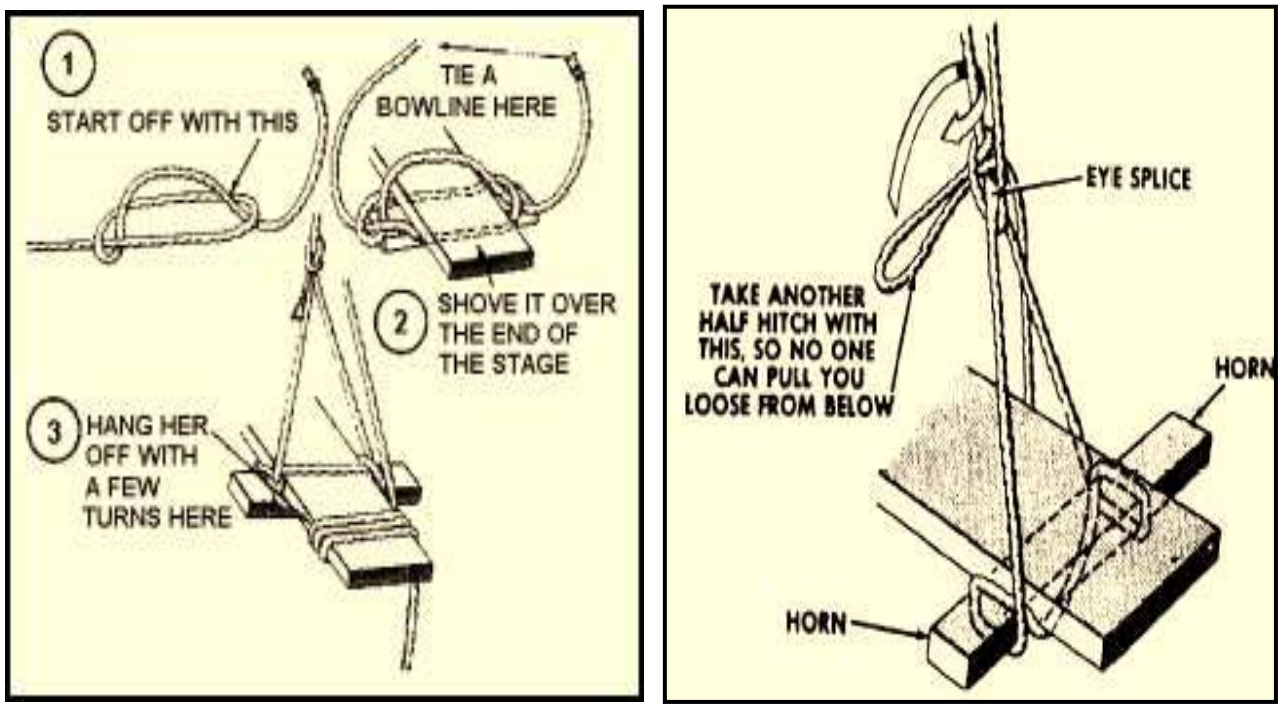


Safety harness attached to safety line and tools/paints secured against falling

- If a worker is required to lower himself while using a bosun's chair, he should first frap both parts of the gantline together with a suitable piece of line to secure the chair before making the lowering hitch. The practice of holding on with one hand and making the lowering hitch with the other is dangerous. It may be prudent to have someone standing by to tend the lines.

Stage

Use a stage for working over the side of a vessel. A stage consists of a plank with a wooden horn attached at a right angle to the plank near each end to keep it away from the side.



Rigging a Stage

NOTE: Two parts of the line go under the plank. Therefore, the line supports the plank, as well as the horns. This gives more protection to persons working on the stage.

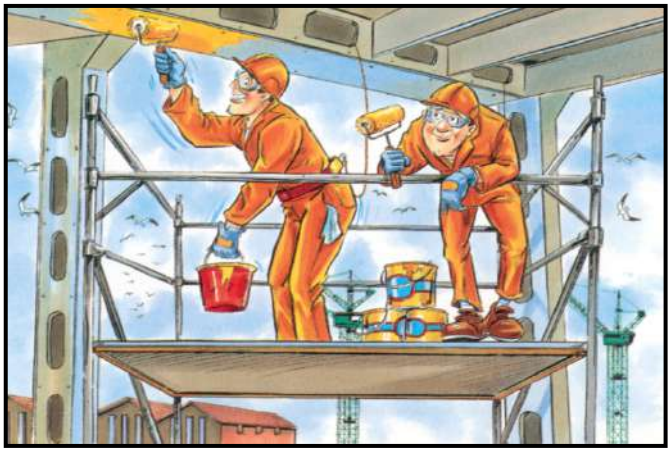
- Planks and materials used for the construction of ordinary plank stages must be carefully examined to ensure adequate strength and freedom from defect.
- Wooden components of staging should be stowed in a dry, ventilated space and not subjected to heat.
- Ancillary equipment, lizards, blocks and gantlines should be thoroughly examined before use.
- When a stage is rigged overside, the two gantlines used in its rigging should be at least long enough to trail into the water to provide additional lifelines should the operator fall. A lifebuoy and line should still be kept ready at a close position.
- Gantlines used for working aloft should not be used for any other purpose and should be kept clear of sharp edges when in use.
- The anchoring points for lines, blocks and lizards must be of adequate strength and, where practicable, be permanent fixtures to the ship's structure. Integral lugs should be hammer tested. Portable rails or stanchions must not be used as anchoring points. Any anchoring points should be treated as lifting points and should be inspected/tested in accordance with relevant regulations.

- Stages and staging which are not suspended should always be secured against movement. Hanging stages should be restricted against movement to the extent practicable.
- In machinery spaces, staging and its supports should be kept clear of contact with hot surfaces and moving parts of machinery. In the engine room, a crane gantry should not be used directly as a platform for cleaning or painting, but can be used as the base for a stable platform if suitable precautions are taken.
- Where personnel working from a stage are required to raise or lower themselves, great care must be taken to keep movements of the stage small and closely controlled.

Working aloft using Bosun's Chairs and Stage

Scaffolding

General



- All scaffolding and support work should be designed and approved by a competent officer or person.
- Warning signs and barriers should be used to isolate incomplete or unsafe scaffolding.
- Correct tools should be used at all times to ensure all fittings are properly fastened; *namely*:
    - Combination cone extractor
    - Podger hammer
    - Anchor crew and steel cone extractor
    - Shifting spanner
- The chief officer should check the scaffold that it is properly erected and a 'Permit to Work' issued and signed off

Figure 39 – Correctly erected scaffolding

Foundations

- Sole plates under bases are required in all cases.
- Minimum dimensions of sole plate for scaffold plank should be 50mm thick x 225mm wide x 700mm.
- Ensure ship is even keel and not listing.
- Wherever possible, sole plates should support all four standards.
- Minimum distance between standard and end of sole plate is 500mm.

Standards

- Ensure that scaffold tubing is high yield steel.
- Tube for use in a scaffold has to be corrosion free.
- Scaffold support work must be set as plumb.
- Ensure scaffold work is braced as follows as necessary:
    - Face bracing – to prevent sway
    - Ledger bracing – to stiffen scaffold
    - Plan bracing – to prevent displacement of inside and outside rows of standard
- Maximum gap allowed between scaffold and structure is 300mm

Ties

- All scaffolding should be tied to the structure to prevent complete collapse of the scaffold structure.
- Toe boards and guardrails must be provided for scaffolding higher than 2m above deck.
- The scaffold platform surface should be non-slip.
- Scaffold boards are too be secured to the frames.
- Guardrails are to be provided on all sides of the scaffold, except on the side facing the work area.

Figure 40 – Safe working practices

Safety During Work

- Working area on the scaffolding must be completely covered and secured.
- At no time must tools be dropped to the deck whether it be after/during work.
- Lifting and lowering of tools should be done by rope.
- Safety harness to be worn at all times when working on scaffolding.
- PPE to be worn, (hard hats, non-slip safety shoes, safety goggles).
- Loads with a tendency to swing while being hoisted should be controlled with guy ropes.

Safety Around Work Area

- Safety signs like 'Men Working Aloft' should be displayed.
- Working area should be cordoned off with high visibility or retro reflective tape.
- No public access to cordoned-off area or under the scaffold should be allowed.

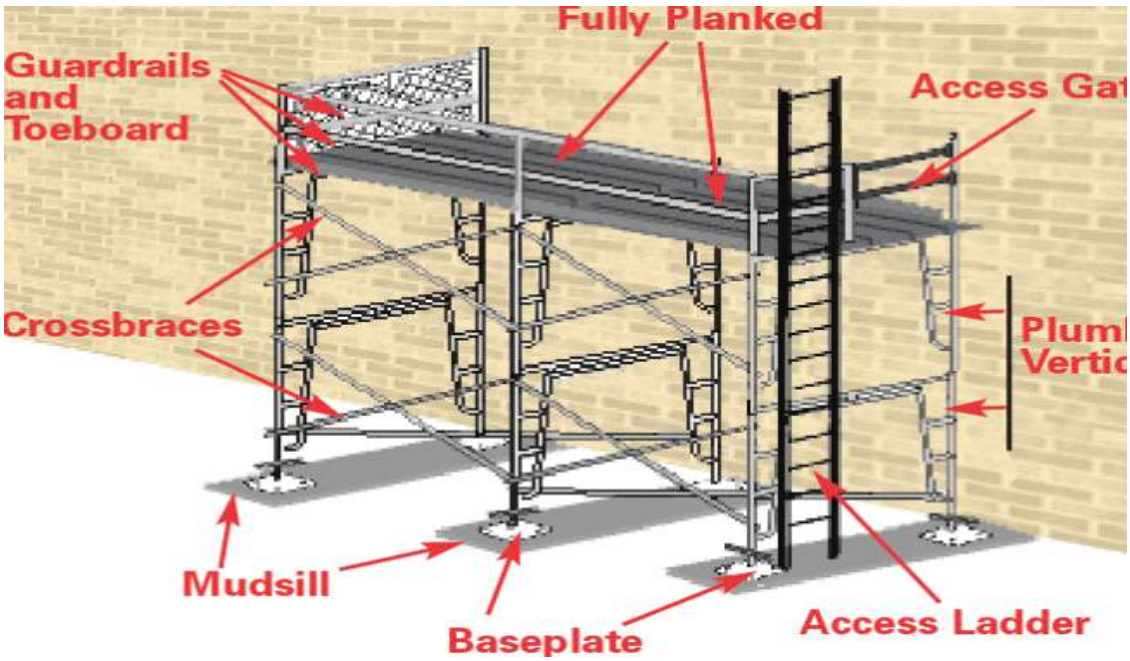


Figure 41 - Scaffolding

Figure 42 Scaffolding erected on board a ship that is listing to port

COSWOP Chapter 22: BOARDING ARRANGEMENTS

Gangways and Accommodation Ladders

For many people the gangway or accommodation ladder is the first point of contact with a ship. Initial impressions are important and a securely rigged gangway ladder may be the first indication to a visitor that they are boarding a well-run vessel. However, someone compelled to climb a ladder which is unsteady, slippery or unsafe may have formed an unfavourable opinion of the ship and its crew by the time they have reached the top.

Gangway Incidents

Gangways and accommodation ladders can be hazardous if badly rigged, improperly attended or inadequately maintained or unsafe working.

Among the causes of gangway accidents are:

- Not observing safety precautions when rigging the gangway in or out
- The vessel moving excessively alongside
- Damaged or overloaded gangway

Rigging Gangways

Gangways and accommodation ladders are heavy and difficult to manoeuvre. It is essential that the personnel required to break out and rig ladders or operate lifting gear are sufficiently experienced, bearing in mind the consequences of a mistake. Anyone unfamiliar with such tasks should be closely supervised by a responsible person until considered competent.

Personal safety equipment such as a safety harness and/or lifejacket should be worn as appropriate. Safety nets are often rigged incorrectly and are frequently found to be secured to each side of the ladder along its entire length. This results in the net hanging uselessly below the steps instead of leading away to the side of the ship to catch anyone unfortunate enough to fall off.

Rope guardrails must be tight if they are to be effective, and all stanchions must be fitted into place and properly secured. Steps, handrails and platforms should be free of oil and grease. When landed on the quay, care should also be taken to ensure that the lifting gear is kept well above head height or moved clear as necessary.

Gangways and accommodation ladders should be adequately illuminated at night. If there are no permanent fittings, portable lighting should be rigged. A lifebuoy with a self-activating light plus a buoyant lifeline with float attached should be stationed nearby ready for immediate use.

A small box containing a fire plan, stowage plan, stability details, crew list and other relevant information is often placed at the head of the ladder ready to be grabbed in an emergency.

Positioning Gangways

Gangways must be rigged out of the way and as far away from cargo working areas as possible. Gangways should never be secured to a ship's guard rails unless they have been designed for that purpose. If positioned through an open section of bulwark or railings, any remaining gaps should be roped off.

Consideration should also be given to the angle of the gangway steps. The tide changes and may cause the ship to rise up or lower down alongside the quay. The base of the gangway must be out of the way of crane tracks or bollards on the quay.

Examples of gangways

Tending Gangways

Gangways and accommodation ladders require regular adjustment due to movement caused by tidal conditions and variations in draft and trim during cargo operations. Regular monitoring is essential to ensure safety is maintained at all times.

Maintenance

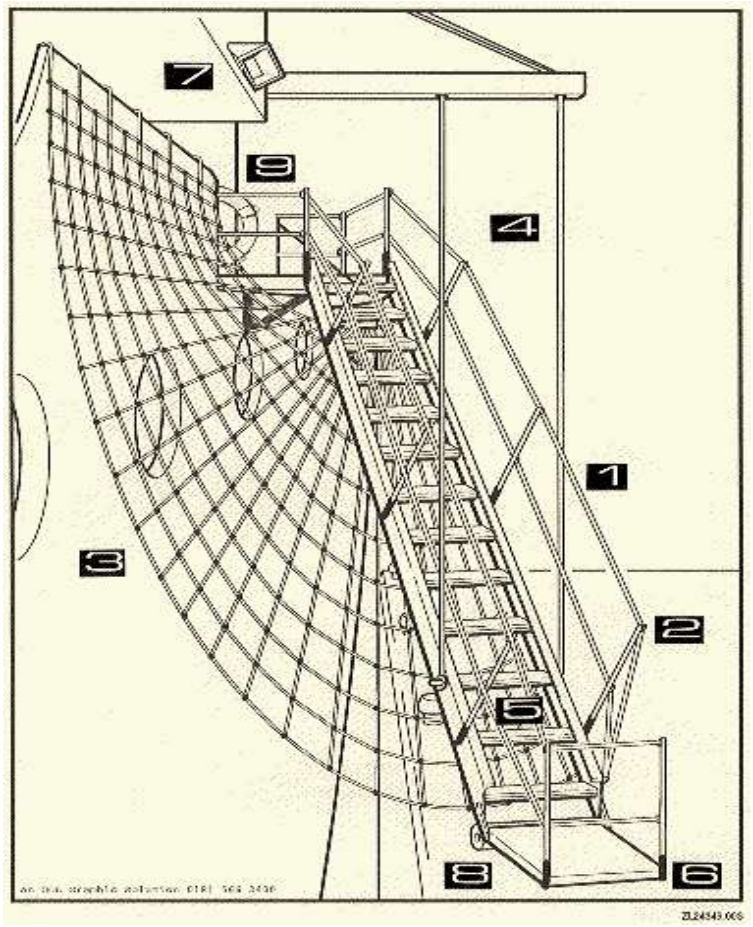
Inspection and maintenance routines should always be carried out in accordance with manufacturers' instructions. Additional checks should be made each time the ladder is rigged, looking out for signs of distortion, cracks and corrosion.

- If an aluminium ladder has fittings made of mild steel these areas should be examined for corrosion which may occur if the two metals come into contact, and deterioration of the separation material could weaken the structure.
- Bent stanchions should be replaced or repaired.
- Guard ropes inspected for wear and renewed where necessary.
- Moving parts should be free to turn and greased as appropriate.

- Lifting winch and wire ropes should be inspected, tested and maintained according to a planned schedule, paying careful attention to the condition of the hoist wires.

Arrangements should also be made to examine the underside of gangways and accommodation ladders at regular intervals.

Checklists may be used as an additional safeguard when rigging gangways and accommodation ladders. The example below may be adapted to suit individual requirements.



Key	
1	Rope guardrails tight
2	Stanchions free of distortion and all in place
3	Safety net positioned between ladder and ship
4	Hoisting arrangements clear of head height
5	Steps free of oil, grease and ice
6	Bottom platform level (where fitted)
7	Lighting arrangements positioned effectively
8	Base clear of obstructions
9	Lifebuoy with light/line and float available

Parts of a gangway

COSWOP Chapter 26: ANCHORING, MOORING AND TOWING OPERATIONS

All seafarers involved in anchoring, mooring and towing operations should be given additional instruction on the specific equipment and mooring configurations used on the vessel. This should include (but may not be limited to):

- The types of winches and windlass and their operation
- The location of emergency stop buttons
- The types of ropes and/or wires used
- The location and use of rollers, dollies and leads

Records of Instruction

Based on the risk assessment, appropriate control measures should be put in place.
It is particularly important that the risk assessment considers the consequences of failure of any equipment. This chapter identifies some areas that require attention when anchoring, mooring or conducting towing operations. The risk assessment and control measures should be reviewed for each new mooring operation, taking account of the expected mooring configuration, with particular attention to potential risk of snap-back.

When anchoring, mooring or towing operations are taking place, all seafarers should be adequately briefed on the mooring configurations and correctly dressed in appropriate personal protective equipment.

Anchoring and Weighing Anchor

Before using an anchor, a competent seafarer must check that the brake is securely on and then clear all securing devices. A responsible person must be put in charge of the anchoring party, with a suitable means of communication with the vessel's bridge. The anchoring party should wear protective clothing, including safety helmet, safety shoes, gloves and goggles, to protect from injury by rust particles and debris that may be thrown off the cable during the operation. Where the noise levels generated may be harmful, hearing protection may be considered; however, the time exposure and the greater risk from impaired communication should be taken into account.

During anchoring, they should stand aft of, or at a safe distance from, the windlass/capstan and be mindful of the potential risk of snap-back. Where the means of communication between bridge and anchoring party is by portable radio, the identification of the ship should be clear to prevent confusion caused by other users on the same frequency

Before the anchor is let go, a check must be made that there are no small craft or other obstacles under the bow. As a safety precaution, it is recommended that the anchor is 'walked out' clear of the pipe before letting go. For very large ships with heavy anchors and cables, the anchor should be either walked out at intervals or all the way to avoid excessive strain on the brakes (and on the bitter end, if the brakes fail to stop the anchor and cable).

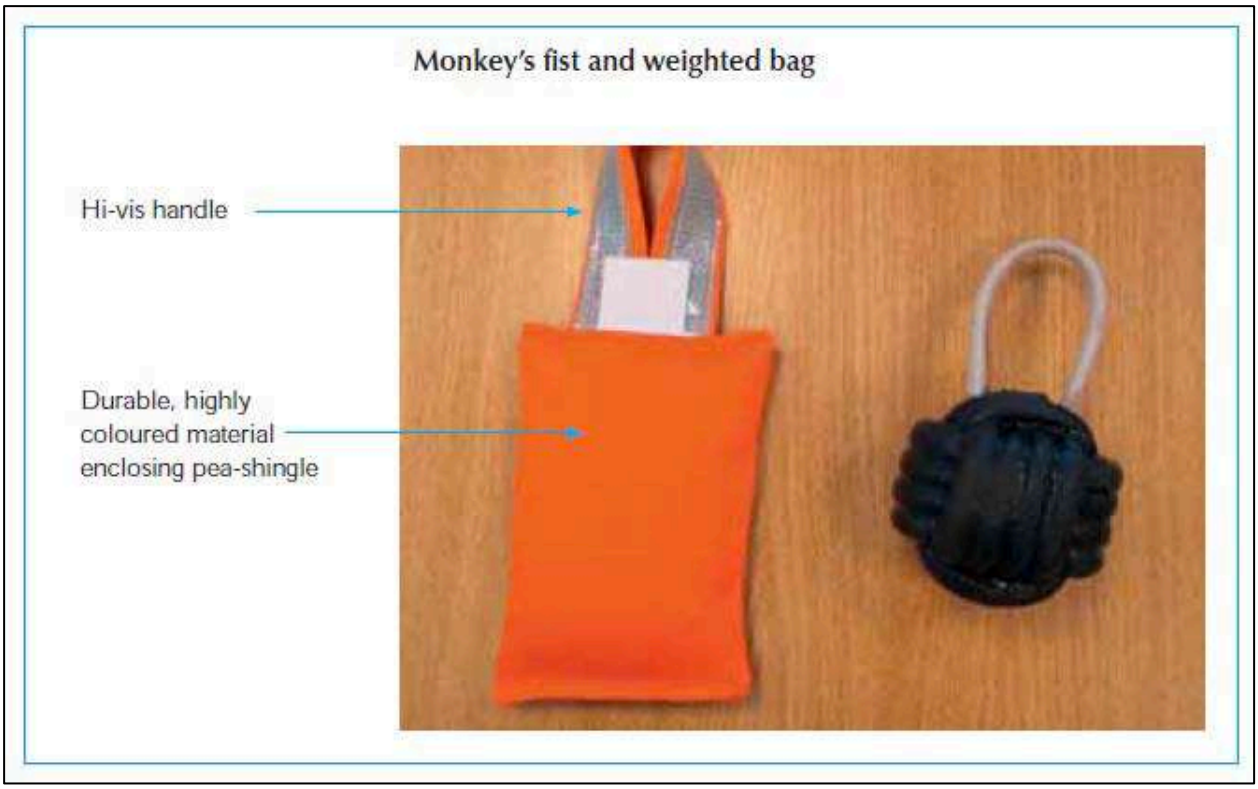
When the anchor is let go from the stowed position, if, on release of the brake, the anchor does not run, seafarers should not attempt to shake the cable. The brake should be reapplied, the windlass placed in gear and the anchor walked out clear prior to release

Cable should stow automatically. If, for any reason, it is necessary for seafarers to enter the cable locker, they must first take proper precautions for entering an enclosed space. They should stand in a protected position and be in communication with the windlass/capstan operator. Anchors that are housed and not required should be properly secured to prevent accidental release.

Making Fast and Casting Off

During mooring and unmooring operations, a sufficient number of seafarers should always be available both forward and aft of the vessel to ensure a safe operation. A responsible person should be in charge of each of the mooring parties, and a suitable means of communication between the responsible persons and the vessel's bridge team must be established. If this involves the use of portable radios, then the ship should be clearly identified by name to prevent confusion with other users.

All seafarers involved in such operations must wear protective clothing, including safety helmet, safety shoes and gloves, and be fully briefed on the berthing plan.



Owing to the design of mooring decks, the entire area should be considered a potential snap-back zone. All crew working on a mooring deck should be made aware of this with clear visible signage. The painting of snap-back zones on mooring decks should be avoided because they may give a false sense of security. Working on enclosed mooring decks adds additional hazards and therefore extra caution should be exercised. Particular attention should be paid to ensure adequate lighting.

To prevent personal injury to those receiving heaving lines, the 'monkey's fist' should be made with rope only and must not contain added weighting material. Safe alternatives include a small high-visibility soft pouch, filled with fast-draining pea shingle or similar, with a weight of not more than 0.5 kg. Under no circumstances is a line to be weighted by items such as shackles, bolts or nuts or twist locks.

Areas where mooring operations are to be undertaken should be kept tidy and clutter free. All mooring ropes should be properly stowed, heaving lines and stoppers coiled away and any oil and grease cleaned up immediately. Decks should have anti-slip surfaces provided by fixed treads or anti-slip paint coating, and the whole working area should be adequately lit for operations undertaken during periods of darkness.

Equipment used in mooring operations should be regularly inspected for defects. Defects found should be corrected. Particular attention should be paid to oil leaks from winches. The surfaces of fairleads, bollards, bitts and drum ends should be clean and in good condition and drum ends should not be painted. Rollers and fairleads should turn smoothly, and a visual check be made

that corrosion has not weakened them. Pedestal roller fairleads, lead bollards, mooring bitts, etc. should be:

- Properly designed for the task
- Able to meet all foreseeable operational loads and conditions
- Correctly sited
- Fixed to a part of the ship's structure that is suitably strengthened

Mooring ropes, wires and stoppers are to be in good condition. Ropes should be inspected frequently for both external wear and wear between strands. Wires should be regularly treated with suitable lubricants and inspected for deterioration internally and broken strands externally. Lubricants should be thoroughly applied so as to prevent internal corrosion as well as corrosion on the outside, and wires should never be allowed to dry out. Splices in both ropes and wires should be inspected regularly to check that they are intact.

Where wire rope is joined to fibre rope, a thimble or other device should be inserted in the eye of the fibre rope. Both wire and fibre rope should have the same direction of lay. Ropes and wires that are stowed on reels should not be used directly from stowage but should be run off and flaked out on deck in a clear and safe manner, ensuring sufficient slack to cover all contingencies. If there is doubt over the amount required, then the complete reel should be run off.

Ship's equipment can be employed to best effect if the following general principles are remembered:

- Breast lines provide the bulk of athwartships restraint.
- Springs provide the largest proportion of the longitudinal restraint.
- Very short lengths of line should be avoided when possible because such lines will take a greater proportion of the total load when movement of the ship occurs.
- Very short lengths may be compensated for by running the line on the bight.

Careful thought should be given to the layout of moorings, so that the leads are those most suited without creating sharp angles, and ropes and wires are not fed through the same leads or bollards. Pre-planning of such operations is essential, and a risk assessment of the operation must be completed, especially in cases where unusual or non-standard mooring arrangements are used. Personnel should not, in any circumstances, stand in a bight of rope or wire. Operation of winches should be undertaken by competent seafarers to ensure that excessive loads do not arise on moorings.

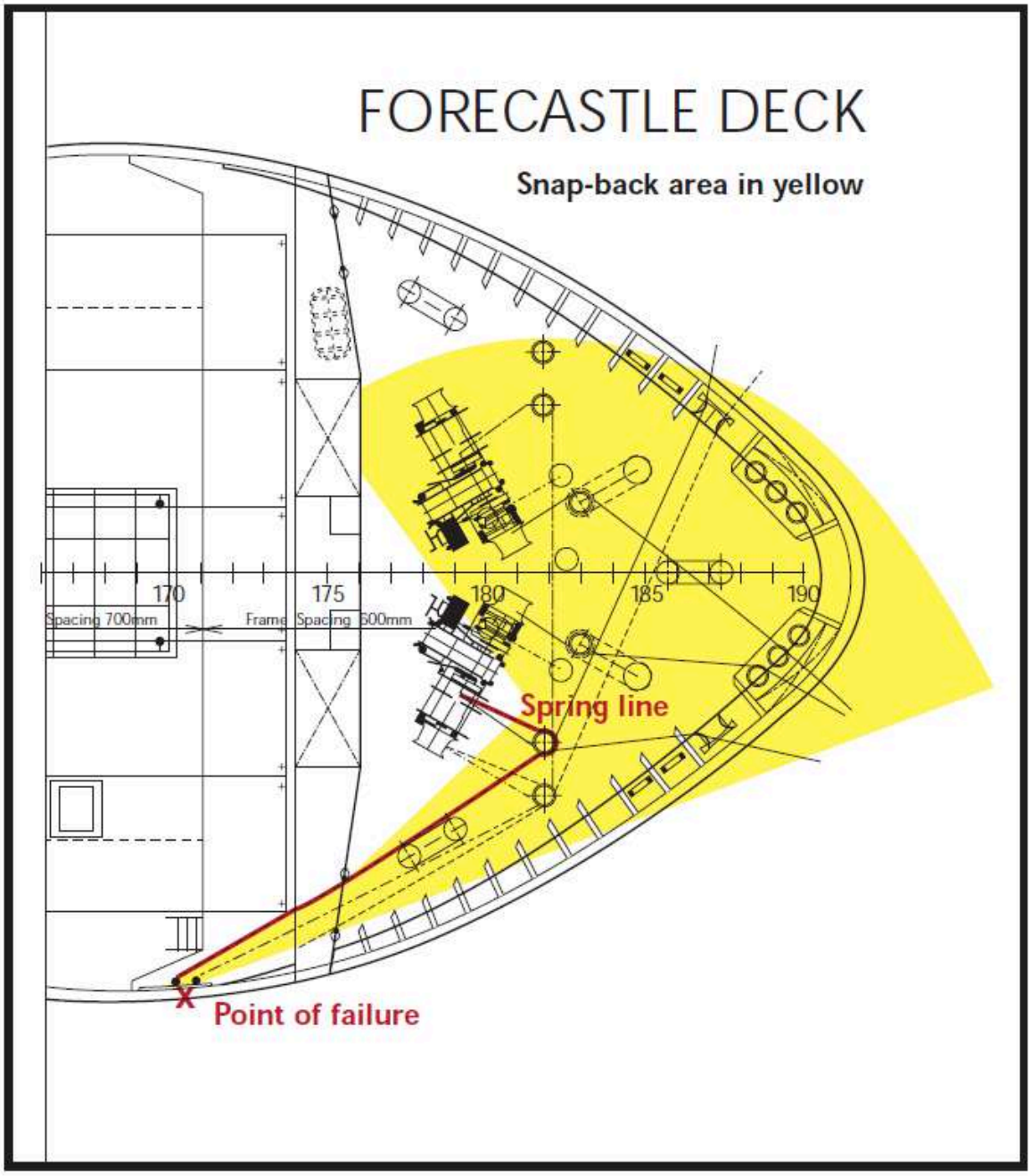
When moorings lines are under strain, all personnel in the vicinity should remain in positions of safety i.e. avoid the snap-back zones. It is strongly recommended that a bird's eye view of the mooring deck arrangement is produced to identify danger areas. Regardless of designated snap-back zones, seafarers should always be aware of other areas of potential danger – the whole mooring deck may be considered a danger zone. Immediate action is to be taken to reduce the load should any part of the system appear to be under excessive strain. Care is needed to ensure that ropes or wires will not jam when they come under strain, so they can be slackened off quickly if necessary.

Where a mooring line is led around a pedestal roller fairlead, the snap-back zone area will change and increase in area. Where possible, lines should not be led round pedestals, except during the operation to moor the ship. Thereafter, lines should be made up on bitts, clear of pedestals if at all possible. When moorings are to be heaved on a drum end, the winch operator must have a full view of all activity. The 'fleet angle' or lead angle of the rope onto the drum should be no more than a few degrees. One person should be stationed at the drum end, backed up by a second person, who is standing at least a metre away, backing and coiling down the slack. In most circumstances, three turns on the drum end are sufficient to undertake a successful operation and avoid riding turns. A wire on a drum end should never be used as a check wire.

A synthetic rope should never be surged on the drum end. After being hauled tight, a stopper is to be used to allow the rope to be removed from the warping drum and then placed on a bollard or bitts by using either single turns or figures of eight. For wire rope, at least the top three lays of the figure of eight must be secured by a fibre rope to prevent jumping. The stopper material should be like for like (i.e. natural for natural, and chain for wire ropes).
A wire should never be led across a fibre rope on a bollard. Wires and ropes should be kept in separate fairleads or bollards.

When stoppering off moorings, the following applies:

- Natural fibre rope should be stoppered with natural fibre.
- Man-made fibre rope should be stoppered with man-made fibre stopper (but not polyamide).
- The 'West Country' method (double and reverse stoppering) is preferable for ropes.
- Wire moorings should be stoppered with chain, using two half-hitches in the form of a cow hitch, suitably spaced with the tail backed up against the lay of wire, to ensure that the chain neither jams nor opens up the lay of the wire.



The diagram shows the potential area of danger (snap-back zone) when the spring line parts at the spring line fairlead. The snap-back zone would be increased if both pedestal fairleads were used. (Swedish Accident Investigation Authority Report S-95/11 Morraborg)

Mooring to a Buoy

Where mooring to a buoy is undertaken from a ship's launch or boat, seafarers engaged in the operation must wear a working lifejacket (personal flotation device). A lifebuoy with an attached lifeline should be available in the boat. Means should be provided to recover a man overboard. If a boarding ladder with flexible sides is used, it should be weighted so that the lower rungs remain below the surface.

Where mooring to a buoy is undertaken from the ship, a lifebuoy with an attached line of sufficient length is to be available for immediate use. When slip wires are used for mooring to buoys or dolphins, the eyes of the wires should never be put over the bitts, because at the time of unmooring it may not be possible to release the load sufficiently to lift the eye clear. To prevent accidental slippage of the wire eye(s) over the bitts or other obstruction, the eyes should be seized, partially closing the eye.

Towing

A number of accidents have occurred during the operation of making fast and releasing a tow. It is not uncommon for the gear to become taut without warning, causing the messenger to part and strike anyone in the snap-back zone, resulting in serious injury. Poorly controlled towing operations are also a significant hazard to tug crews.

Equipment used for towing should be adequately maintained and inspected before use because during towing operations, excessive loads may be applied to ropes, wires, fairleads, bitts and connections. If there are suspicions over the quality of the towline, it should be rejected and an alternative line used.

Prior to towing operations being undertaken, the master (and pilot) should establish a suitable means of communication, exchange relevant information (e.g. speed of vessel) and agree a plan for the tow with the tug master. Seafarers involved must understand their duties and they should be adequately briefed on the operation and the safety precautions to be taken. They should be equipped with personal protective equipment including safety helmets, safety shoes and gloves. During hours of darkness, care should be taken to ensure that floodlighting will not dazzle and destroy the night vision of the tug master.

During operations, communications should be maintained between:

- The towing vessel and both the bridge team and the foredeck of the vessel under tow
- The tow party and the bridge team.

All parties should identify themselves clearly to avoid misunderstandings.

CHAPTER NINE
STOPPERS AND DIPPING OF A LINE

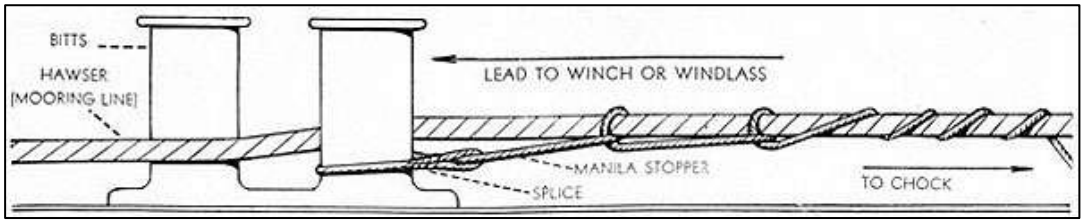
Use and Selection of Stoppers for Wires and Ropes

Stoppers are used to take the strain on chain or lines while being transferred to the bitts or cleats such as from a winch to the bitts. The stopper material when using rope should match, i.e. natural fibre stopper should be used on natural fibre lines, ditto synthetic ropes. Chain stoppers should be used on wire rope. The stopper rope diameter should be half that of the line to be stopped. It is vital that the correct stoppers are used with the appropriate mooring lines.

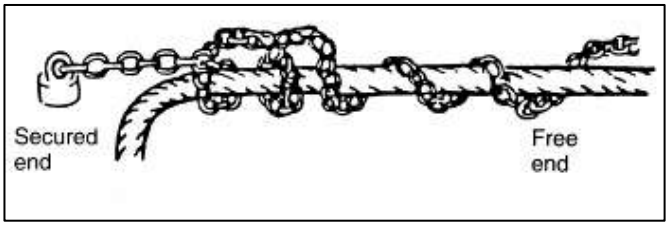
Stoppers should not be left on mooring lines once they have been made fast to the bitts. A stopper used on a fibre line should be about two metres in length or either single or double rope with a significantly smaller diameter than the mooring line and with an eye at the one end securing it to an eye pad either on the bitts or on the deck close by.

The ideal line for stoppers should:

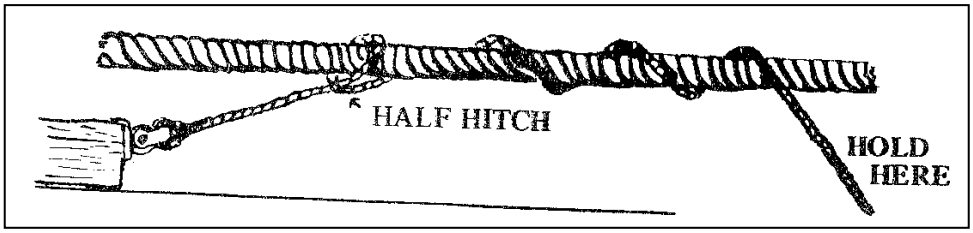
- Be made from synthetic fibre rope
- Be very flexible and its size should be as small as possible
- Be made from a high melting point material, such as polyester or polyamide
- Have a combined strength equal to 50% of the breaking load of the mooring line on which it is to be used



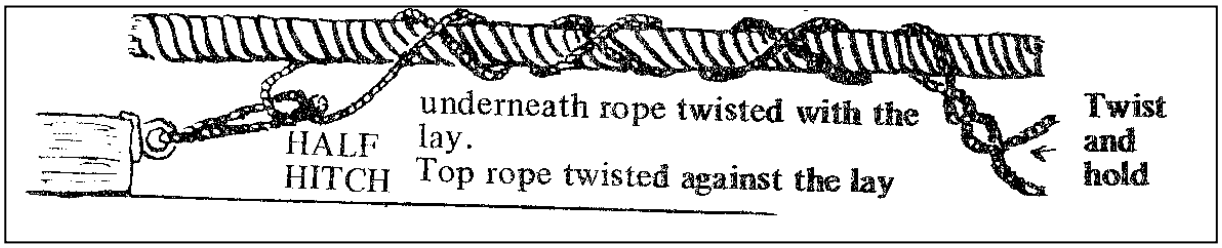
Stopper on rope



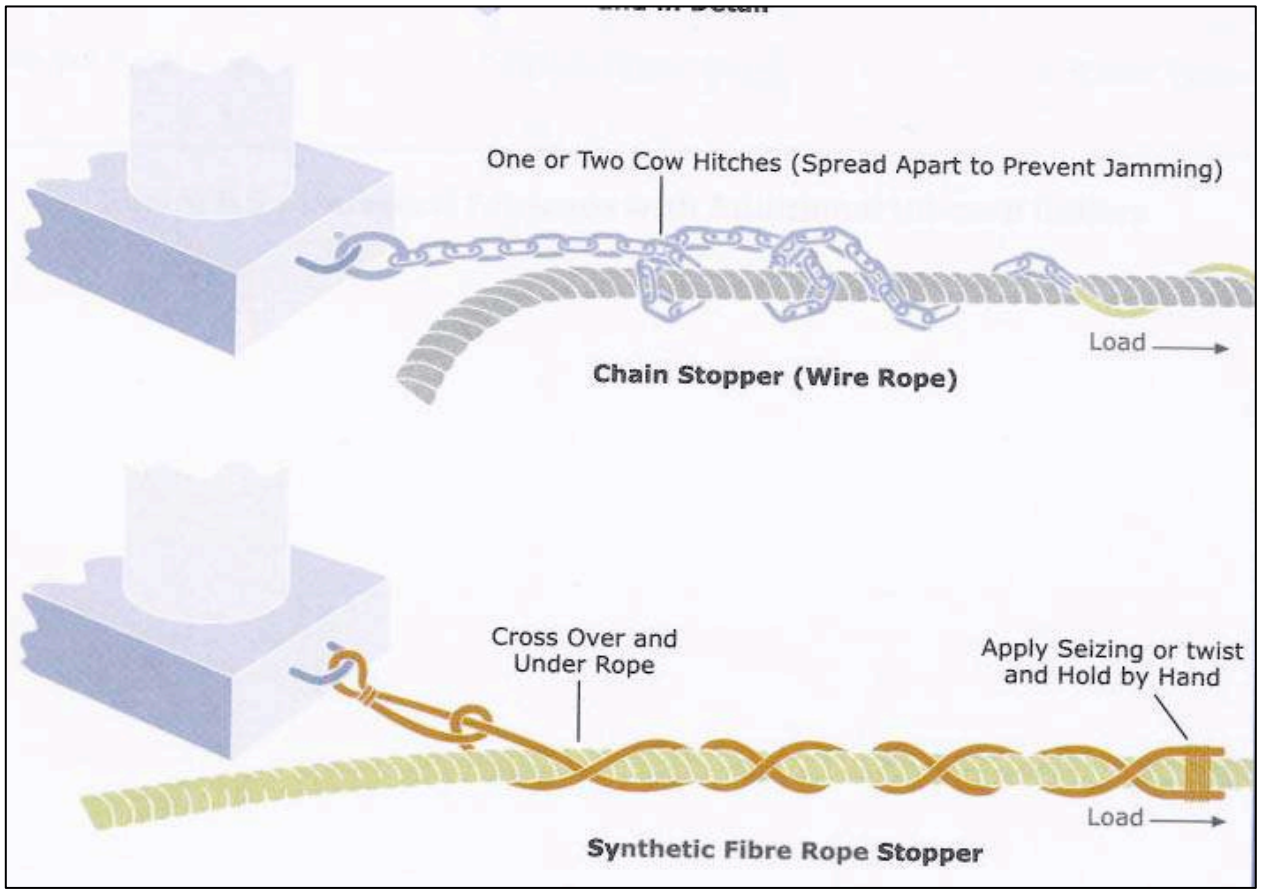
Chain stopper



Rope stopper for natural fibre ropes

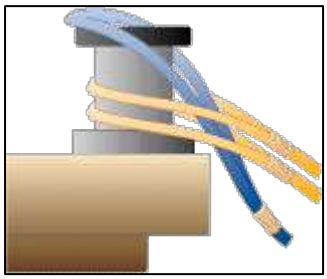


West Country stopper for natural or synthetic fibres



Chain stopper on wire rope and synthetic rope stoppers

Dipping a line



Dipping the Eye allows a second line to be passed over a bollard still enabling all the lines to be accessible for release

CHAPTER TEN
SHIPBOARD MAINTENANCE

Painting

Paint consists of the following parts:

1. **Pigment** which provides the colouring, rust prevention (in primers) and the lasting quality of the paint. The most common pigments are made of metals, such as lead, zinc, or titanium
2. **Base** or the vehicle is the liquid portion in a paint. It wets the surface being painted, penetrates into the pores, and ensures adhesion. Until recently, the base of most paints was oil, such as linseed oil, but few paints today contain oils. Some have vehicles of processed oils in combination with synthetic resins; others have vinyl chlorinated bases that are quick drying.
3. **Driers** add to the drying properties of paint. Certain metallic compounds, called driers, are added to the paint. When mixed with oil, they act as conveyers of oxygen, which they take from the air and add to the oil, speeding up the drying process.
4. **Thinners** are used for thinning the paint to the proper degree for spraying, brushing, or rolling. They also increase the penetration of the paint into the surface and cut down the gloss. Too much thinner affects the durability of the paint. The most common type of thinner is made of mineral spirits, but the proper type to use depends on the paint base.

Types of Paint

Primers are base coats of paint that stick firmly to bare woods and metals providing a smooth surface for finishing coats. They also serve to seal the pores. Those applied on steel are rust inhibitors as well. A minimum of two coats of primer should always be used after the surface is cleaned down to the bare metal. A third coat should be added at all outside corners and edges. At least eight hours of drying time should be allowed between primer coats.

Synthetic paints are synthetic resin coatings, such as epoxies, urethanes and inorganic zinc, are used for areas subject to severe service or exposure, such as bilges, tanks, and decks. The base coating is mixed with a converter (hardener) to cure or harden the paint film.

Exterior paints are used on vertical surfaces above the upper limit of the boot topping (waterline area) which are given two coats of paint. A non-skid deck paint is used on main walkways. It contains a small amount of pumice /sand/grid, which helps to give it a better footing.

Interior paints are applied in various colours depending on the use of individual compartments, several colours are authorized or prescribed for interior bulkheads, decks, and overheads.

Note: Always consult the product data sheet before deciding on what paint to use where and ask if unsure.

What Not to Paint

***Never* paint the following items**:

- Start-stop mechanisms of electrical safety devices and control switchboards on machinery elevators
- Bell pulls, sheaves, enunciator chains, and other mechanical communications devices
- Metal on water ends of pumps
- Outside surfaces of condensers made of composition metal
- Sprinklers (CO^2 outlet nozzles)
- Glands, stems, yokes, toggle gear and all machined external parts of the valves such as visible thread
- Heat exchange surfaces of heating or cooling equipment
- Identification plates
- Joint faces of gaskets and packing surfaces
- Lubricating gear, such as oil holes, oil or grease cups, grease fittings, lubricators, and surfaces in contact with lubricating oil
- Lubricating oil reservoirs
- Machined metal surfaces (working surfaces) of reciprocating engines or pumps
- Metal lagging
- Rods, gears, universal joints, and couplings of valve operating gear
- Rubber elements of isolation mounts
- Springs
- Threaded parts
- Zinc sacrificial anodes
- Working surfaces
- Hose and applicator nozzles
- Knife edges; rubber gaskets; dogs; drop bolts; wedges; and operating gear of watertight doors, hatches, and scuttles
- Electrical contact points and insulators
- The original enamel, lacquer, or crackle finish on all radio, electrical, and sound equipment, unless existing damage makes refinishing essential
- Decorative plastic, such as tabletops

Preparation of Surfaces

Preparation for every type of material begins with cleaning the area to be prepared, including removed of pre-existing paint flakes, dust, grime etc. and then a thorough degreasing. The products for each material will be different and depend on the type of application being prepared for.

PPE masks, eye protection, gloves etc. should always be used

Aluminium

Aboard ship, aluminium surfaces are a special problem. If they're not treated properly, corrosion will result. Corrosion is greater when dissimilar metals, for example aluminium and steel, are in contact with each other and are exposed to seawater. Seawater is an electrolyte (an electrical conductor). The seawater causes an electrical current to flow between the steel and the aluminium surfaces, resulting in galvanic corrosion of the aluminium.
Normally the first sign of aluminium corrosion is a white and powdery residue in an area where the two dissimilar metals are in contact with each other. Later, the aluminium surface becomes pitted and scarred. Then a complete deterioration of the aluminium area follows. Holes in the aluminium plate enlarge and screws and bolts may pull through or disintegrate.

Before joining aluminium to another metal, give each surface a pre-treatment formula and two coats of primer formula.

- Never use red lead as a primer on aluminium.
- If the joint is exposed to the weather, use insulation tape between the two surfaces, and fill the joint with a caulking compound.
- When aluminium is joined to wood, give the wood one coat of phenol varnish.
- Replace any missing fasteners, for example screws, bolts, rivets, with items of the original type.
- Replacements of stainless or galvanized steel may be used.
- When painted, the best way to prepare the aluminium surface before painting is to use hand scrapers, hand and power wire brushes, or fine grit sandpaper.
- Be careful if you use a power sander to prepare and never use scaling hammers on aluminium.

Wood

Varnished wood is used on yachts extensively and requires extra work as it has to contend with sun and sea and often with harsh chemicals such as teak deck treatments that can run or be splashed over its surface.

Preparation

Repair soft or discoloured wood with epoxy, wood bleach or stain as needed.

- Use quality masking tape for extended use and protect other surfaces with polyethylene sheeting.
- Sand with the grain. Early coats are sanded with 180-220 grit paper, for later coats use 320-400-grit paper.
- Orbit sanders must be very cautiously used to avoid uneven sanding, gashes and nicks.
- If using chemical paint stripper to remove old layers of varnish, work in well-ventilated areas, wear protective gear and avoid direct skin contact.
- Using a heat gun or putty knife for removal of old paint and varnish is less toxic needs patience to avoid gouges or burns.

All bare wood should be sanded down either by hand or mechanical methods. Always sand along the grain to remove remnants of old paint out of the grain. Sanding across the grain causes scratches, which even in new construction will show as unsightly marks particularly when varnishing. All traces of sanding dust must be removed as this will impair adhesion and produce a bitty finish. With oily woods such as teak, swab the surface with a degreaser and wipe down with lint free tack cloths after sanding. This removes the residual oil which otherwise would impair subsequent paint or varnish adhesion.

Once all the dust is removed, the first coat of varnish (thinned by 25%) can be applied to seal the timber before further varnishing. A further 8 coats will need to be applied with a careful sanding in between per above paper guide.

There are a number of rules for varnishing successfully:

- The temperature should ideally be between 50° and 75°F (10° – 23°C) with around 50% relative humidity.
- Conditions should be calm with no wind.
- No dust should be present so thorough cleaning should take place after each sanding.
- Direct sunlight must be avoided to stop uneven drying leading to ripples.
- Avoid varnishing in high humidity and if rain is forecast.
- The last coat of the day should have time to dry thoroughly before night time dews.
- Paint in clean clothes with dust free PPE.

- Have supplies of tack cloth for drips etc.
- Varnish does not need to be stirred or mixed, except when adding thinner. Shaking and stirring leads to bubbles and poor finish.
- Gentle brush strokes are also needed to avoid bubbles produced by jabbing or squeezing the brush.
- Decant the varnish into a dedicated pan and have a second empty can to remove excess varnish from the brush.
- Unused varnish should not go back into the can.
- Do not overload the brush nor dip it too deep.
- Brush with the grain brushing towards the area just varnished.

Teak

Teak is a hard oily wood that mostly is left unfinished but it does becomes grey and dull over time unless properly looked after.

To maintain it:

- Teak is best cleaned with salt water, it rots with fresh water which allows fungi to grow leading to black spots. Clean with mild soap and water, using a soft brush across the grain and flush with plenty of salt water.
- Cleaning with the grain, using pressure cleaners and some teak cleaners eats in to the softer grains leaving a rough serrated finish.
- Removing stains from teak is very hard especially oils including machine oils, grease and sunscreen, use K2R to clean oily stains. When working in proximity to teak make sure the area is thoroughly masked.
- Teak oil should be applied to protect the teak from the marine environment. Teak oil can be applied with a cloth or brush in one or two layers. Wipe away any excess oil after the wood is saturated.

Steel

When painting a steel surface, preparation of the surface is important. Steel surfaces must be completely free of rust, loose paint, dirt, scale, oil, grease, salt deposits and moisture. Old paint in good condition is an excellent base for repainting.


Examples of surfaces unsuitable for repainting

- Smooth, thoroughly clean and dry the surface before applying new paint.
- In touch-up painting (when only small areas or spots need repainting), remove old paint to the edges of the spot or area until an area of completely intact paint is reached.
- Feather the edges of the remaining paint.
- When completely reworking an old painted surface, take the old paint down to the bare metal.
- Then apply a primer before painting.
- Never leave a base metal surface exposed overnight. Always put on a primer coat before you secure for the day.


Well-painted surfaces

Painting Techniques

The three most common means of applying paint are:

- Brush
- Roller
- Spray

The majority of painting aboard ships is by means of various types of brushes and rollers.

Brush

Smooth and even painting depends as much on good brushwork as on good paint. There is a brush for almost every purpose. You should use the proper brush and keep it in the best condition. The two most common useful brushes are the flat brush and the sash tool brush. These brushes and some others commonly used aboard ship are shown in the picture below.

Flat paint brushes

Dog's paw paint brushes

With a **flat brush**, you can paint almost anything aboard ship. Flat brushes are wide and thick. They carry a large quantity of paint and provide a maximum of brushing action.
Sash brushes are handy for painting small items, for cutting in at corners, and for hard-to-get-at spaces.

The **fitch brush** also is useful for small surfaces.

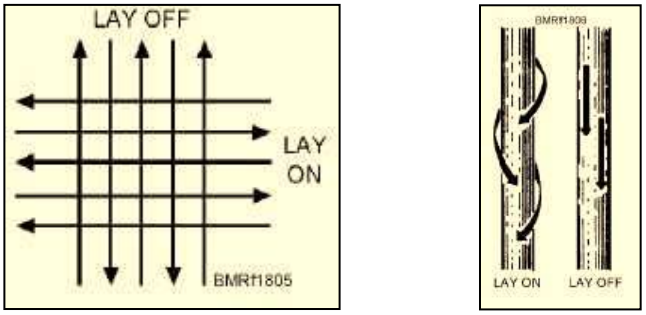
The painter's **dusting brush** is used for cleaning surfaces.

The following are hints to help you use a paintbrush properly:

- Grip the brush firmly, but lightly. Don't put your fingers on the bristles below the metal band (ferrule). The grip shown permits easy wrist and arm motion. To hold it otherwise restricts your movements and causes undue fatigue.
- When using a flat brush, don't paint with the narrow edge. This practice wears down the corners and spoils the shape and efficiency of the brush.
- When using an oval brush, don't revolve it too much or it soon wears to a pointed shape and becomes useless.
- Do not poke oversized brushes into corners and around mouldings. Such a practice bends the bristles, eventually ruining a good brush. Use a smaller brush that fits into such odd spots.
- Dip the brush into the paint, but not over halfway up the bristles. Remove the excess paint by patting the brush on the inside of the pot. Overfilling the brush will cause paint to drip onto the deck or other surfaces and run down the handle
- Hold the brush at right angles to the surface being painted, with the ends of the bristles just touching the surface
- Lift the brush clear off the surface when starting the return stroke. If the brush is not held correctly and is not lifted, the painted surface will be uneven, showing laps and spots and a daubed appearance. Also, a brush that is held at any angle other than a right angle will soon wear away at the ends.

Laying On and Laying Off

For complete and even coverage, follow the correct method and first lay on, and then lay off. '**Laying on'**, means applying the paint first in long strokes in one direction. '**Laying off'**, means crossing your first strokes. The proper method is shown in the picture.



Laying on and laying off paint

By using the recommended method and crossing your strokes, you can distribute the paint evenly and completely with a minimum amount of paint being used. Always paint the overhead first, working from the corner that is farthest from the entrance of the compartment. By painting the overhead first, you can wipe drippings off the bulkhead without smearing the bulkhead paint.

When overhead surfaces are being painted, sections should normally be painted in a fore-and-aft direction and beams in an athwart ship direction. But where sections of the overhead contain many pipes running parallel with the beams, it is often difficult to lay off the paint in a fore-and-aft direction. In such situations, better results are obtained by laying off the paint parallel with the beams.

To avoid brush marks when finishing up an area you have painted, use strokes directed toward the last section finished, gradually lifting the brush near the end of the stroke while the brush still is in motion.

Every time the brush touches the painted surface at the start of a stroke, it l eaves a mark. For this reason, never finish a section by brushing toward the unpainted area. Instead, always end up by brushing back toward the area already painted.

When painting pipes, stanchions, narrow straps, beams, and angles, lay the paint on diagonally, as shown in the picture. Lay off along the long dimension. Always carry a rag for wiping up dripped or smeared paint. Carefully remove loose bristles sticking to the painted surface.

Cutting In

After you master the art of using a paintbrush properly, learn to cut in. Cutting in is a simple procedure that you can learn in a short time.

Suppose you have to cut in the angle between an overhead and a bulkhead, as shown in the picture.
Start at one corner.

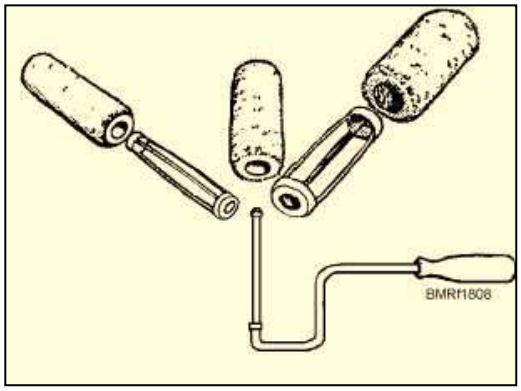
Hold your brush at an angle of about 75º from the bulkhead and about 10º from the overhead.

Draw your brush along in fairly long, smooth strokes. This is one job where working slowly does not produce better results. The slower you stroke, the wavier your line will be.

Correct method of cutting in

Use of rollers

The most common type of paint roller used is equipped with a replaceable cylinder of soft fibre fabric, synthetic or natural fibres, over a solvent-resistant paper or plastic core. It rotates on the shaft of a corrosion-resistant steel frame. Large areas, such as ships' decks and sides; free of rivets, bolts, cable, pipes, and so on, can be covered with paint quickly by the roller method.



Rollers

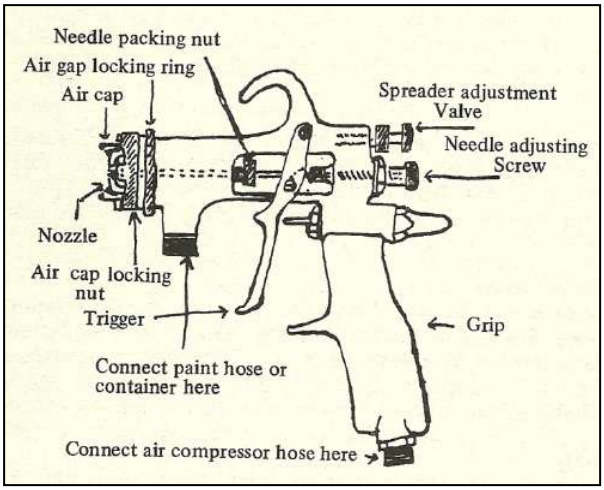
Laying on the paint

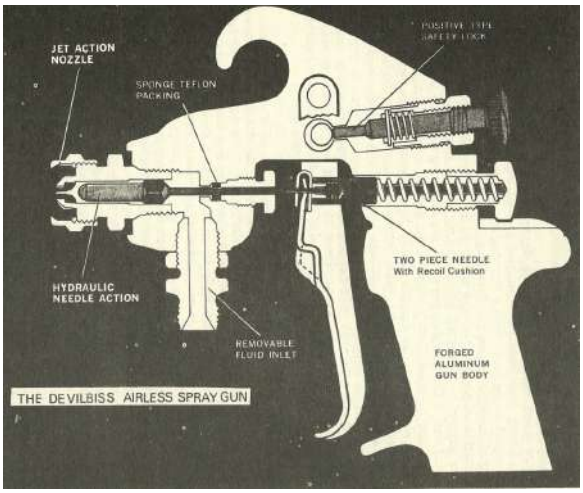
The paint should be laid on and laid off the same way as when brushes are used. Apply a moderate amount of pressure to the roller to make sure the paint is worked into the surface. If pressure is not applied, the paint doesn't stick and soon peels off. When the paint roller is properly used, it will apply a more even coat and use less paint than with a brush.

Spray guns

Conventional spray

The paint in a container is drawn through a nozzle by pressurised air. This very fast method of painting is unsuitable for confined spaces unless the correct safety and breathing apparatus is utilised. Goggles should always be worn when using a spray gun and vapour should be quickly

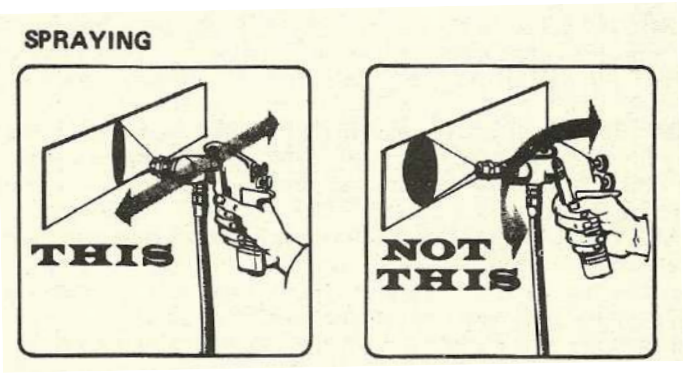




dispersed by good ventilation. This method is suitable for most paints, but, paints must be thinned before spraying.

Airless spray

Again suitable for most paints, but while some paints must be applied by airless spray, others are not suited to this method. While it is probably the fastest method of applying paint, it is also the most complicated as different paints require different size nozzles. It takes a very skilled operator to be able to apply an even coating over a large area. NEVER attempt to operate an airless spray gun unless you have been thoroughly trained and properly instructed in how to use this equipment.



Correct method of spray painting

WARNING: The actual fluid pressure at the gun nozzle can be as high as 3000 PSI, over 200 bar. For this reason caution must be used when handling an airless spray gun and **never** point it at any part of your body.

Care of Brushes and Rollers

Unfortunately, too many good paintbrushes and rollers are ruined because painters have little or no idea how to clean them, or they are too lazy to clean them.

To avoid damaging paintbrushes and rollers, pay attention to the following hints:

- Treat applicators as though you paid for them yourself, and replace them when they no longer are usable
- Do not let a brush stand on its bristles in a pot of paint more than a few minutes**.** The weight of the brush bends the bristles, making it almost impossible to do a good job
- Never allow paint to dry on a brush. If you intend to leave a paint-filled brush for long periods, as over lunch break, fold wax paper or heavy paper around the bristles and ferrule in such a way that air is kept away from the bristles. Twist the paper around the handle and secure it with rope yarn or sail twine
- Cover your pot of paint, and place both it and the brush in a safe place
- Before starting to paint again, stir the paint thoroughly with a paddle—not the brush

- At the end of the day, clean as much paint from the brush as possible by wiping it across the edge of the paint pot or mixing paddle**.** Clean the brushes thoroughly in the correct solvent for the paint being used.




C***are of paint brushes and rollers***

Safety While Painting

Safety gear must be used when the painting to be done is in a dangerous environment such as an enclosed space, poorly ventilated space, high up on a bulkhead or deckhead or working aloft.

- Use safety harness and lanyard clipped to a secure location.
- Use a dust mask while chipping or scaling.
- Use eye and face protection when chipping or scaling.
- Use hand protection such as a pair of rubber gloves when working with chemical such as paints and thinners.
- Use eye protection when working with chemicals such as paints and thinners.
- Use a filter respirator when working with chemicals such as paints.
- Always wear your safety boots/shoes and good quality protective clothing such as overalls.

Respiratory Protection

Because some surface coatings contain chemicals that vapourise during the curing process and are a health hazard (harmful if breathed over a period of time) respirators with special filter elements may be required. These are also to be used when painting in small spaces or enclosed spaces where ventilation is not good. Ordinary paper dust masks do not filter out the harmful chemical vapours.


Correct safety procedures

Make Sure it Fits

Two easy tests can indicate whether most respirators fit properly and do not leak.

Negative Pressure Test

- Block the air inlets (usually the filter openings on the sides of the face piece)
- Try to breathe in. If there are no leaks, the face piece should collapse slightly and not let any air in.

Positive Pressure Test

- Put on the face piece and adjust it to fit comfortably (snug, not overly tight).
- Block the exhalation valve (usually on the bottom of the respirator).
- Try to breathe out. The face piece should puff slightly away from your face but should not let air out.

Either test will readily detect any significant leaks. After readjusting the face piece, test again and repeat until fit is satisfactory.

- Test every time you put on a respirator and throughout the shift to make sure that you are being protected.
- Make sure that your respirator does not leak or slip. It must fit properly.
- Beards, long sideburns, and moustaches can prevent most respirators from fitting properly.
- With respirators its good practice to be clean-shaven, since even one day's growth of beard can significantly affect the protection provided.
- Missing dentures, scar tissue, and other facial features can also affect how well a respirator protects you.

To help with these and other problems, most manufacturers offer small, medium, and large face pieces, as well as full- and half-face versions.

CHAPTER ELEVEN
USE AND MAINTENANCE OF HAND AND POWER TOOLS

Nearly every task on a ship or yacht requires the use of tools, equipment and machinery. Most equipment and machinery will require the user to have specific training. In addition there will be a Ship's Safety Management System Handbook outlining safe practices, also national legislation and Safety Conventions as well as manufacturer's guidelines for equipment and materials. The COSWP has considerable information and guidelines for safe operations on board.

Guidelines also cover the disposal of waste materials, including how they should be safely stored until appropriate disposal in shore facilities can occur. There are requirements for logging these actions.

All equipment and most materials will have manufacturer guidelines and product data which should all be read and clearly understood before use. It should also be noted that non-compliance with manufacturer's guidelines may result in warranty waiver.

Hand Tools

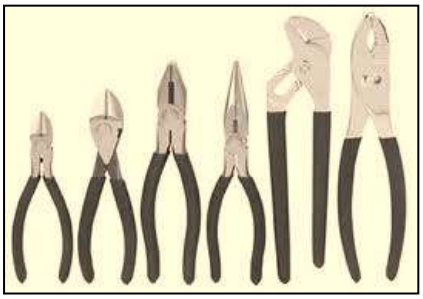
- Ensure that crew are properly trained in the safe use of hand tools.
- Use the right tool for the job. Substitutes increase the chance of having an accident.
- Correctly use each tool, and identify when tools need repair
- Use tools designed to allow wrist to stay straight. Avoid using hand tools with wrist bent.
- Use good quality tools.
- Keep tools in good condition at all times.
- Inspect tools for defects before use. Replace or repair defective tools.
- Keep cutting tools sharp and cover sharp edges with suitable covering to protect the tool and to prevent injuries from unintended contact.

- Replace cracked, splintered, or broken handles on files, hammers, screwdrivers, or sledges.
- Ensure that the handles of tools like hammers and axes fit tightly into the head of the tool.
- Replace worn jaws on wrenches, pipe tools and pliers.
- Repair burred or mushroomed heads of striking tools.
- Pull on a wrench or pliers; never push unless the tool is held with palm open.
- Point sharp tools (e.g., saws, chisels, knives) laying on benches away from aisles and handles should not extend over the edge of the bench top.
- Maintain tools carefully, clean and dry and stored properly after each use.
- Carry tools in a sturdy tool box to and from the worksite.
- Wear safety glasses or goggles, or a face shield (with safety glasses or goggles) and well-fitting gloves appropriate for the hazards which may occur when doing various tasks.
- Keep the work environment clean and tidy to avoid clutter which may cause accidents.
- Hang tools at your sides, not behind your back.
- Do not use tools for jobs they are not intended to do. For example, do not use a slot screw drivers as a chisel, pry bar, wedge or punch or wrenches as hammers.
- Do not apply excessive force or pressure on tools.
- Cut away from the body when using cutting tools.
- Do not hold the stock in the palm of your hand when using a cutting tool or a screwdriver.
- Do not wear bulky gloves to operate hand tools.
- Do not throw tools, hand them handle first, directly to others.
- Do not carry tools in a way that interferes with using both hands on a ladder, while climbing on a structure, or when doing any hazardous work. If working on a ladder or scaffold, tools should be raised and lowered using a bucket and hand line.
- Do not carry a sharp tools in your pocket.

Screwdrivers

- Most screwdrivers are not designed to be used on electrical equipment. Use an insulated screwdriver
- Do not hold an object in the palm of one hand and press a screwdriver into it, place it on a bench or a table
- Never hammer with a screwdriver
- Check for broken handles, bent blade, etc.

Pliers



- Do not use pliers as a substitute for hammers or wrenches
- Use insulated pliers when doing electrical work
- Inspect installation frequently to make certain that it is free of breaks or cracks.

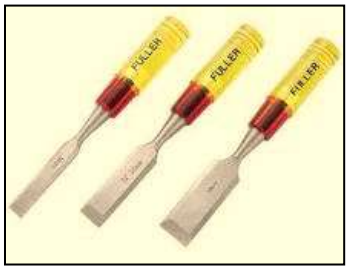
Hammers and Mallets

- Use the correct hammer for the type of work to be done
- Have an unobstructed swing when using a hammer and watch for overhead interference
- Check for defects before using.

Wrenches

- Select the correct size of wrench for the job
- Never use a pipe wrench as a wrench handle extension
- Too much leverage can ruin a tool and cause injury
- To avoid sudden slips, stand in a balanced position and always pull on the wrench instead of pushing against the fixed jaw.

Chisels



- Always wear safety goggles or a face shield when using a chisel
- Drive wood chisel outward and away from your body
- Do not use chisels to pry
- Keep edges sharp for most effective work and protect when not in use

Knives

- Always cut away from the body
- Keep hands and body clear of the knife stroke
- Keep blades sharp

Power Tools

Types of power tools include electric, pneumatic, liquid fuel, hydraulic and powder-actuated. Appropriate personal protective equipment such as safety goggles and gloves must be worn to protect against hazards that may be encountered while using power tools. The work area should be kept as clean and dry as possible.

Power tools must be fitted with guards and safety switches; they are extremely hazardous when used improperly, should only be used for the job they are designed for by competent and trained users.

General guidelines for the safe use of power tools include:

- Never carry a tool by the cord or hose.
- Never yank the cord or the hose to disconnect it from the receptacle.
- Keep cords and hoses away from heat, oil, and sharp edges.
- Disconnect tools when not using them, before servicing and cleaning them, and when changing accessories such as blades, bits, and cutters.
- Keep all people not involved with the work at a safe distance from the work area.
- Secure work with clamps or a vice, freeing both hands to operate the tool.
- Avoid accidental starting. Do not hold fingers on the switch button while carrying a plugged-in tool.
- Maintain tools with care; keep them sharp and clean for best performance.
- Follow instructions in the user's manual for lubricating and changing accessories.
- Be sure to keep good footing and maintain good balance when operating power tools.
- Wear proper apparel for the task. Loose clothing, ties, or jewellery can become caught in moving parts.
- Remove all damaged portable electric tools from use and tag them: "Do Not Use."

Guards

The exposed moving parts of power tools have manufacturer's safeguards, ie belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating, or moving parts. Guards, which must NOT be removed, are provided to protect the operator and others from the following:

- Point of operation and nip points.
- Rotating parts.
- Flying chips and sparks.

Electric Tools

Crew using electric tools must be aware of electrical burns and shocks. Electrical shocks, which can lead to injuries such as heart failure and burns, are among the major hazards associated with electric-powered tools. Under certain conditions, even a small amount of electric current can result in fibrillation of the heart and death. An electric shock also can cause the user to fall.

To protect against shock and burns, electric tools must have a three-wire cord with a ground and be plugged into a grounded receptacle, be double insulated, or be powered by a low-voltage

isolation transformer. Double-insulated tools are available that provide protection against electrical shock without third-wire grounding. On double-insulated tools, an internal layer of protective insulation completely isolates the external housing of the tool.

The following general practices should be followed when using electric tools:

- Operate electric tools within their design limitations.
- Use gloves and appropriate safety footwear when using electric tools.
- Store electric tools in a dry place when not in use.
- Do not use electric tools in damp or wet locations unless they are approved for that purpose.
- Keep work areas well lighted when operating electric tools.
- Ensure that cords from electric tools do not present a tripping hazard.

Electric Grinders and Cutters

These include grinding, cutting, polishing, and wire buffing wheels which may throw off flying fragments. All must be equipped with guards that cover the spindle end, nut, and flange projections and maintain proper alignment with the wheel.

Before using a disc it must be checked closely for damage. A stable and undamaged wheel, when tapped, will give a clear metallic tone or "ring." The spindle nut must be tightened enough to hold the wheel in place without distorting the flange. Always follow the manufacturer's recommendations. Take care to ensure that the spindle speed of the machine will not exceed the maximum operating speed marked on the wheel.

A disc may disintegrate during start-up and it is important to allow the tool to come up to operating speed prior to grinding or cutting.

When using a powered grinder:

- Always use eye or face protection.
- Turn off the power when not in use.
- Never clamp a hand-held grinder in a vice.

Pneumatic/ Air driven power Tools

Pneumatic tools are powered by compressed air and include chippers, drills, hammers, and sanders. There are several dangers which include being hit by one of the tool's attachments or by some kind of fastener the worker is using with the tool.

Pneumatic tools must be fastened securely to the air hose to prevent them from becoming disconnected. A short wire or positive locking device attaching the air hose to the tool must also be used and will serve as an added safeguard.

Precautions should be taken with an air hose as the hose is subject to damage by accidental impact by the tool itself and because it also presents tripping hazards.

When using pneumatic tools, a safety clip or retainer must be installed to prevent attachments such as chisels on a chipping hammer from being ejected during tool operation.

Pneumatic tools that shoot must be equipped with a special device to keep fasteners from being ejected, unless the muzzle is pressed against the work surface.

Airless spray guns that atomize paints and fluids must be equipped with automatic or visible manual safety devices that will prevent pulling the trigger until the safety device is manually released.

Eye protection and full PPE is required when using these tools. Also screens must also be set up to protect others from being struck by flying fragments around chippers, riveting guns, or air drills.

Compressed air guns should never be pointed toward anyone. A chip guard must be used when compressed air is used for cleaning.

Noise is another hazard associated with pneumatic tools. Working with noisy tools requires proper, effective use of appropriate hearing protection.

Hydraulic Power Tools

The fluid used in hydraulic power tools must be an approved fire-resistant fluid and must retain its operating characteristics at the most extreme temperatures to which it will be exposed.

The manufacturer's recommended safe operating pressure for hoses, valves, pipes, filters, and other fittings must not be exceeded.

All jacks - including lever and ratchet jacks, screw jacks, and hydraulic jacks - must have a stop indicator and the stop limit must not be exceeded. Also, the manufacturer's load limit must be permanently marked in a prominent place on the jack, and the load limit must not be exceeded.

CHAPTER TWELVE

Precautions for the Prevention of Pollution of the Marine Environment (MARPOL)

"In 2010 there was 8 million metric tons of plastic in the ocean, that equals 5 grocery bags filled with plastic for every foot of coastline in the world "

(Source: University of California)

At this rate there will be 155 million metric tons of plastic in the ocean by 2050.

All seafarers have a duty to consider the environment and now there are stringent international laws to try to mitigate further damage.

Marine Environmental Awareness Issues

Pollution stems from many sources, but there are two main areas of concern for the maritime industry: the operational type, covered by legislation such as MARPOL and individual States and local/regional laws, and that of general human impact, which is the individual's impact.

Marine pollution is the introduction of harmful substances or products into the world's oceans and also emissions in to the air by marine engines. The direct result of this pollution is harm to living resources, hazards to human health, hindrances to marine activities including tourism, shipping, fishing, impairment of the quality of sea water and reduction of amenities.

Only humans make products that nature cannot digest.

Three ways that the marine pollution impact the earth:

1. **Economic Impact from Pollution**

The direct result of pollution is harm to the economies of coastal and inland waters states and regions. The industries dependent on the marine environment include fisheries, coastal tourism and coastal urban development. The impact on an economy relying on these resources is significant on terms of income generated and jobs lost.

2. **Environmental Impact from Pollution**

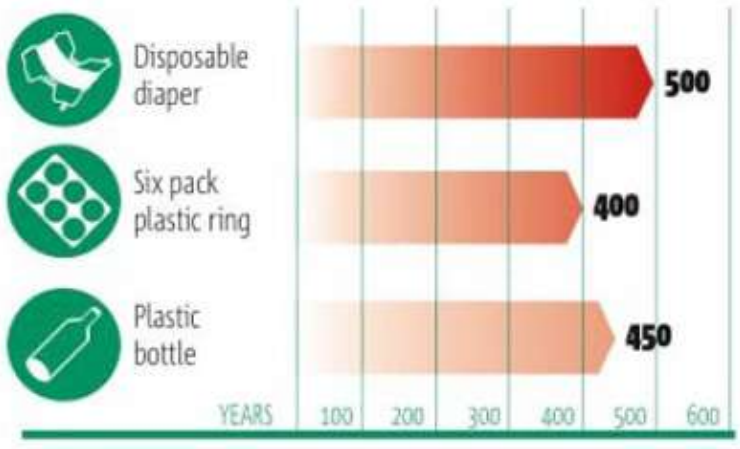
The environmental impact is hard to measure but there is evidence of significant harm to living marine life which may be hard to reverse. The ecosystem relies on a huge and balanced diversity, the alteration of which may lead to a chain reaction of resource loss due to changes in the food chain and loss of habitat.
Sea, rivers and lakes water quality can lead to significant harm to human health as well as the plant and animal life.

3. Climate Change

Potentially, the impact of climate change could put many thousands of miles of coastline and island states at risk. While the smoke and gas emissions from vessels may not seem high compared to other industries, construction and materials used all add to the pressure on the atmosphere.

Pollution Facts

- Approximately 80% of marine litter is land-based.
- In 2004, marine water samples contain 6 times more plastic than plankton, i.e. out of 7 kilos of water, 6 kilos were plastic and only 1 kilo was made up of plankton.
- Cruise ships release 95 000 m^3 of sewage from toilets and 5 420 000 m^3 of sewage from sinks, galleys and showers into the oceans each day.
- 250 000 kg of waste are removed from the North Sea yearly.
- 1 kg out of every 5 kg of plastic waste ends up in oceans.



Plastic never biodegrades, but with the sunlight it splits into ever and ever smaller pieces ("photo-degradation"), bits that are still plastic. The pieces get so small, that in the end they are ingested by over 180 known marine species, being mistaken for food and thus entering the food chain

The impact of invasive *marine* species from bilge and water tanks as well as from cargo/spaces is often irreversible.

Underwater noise affects sea life as it can confuse navigation systems of sea mammals. The noise produced by ships can travel long distances and marine species that may rely on sound for their orientation, communication and feeding, can be harmed by this sound pollution

Particularly in shallow and coastal/estuarine waters, the effects of bow waves and wash can have a considerable impact on the marine environment by disturbing seabed species, breeding and nesting areas and erosion of banks and coastline.

Protecting the Environment from Human Impact

It is very important to observe some fundamental rules which will reduce the impact by all water users on the environment:

- Make sure that the water is deep enough to navigate safely. Going aground in some parts of the world is a hazard, but it may also cause damage to the natural habitat.
- Avoid getting near shore and do not dock or beach a boat in reeds and grasses. This could damage fragile environments.
- Never operate a vessel in such a way to disturb, chase or harass wildlife.
- Avoid causing erosion by operating at low speed, specifically by not creating a large wake in power craft. Also operating in shallow water can suck in sand, mud and plant life damaging the engine and the environment.
- Take extra care when fuelling in or near the water because diesel, oil and gas/petrol spills are very detrimental to the aquatic environment. Spills, even small accidental spills, can attract a very high fine in some states.
- Observe the requirements for black and grey water disposal, use pump out facilities to dispose of the contents of holding tanks.
- Always take home any rubbish, garbage etc., especially plastics.

The two main types of pollution are **operational** and **accidental** and are recognised and are dealt with by international conventions as well as state and local legislation.

Operational Pollution

This includes:

- Oil, Including oil and related products carried as cargo, fuel and oily waste
- Chemicals, liquefied gases and other noxious liquid substances carried as cargo in bulk and chemical waste
- Dangerous goods carried in bulk and packaged form as well as other packaged and containerised goods that may be hazardous to the environment if spilled or lost
- Garbage, including bio and non-biodegradable waste
- Sewage.
- Cargo vapours emissions including their toxic effect on health, climate and plant life
- Exhaust emissions, including gases and unburnt hydrocarbon particles and their contribution to smog, acid rain and the greenhouse effect
- Ozone depleting substances, including CFCs and halon gases and their effect on global warming
- Noise levels from machinery
- Office-generated waste including waste paper, special waste and other consumables

- Ballast water including the possibility of aquatic organisms or water-borne pathogens being transported in ships' water ballast
- Anti-fouling paints and their effect on shellfish and other aquatic life

Accidental Pollution

Can occur when bunkering oils or fuel, vessel grounding, transporting of garbage between vessel or accidental release of sewage or oil due to human error and/or malfunctioning equipment. Accidental polluting is **not** an excuse and should be documented and recorded into the correct document and reported to all necessary authorities immediately

Ballast Water Management

The IMO has stated that while ballast water is essential for safe and efficient modern shipping operations, it may pose serious ecological, economic and health problems due to the multitude of marine species carried in ships' ballast water. These include bacteria, microbes, small invertebrates, eggs, cysts and larvae of various species. The transferred species may survive to establish a reproductive population in the host environment, becoming invasive, out-competing native species and multiplying into pest proportions.

The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) was adopted by consensus at IMO Headquarters in London on 13 February 2004. The BWM Convention requires that ballast water management systems used to comply with the Convention must be approved by the Administration taking into account the Guidelines for approval of ballast water management systems.

Anti-Fouling Systems Management
Under the terms of the IMO International Convention on the Control of Harmful Anti-fouling Systems on Ships, parties to the Convention are required to prohibit and/or restrict the use of harmful anti-fouling systems on ships, ports, shipyards or offshore terminals under their authority.

This has been added to by a requirement that bottom paint needs to act as a barrier for any pollutants that might leach from the hull treatment under the antifoul coat.

Hull Biofouling

The entry into force of the Ballast Water Convention will not prevent the transfer of invasive aquatic species (IAS) unless there is mandatory legislation in place to prevent biofouling on ships' hulls.

Hull biofouling could be more damaging than ballast water transfer as currently there is no legislation to prevent the transfer of IAS on ships' hulls though fouling.

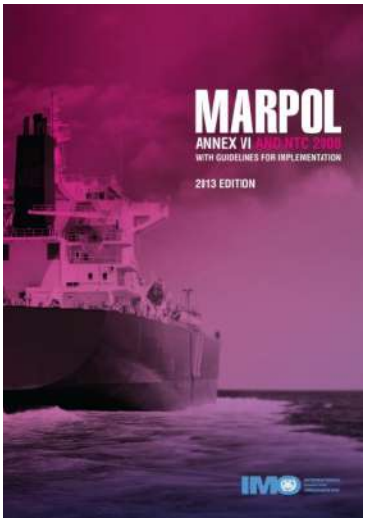
There have been a number of studies comparing the transfer of IAS through ballast with that transferred by hull fouling, with some studies concluding that hull fouling is more environmentally damaging than IAS relocated through ballasting operations.

A number of areas where hull biofouling was the primary factor for IAS:
In New Zealand, for example, biofouling was found to be responsible for 69% of IAS as opposed to just 3% from ballast water. In Port Phillip Bay, Australia, 78% of IAS reported was from ships' hulls with 20% from ballast water. In the North Sea it was 57% over 38% and in US waters, hull biofouling accounted for 36% of IAS compared to 20% from ballast water.

Research has concluded the only real answer to preventing the spread of IAS is by ensuring that ships sail with a clean hull from their point of origin. Only a non-toxic hard-type coating and regular in-water cleaning can achieve this. Indeed, many ports and harbours permit the in-water cleaning of this type of coating system. Effective biofouling control is also the most efficient way of reducing fuel consumption and greenhouse gas emissions

Marine Pollution Prevention Measures

International measures have been taken for prevention of marine pollution from ship operations is encapsulated in the **International Convention for the Prevention of Pollution from Ships - MARPOL 73/78 (Annexes I to VI**).



The Convention identifies six major ships sources of pollution and measures necessary to prevent pollution; petroleum oil, bulk chemicals, packaged chemicals, sewage, garbage and air pollution. The particular sources is set out in separate annexes.

MARPOL applies to all ships over 400 gt, but excludes warships and state owned ships generally. It must be noted that the provisions of MARPOL apply to **ALL VESSELS** of whatever size; however the requirement for documents and records may not apply.

Each Annex specifies the certificates and documents which ships must carry, associated surveys required and the rules for preventing pollution of the marine environment by the substances identified in that Annex as follows:

Annex I Petroleum Oil covers prevention of pollution by oil from operational measures as well as from accidental discharges; the 1992 amendments to Annex I made it mandatory for new oil tankers to have double hulls and brought in a phase-in schedule for existing tankers to fit double hulls, which was subsequently revised in 2001 and 2003.
Required Documents include:

- International Oil Pollution Prevention Certificate
- Oil Record Book
- Shipboard Oil Pollution Emergency Plan (SOPEP)

Bunkering

The taking on board of fuel or diesel oil requires utmost care and alertness to prevent any kind of fire accident or oil spill.

Pre-Bunkering Procedure

1. State of adjacent waters noted
2. Vessel properly secured to dock
3. Check supplier's product corresponds to ordered product
4. Agree quantity to be supplied
5. Check valves open
6. Day tanks full and supply valves closed
7. Warning signs in position e.g. No Smoking
8. SOPEP plan available
9. Clean up materials in place
10. Oil boom in place
11. Foam fire extinguisher placed at bunker station
12. Fuel transfer pumps off
13. Fuel tank supply valves open
14. Agree stop/start signals between vessel and barge/truck
15. Bravo flag flying/red light showing
16. Agree pumping/transfer rate
17. Agree emergency shut down procedure
18. Specification sheet received
19. Check hose and couplings are secure and in good order
20. Plug scuppers
21. Fuel nozzle and hose secured to vessel
22. Check barge/truck meter readings
23. Check on board meter readings
24. Bunker valve open
25. Unused manifold connections blanked off
26. Master informed
27. Signal pumping to commence

During Bunkering Procedure

1. Witness taking and sealing of 2 representative product samples
2. Monitor fuel connections for leaks fuel flow and control tank levels
3. Changeover of tanks whenever necessary
4. Checking the rate at which bunkers are received
5. Checking the tightness/slackness of mooring lines
6. Checking trim/list of the bunker barge & the ship
7. Continuous monitoring/look outs for the vessel's position (when at anchor)

Post Bunkering Procedure

1. Bunker valve closed
2. Disconnect hose (drain before disconnecting)
3. Check barge/truck meter reading
4. Check ship's meter reading
5. Sign Bunker Delivery Receipt BDR No: (Bunker Delivery Report/Note)
6. Retain BDR with product sample
7. SOPEP plan returned to bridge
8. Clean up gear stowed, oil boom returned
9. Bravo flag stowed/red light switched off
10. Remove and pack away warning/safety signs
11. Foam fire extinguisher placed back in correct location
12. Complete Oil Record Book
13. Master informed of completion
14. Confirm in Oil Record Book Bunkering checklist completed

Annex II Bulk Chemicals as Cargo details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk; some 250 substances were evaluated and included in the list appended to the Convention; the discharge of their residues is allowed only to reception facilities until certain concentrations and conditions (which vary with the category of substances) are complied with.

In any case, no discharge of residues containing noxious substances is permitted within 12 miles of the nearest land.

Annex III Packaged Chemicals as Cargo contains the general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications.
For the purpose of this Annex, "harmful substances" are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code) or which meet the criteria in the Appendix of Annex III.

Annex IV Ship's Sewage contains requirements to control pollution of the sea by sewage; the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or when the ship is discharging comminuted and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land; sewage which is not comminuted or disinfected has to be discharged at a distance of more than 12 nautical miles from the nearest land.

Sewage systems

Annex V Ship's Garbage deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of; the most important feature of the Annex is the complete ban imposed on the disposal into the sea of all forms of plastics.

Required documents include a Garbage Management Plan the format of which must be approved by the Flag State and include provisions of collecting, sorting, storage and approved disposal:

1. Garbage minimization
2. Garbage collection
3. Garbage storage
4. Garbage processing
5. Garbage disposal
6. Equipment used on board for handling of garbage
7. The designation of the person in charge for implementing the Garbage Management Plan:

    - All refuse will be collected, processed and disposed of properly on a daily basis.
    - All refuse will be contained in plastic bags and stored in a designated area.
    - Galley personnel hand are responsible for refuse generated by the galley.
    - Engineering personnel are responsible refuge generated by the engine spaces.
    - A.B. and/or O.S. will be responsible for refuse from all other areas of the vessel.
    - Master to ensure that all stored refuse is removed from the vessel promptly and properly deposited into an approved port or terminal facility.
    - All garbage will be handled and disposed of in accordance to the regulations posted

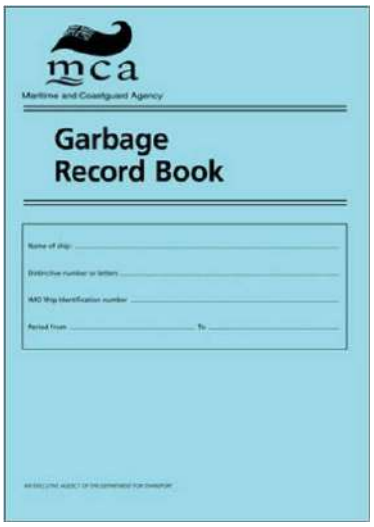
Every MCA registered vessel of 100GT and above, and every ship which is certified to carry 15 persons or more, should carry a garbage management plan.

The revised Annex V prohibits the discharge of all garbage into the sea, except as provided.

Type of garbage	Ships outside special areas	Ships within special areas	Offshore platforms (more than 12 nm from land) and all ships within 500 m of such platforms
Food waste comminuted or ground	**Discharge permitted** ≥3 nm from the nearest land, en route and as far as practicable	**Discharge permitted** ≥12 nm from the nearest land, en route and as far as practicable	**Discharge permitted**
Food waste not comminuted or ground	**Discharge permitted** ≥12 nm from the nearest land, en route and as far as practicable	**Discharge prohibited**	**Discharge prohibited**
Cargo residues[1] not contained in wash water	**Discharge permitted** ≥12 nm from the nearest land, en route and as far as practicable	**Discharge prohibited**	**Discharge prohibited**
Cargo residues[1] contained in wash water		**Discharge permitted** ≥12 nm from the nearest land, en route, as far as practicable and subject to two additional conditions[2]	**Discharge prohibited**
Cleaning agents and additives[1] contained in cargo hold wash water	**Discharge permitted**	**Discharge permitted** ≥12 nm from the nearest land, en route, as far as practicable and subject to two additional conditions[2]	**Discharge prohibited**
Cleaning agents and additives[1] in deck and external surfaces wash water		**Discharge permitted**	**Discharge prohibited**
Carcasses of animals carried on board as cargo and which died during the voyage	**Discharge permitted** as far from the nearest land as possible and en route	**Discharge prohibited**	**Discharge prohibited**
All other garbage including plastics, synthetic ropes, fishing gear, plastic garbage bags, incinerator ashes, clinkers, cooking oil, floating dunnage, lining and packing materials, paper, rags, glass, metal, bottles, crockery and similar refuse	**Discharge prohibited**	**Discharge prohibited**	**Discharge prohibited**
Mixed garbage	When garbage is mixed with or contaminated by other substances prohibited from discharge or having different discharge requirements, the more stringent requirements shall apply		

Garbage Record Book

The garbage is to be grouped into categories for the record book as follows:



A. Plastics
B. Food wastes
C. Domestic wastes (e.g. paper products, rags, glass, metal, bottles, crockery, etc.)
D. Cooking oil
E. Incinerator ashes
F. Operational wastes
G. Cargo residues
H. Animal carcass(es)
I. Fishing gear

Entries in the Garbage Record Book – To be made on each of the following occasions:

1) When garbage is discharged to a reception facility ashore or to other ships:

1. Date and time of discharge
2. Port or facility, or name of ship
3. Categories of garbage discharged
4. Estimated amount discharged for each category in cubic metres
5. Signature of officer in charge of the operation

2) When garbage is incinerated:

1. Date and time of start and stop of incineration
2. Position of the ship (latitude and longitude) at the start and stop of incineration
3. Categories of garbage incinerated
4. Estimated amount incinerated in cubic metres
5. Signature of the officer in charge of the operation

Date/ Time	Position of the Ship/ Remarks (e.g., accidental loss)	Category	Estimated Amount Discharged or Incinerated	To Sea	To Reception Facility	Incineration	Certification/ Signature

3) When garbage is discharged into the sea in accordance with regulations 4, 5 or 6 of Annex V of MARPOL:

    1. Date and time of discharge
    2. Position of the ship (latitude and longitude). Note: for cargo residue discharges, include discharge start and stop positions.
    3. Category of garbage discharged
    4. Estimated amount discharged for each category in cubic metres
    5. Signature of the officer in charge of the operation

4) Accidental or other exceptional discharges or loss of garbage into the sea, including in accordance with regulation 7 of Annex V of MARPOL:

    1. Date and time of occurrence
    2. Port or position of the ship at time of occurrence (latitude, longitude and water depth if known)
    3. Categories of garbage discharged or lost
    4. Estimated amount for each category in cubic metres
    5. The reason for the discharge or loss and general remarks

The ship's master should obtain from the operator of the reception facilities, which includes barges and trucks, a receipt or certificate specifying the estimated amount of garbage transferred. The receipts or certificates must be kept together with the Garbage Record Book.

INTERNATIONAL POLLUTION REGULATIONS

MARPOL CONVENTION ANNEX V

DISCHARGE OF GARBAGE INTO THE SEA IS

PROHIBITED

Garbage should be retained on board for discharge at port reception facilities or other services.
Violation of these requirements may result in penalties

Discharge of the following garbage is only permitted while the ship is 'en route' and as far as practicable from the nearest land.

FOOD WASTE COMMINUTED through equipment with particle size no greater than 25mm*	More than 3nm from nearest land
FOOD WASTE that has not been processed	More than 12 nm from nearest land
CARGO RESIDUES not harmful to the marine environment*	
CLEANING AGENTS/ADDITIVES from cargo hold, deck and external surfaces washing water, *not harmful to the marine environment*	
ANIMAL CARCASSES	As far from the nearest land as possible
SPECIAL AREAS including ANTARCTIC AREA Additional restrictions apply. Refer to MARPOL Annex V	FOOD WASTE COMMUNITED - More than 12 nm from nearest land or ice shelf Discharge of introduced avian products PROHIBITED in Antarctic Area unless incinerated, autoclaved or otherwise treated to be made sterile.

Garbage can be incinerated in equipment complying with MARPOL Annexes V and VI.
All discharges must be recorded in the Garbage Record Book.
All Seafarers must follow procedures for handling garbage in accordance with the Garbage Management Plan.
Note: Cooking oil is not considered food waste and cannot be discharged into the sea.
*Refer to MARPOL Annex V and guidelines for definition of 'nearest land', guidance on the discharge of animal carcasses and substances harmful to the marine environment.
NOTE: All waste on board a ship entering Australian waters is classified as Biosecurity Risk Material (BRM) and must not be discharged of into the sea within the 12nm limit.

International Garbage Placard, required to be carried by all vessels

Amount of Garbage

The amount of garbage on board should be estimated in cubic metres, if possible separately according to category. The Garbage Record Book contains many references to estimated amount of garbage. It is recognized that the accuracy of estimating amounts of garbage is left to interpretation. Volume estimates will differ before and after processing. Some processing procedures may not allow for a usable estimate of volume, e.g., the continuous processing of food waste. Such factors should be taken into consideration when making and interpreting entries made in a record.

Annex VI Air Pollution from Ships sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances; designated emission control areas set more stringent standards for SOx, NOx and particulate matter.

Exhaust fumes

Special Areas are identified in MARPOL as areas where, for ecological reasons, the IMO has recognized the need for special measures to reduce or restrict disposal of the various Annex substances. The selection in the Convention may be because of one or more of the following:

a. The area is environmentally sensitive
b. There is a lack of movement of water
c. High traffic volume
d. An area of dense population.

Each Annex specifies different areas and not all the signatories recognize all of these areas.
As with other Conventions, each flag state has limited freedom as to how it will give effect to the Convention requirements.

Some Special Areas are:

Wider Caribbean area	Antarctic Area	Mediterranean Sea
Baltic Sea	Black Sea	Red Sea
North Seas		

Shipboard Oil Pollution Emergency Plan (SOPEP)

At the bunker manifold and wherever necessary, as per the ships SOPEP plan, the SOPEP equipment should be kept in immediate readiness in order to avoid oil spill/pollution during bunkering operation.

The SOPEP equipment in readiness should include:

1. Absorbent boom
2. Absorbent pads, rolls, granules and other absorbent materials
3. Brooms, shovels, mops and scoops
4. Empty receptacles (200 litres capacity) and plastic bags
5. Portable air driven pumps
6. Approved oil spill dispersants

These items must be stowed in an easily accessible locker, clearly marked, and are to be brought on deck ready for immediate use prior to all oil transfer operations.

Standard SOPEP spill kit

In the event of a spill the following actions should be taken:

1. Sound the emergency alarm.
2. Initiate emergency shutdown, stop all transfer and bunkering operations, close all valves and inform the barge or terminal.
3. Inform the master and initiate the emergency response procedures.
4. Inform the port or local state authority.
5. Identify the source of spill or leak and initiate measures to stop or minimize the overflow.
6. Drain or transfer the oil from affected area of the pipeline into empty tanks taking into account stress and stability of the vessel at all times.
7. If there is a possibility of release of flammable vapours or its entry to the accommodation, engine room or cargo holds, ventilation to these areas must be shut off.
8. Clean up operations must be started using the equipment available on board.
9. All spilled oil that is collected must be carefully stored on board till it can safely be disposed of.
10. No chemical or dispersant to be used if there is a possibility of them going into the water unless prior permission has been obtained from the port authority.
11. Oil gone overboard should be contained so that it will not spread and oil dispersants to be used after getting permission from local authorities.
12. After the spill has been completely brought under control, oil spilled overboard and on board ship has been removed and the cause of spill ascertained and corrective actions taken, the vessel can resume bunkering operation.
13. The chances of recurrences must be completely eliminated before starting bunkering.
14. Before resuming bunkering, permission from port or local authorities must be given.
15. All incidents and corresponding actions to be recorded as it may be required for future litigation purposes.

Approved Methods for Disposal of Marine Pollutants

MARPOL and the International Maritime Dangerous Goods Code (IMDG) cover the approved methods for disposal of pollutants. Nearly all are now required to be processed through shore facilities or through Ship board treatment such as Garbage Incinerators and Sewage Treatment Plants. Bilge water has to be passed through Oily Water Separators and the vessel must be outside Special Areas and moving at a minimum speed to pump overboard.

Leakage and spillage is now probably the most likely pollution issue for all vessels that are correctly operated.

Drills should be in place for all types of substance and include correct PPE for hazardous and noxious items. Actions to be taken will depend upon the material spilled and all dangerous products will have instructions on them on how to deal with spill, fire escape etc.

CHAPTER THIRTEEN
PILOT LADDERS AND PORTABLE LADDERS

Pilot Ladders

The pilot vessel will contact the ship on VHF 12 as it approaches and advise of any special requirements for safe boarding. If the vessels freeboard at the pilot ladder is less than nine metres then a standard IMO regulation ladder should be rigged with the bottom rung 2 metres above the water together with two regulation man-ropes (Manilla) rigged at the same height. A heaving line should be available for the pilot's bag and equipment. All equipment must be clean and in sound order and condition and used solely for the embarkation and disembarkation of personnel.

If the freeboard is in excess of 9 metres then an approved "combination" ladder must be provided. The lower platform of the combination should not be less than 5 metres above the sea level to prevent the pilot vessel from striking the metal parts in the prevailing conditions.
Mechanical pilot hoists are not acceptable.

A speed of 6–8 knots should be maintained together with a good lee and the master should be sure to maintain good sea-room to avoid other traffic during pilot embarkation. In heavy weather it may be necessary for the vessel to steam in a circle to enable sufficient lee for the pilot vessel to approach.

Pilot boarding vessel

Pilot climbing ladder

Transfer Arrangements

Safe and convenient access to, and egress from, the ship shall be provided by either:

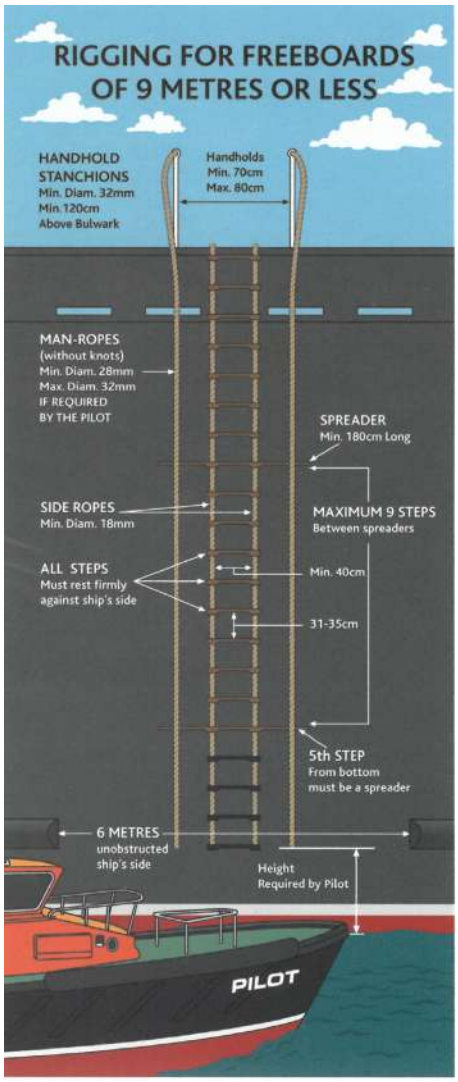
1) A pilot ladder requiring a climb of not less than 1.5 m and not more than 9 m above the surface of the water so positioned and secured that:

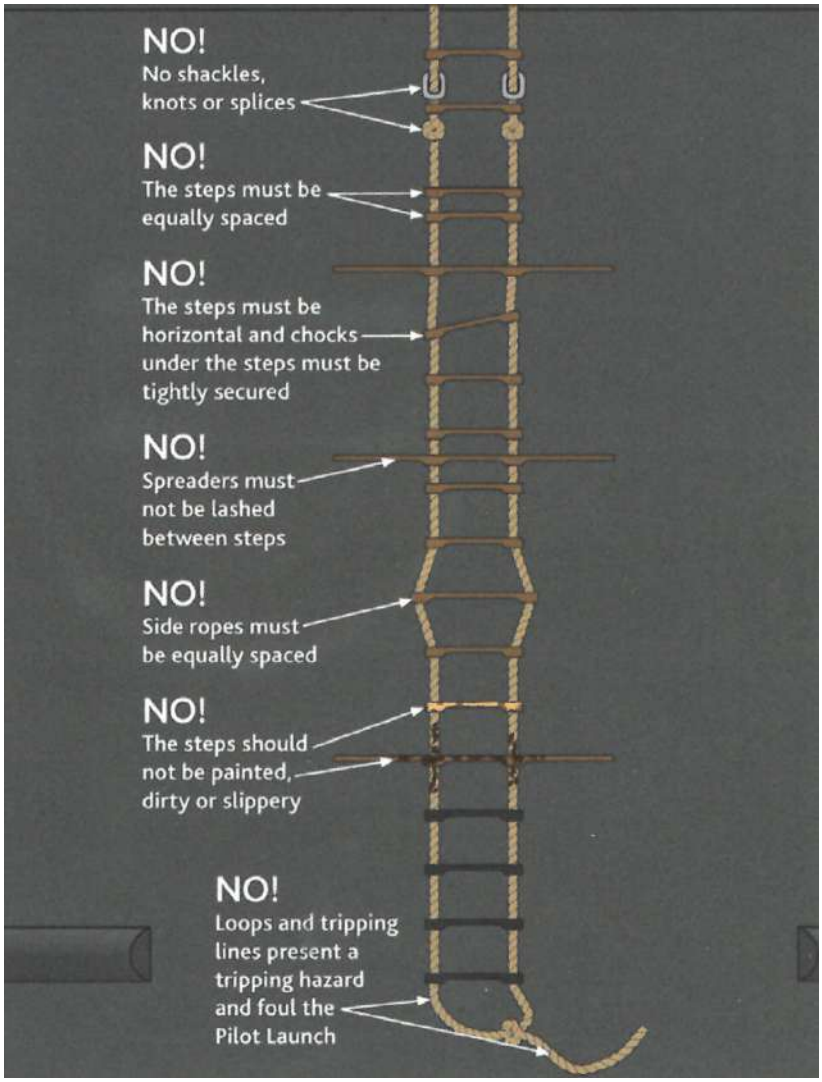
    - It is clear of any possible discharges from the ship;
    - It is within the parallel body length of the ship and, as far as is practicable, within the mid-ship half length of the ship;
    - Each step rests firmly against the ship's side; where constructional features, such as rubbing bands, would prevent the implementation of this provision, special arrangements shall, to the satisfaction of the Administration, be made to ensure that persons are able to embark and disembark safely;
    - The single length of pilot ladder is capable of reaching the water from the point of access to, or egress from, the ship and due allowance is made for all conditions of loading and trim of the ship, and for an adverse list of 15°; the securing strong point, shackles and securing ropes shall be at least as strong as the side ropes;

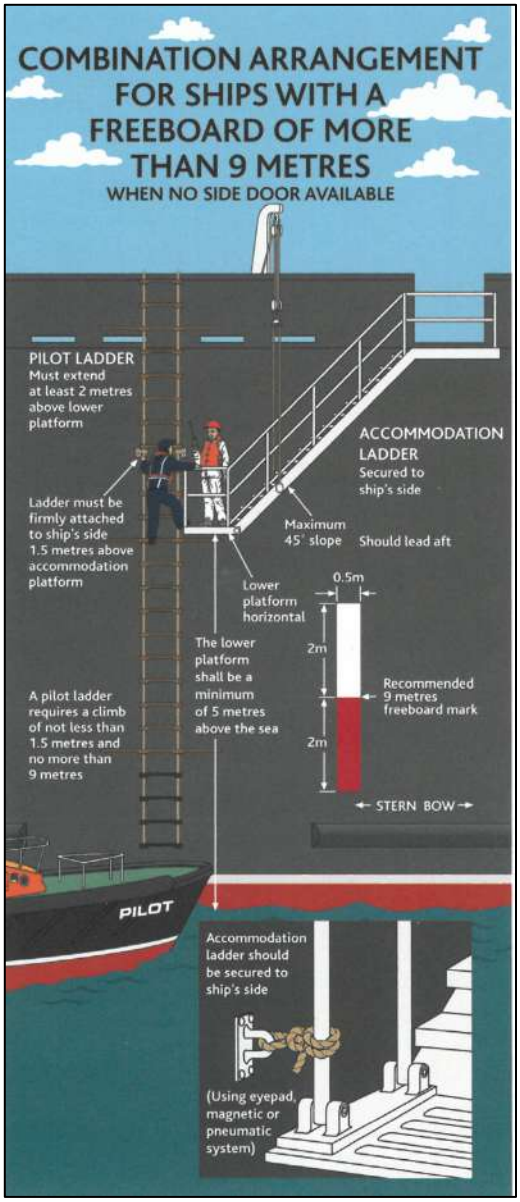
2) An accommodation ladder in conjunction with the pilot ladder (i.e. a combination arrangement), or other equally safe and convenient means, whenever the distance from the surface of the water to the point of access to the ship is more than 9 m. The accommodation ladder shall be sited leading aft. When in use, means shall be provided to secure the lower platform of the accommodation ladder to the ship's side, so as to ensure that the lower end of the accommodation ladder and the lower platform are held firmly against the ship's side within the parallel body length of the ship and, as far as is practicable, within the mid-ship half length and clear of all discharges.

Combination ladder setup

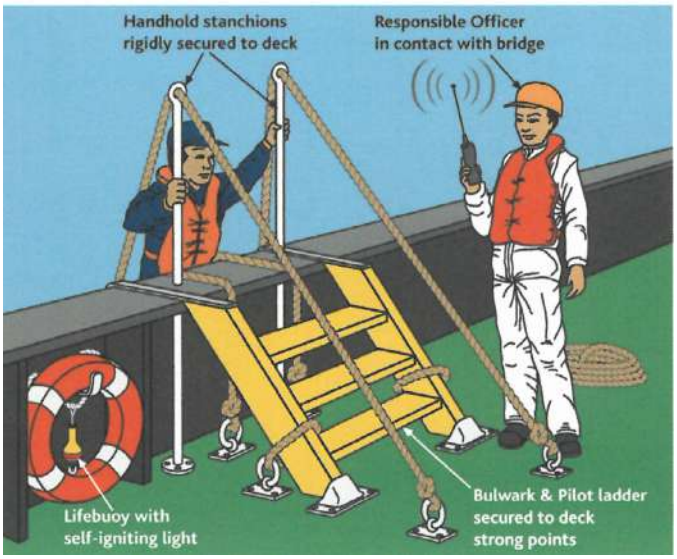
When a combination arrangement is used for pilot access, means shall be provided to secure the pilot ladder and manropes to the ship's side at a point of nominally 1.5m above the bottom platform of the accommodation ladder. In the case of a combination arrangement using an accommodation ladder with a trapdoor in the bottom platform (i.e. embarkation platform), the pilot ladder and man ropes shall be rigged through the trapdoor extending above the platform to the height of the handrail



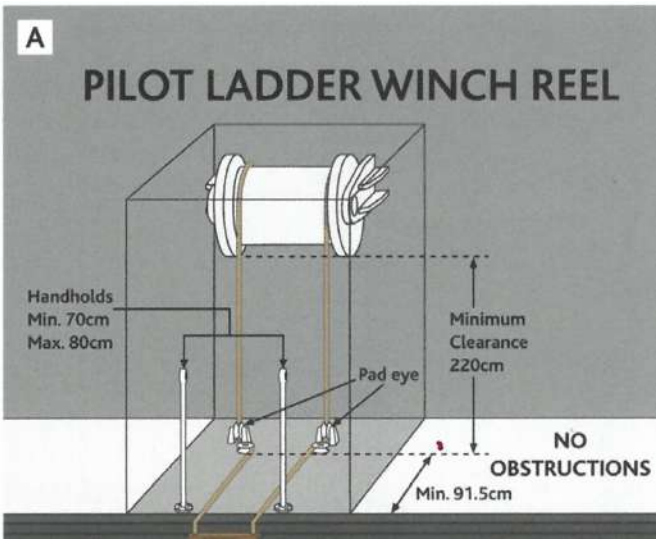




More than 9 m freeboard



Access to ships deck



Pilot ladder winch

Access to the Ship's Deck

Means shall be provided to ensure safe, convenient and unobstructed passage for any person embarking on, or disembarking from, the ship between the head of the pilot ladder, or of any accommodation ladder or other appliance, and the ship's deck. Where such passage is by means of

- A gateway in the rails or bulwark. Adequate handholds shall be provided;
- A bulwark ladder, two handhold stanchions rigidly secured to the ship's structure at or near their bases and at higher points shall be fitted. The bulwark ladder shall be securely attached to the ship to prevent overturning.
- Shipside doors used for pilot transfer shall not open outwards.

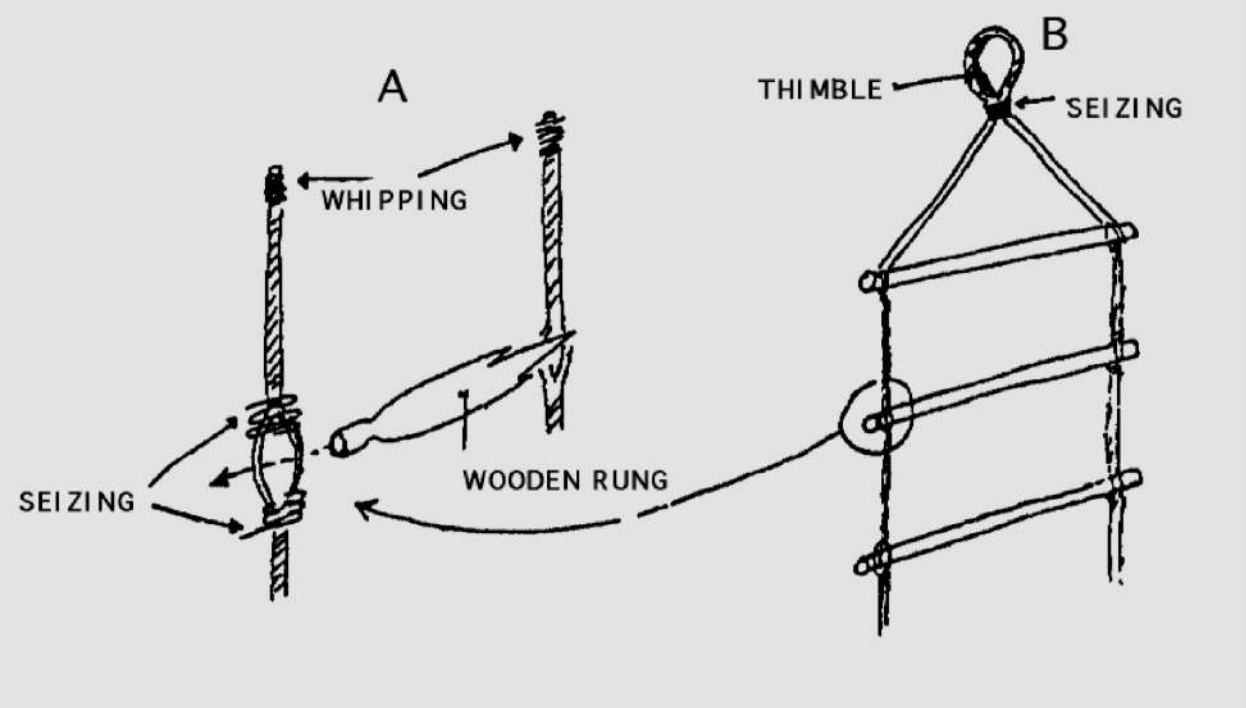
The following associated equipment shall be kept at hand ready for immediate use when persons are being transferred;

- Two man-ropes of not less than 28 mm and not more than 32 mm in diameter properly secured to the ship if required by the pilot
- A lifebuoy equipped with a self-igniting light
- A heaving line

Adequate lighting shall be provided to illuminate the transfer arrangements over side, the position on deck where a person embarks or disembarks.

Portable Jacobs Ladders

Rope ladders/side ladders are used to access stages over the vessels side, over hatch coamings to access parts of a hold etc. They are light and handy ladders easily carried around the decks. The top of the ladder can be left with the rope ends whipped or a thimble can be used. This enables it to be shackled to a boom if necessary.



Jacobs Ladder Stowed

Rigged Jacobs Ladder

CHAPTER FOURTEEN
ROPES, KNOTS, ROPE WORK AND CARE

Rope Manufacture

Rope manufacture starts with individual fibres. They are twisted into 'yarns' or 'threads' which are subsequently twisted into strands. The strands are then twisted into the finished rope. The direction of twist is alternated at each stage to prevent the finished rope from unwinding itself.

A vintage machine for making laid rope

The angle of twist will impart certain properties to a finished rope. A rope that is twisted at an angle that produces the optimum in strength, pliability, elasticity and water absorption is known as 'standard lay'.

A rope twisted at an angle of less than normal is said to have 'soft or long lay'. A rope made in such a manner will have slightly increased breaking strain and will be more pliable and easier to handle. But, the elasticity will be reduced and more water will be absorbed. The rope may also lose its shape.

A rope twisted at an angle greater than normal is said to have a 'hard or short lay'. A rope made in this manner will have greater elasticity and should retain its shape when under load. It will absorb less water but loose some pliability and have a reduced breaking strain.

Finished ropes in use at sea have mostly a right handed lay although there are exceptions, the most notable being the hand lead line.

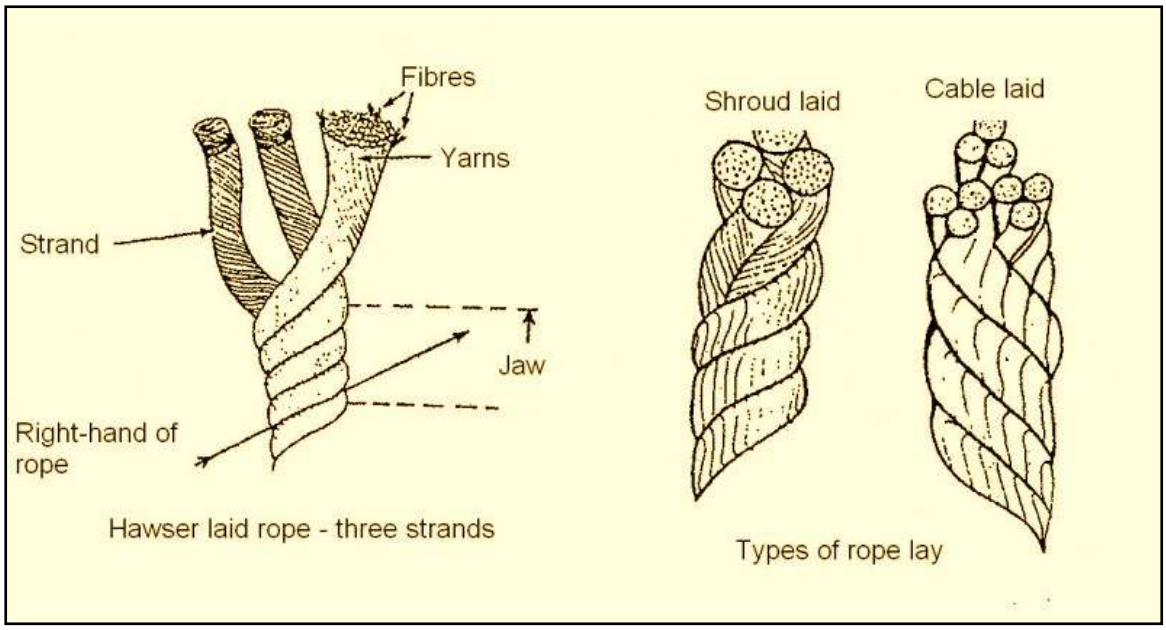
The process of manufacture entails combing a selected fibre into long ribbons which are twisted up into yarns. These yarns are then twisted into strands, three or four of the latter being finally laid up into the finished rope.

Styles of Rope Construction or Lays

Hawser laid rope is rope that is three stranded right or left handed. Rope manufacturers prefer to use the term 'plain lay' to avoid confusion with 'cable laid' rope.

Shroud laid rope is rope that is four stranded laid right or left handed around a central core.

Cable laid rope consists of three hawser laid ropes twisted together to form a single rope. Its advantages over hawser laid rope are its elasticity, pliability and resistance to water absorption. Its breaking strain is less than hawser or cable laid rope of a similar diameter. Cable laid ropes are normally left handed because of the requirement to alternate the direction of the twist, although they may be right handed



Shroud and Cable lay ropes

Braided rope consists of a braided (tubular) jacket over strands of fibre (these may also be braided). Some forms of braided rope with untwisted cores have a particular advantage; they do not impart an additional twisting force when they are stressed. The lack of added twisting forces is an advantage when a load is freely suspended making these ropes ideal for blocks, pulleys, winches, mooring lines, general tie-downs and other similar uses. Braided ropes are generally made from synthetic fibres and have no *lay* (or inherent twist) and uncoil better if each alternate loop is twisted in the opposite direction, such as in figure-eight coils, where the twist reverses regularly and essentially cancels out loop is twisted in the opposite direction

A rope braiding machine

Single braid rope consists of an even number of strands, eight or twelve being typical, braided into a circular pattern with half of the strands going clockwise and the other half going anticlockwise.

Double braid rope, also called braid on braid, consists of an inner braid sheathed in an outer braid that may be of the same or different material. Often the inner braid fibre is chosen for strength while the outer braid fibre is chosen for resistance to abrasion, UV rays etc. In solid braid, the strands all travel the same direction, clockwise or anticlockwise, and alternate between forming the outside of the rope and the interior of the rope. This construction is popular for general purpose utility rope but rare in specialized high performance line.

Plaited rope is made by braiding twisted strands, and is also called *square braid*. It is not as round as twisted rope and coarser to the touch. It is less prone to kinking than twisted rope and, depending on the material, very flexible and therefore easy to handle and knot.

Plaited rope

Brait rope is a combination of braided and plaited, a non-rotating alternative to laid three-strand ropes. Due to its excellent energy-absorption characteristics, it is often used for anchoring and can be used as mooring warps.

Natural and Synthetic Fibres

It is likely that the earliest "ropes" were naturally-occurring lengths of plant fibre, such as vines, followed soon by the first attempts at twisting and braiding these strands together to form ropes. Rope was made from the fibres of date palms, flax, grass, papyrus, leather or animal hair, Hemp fibres having been used in China since about 2 000 BC.

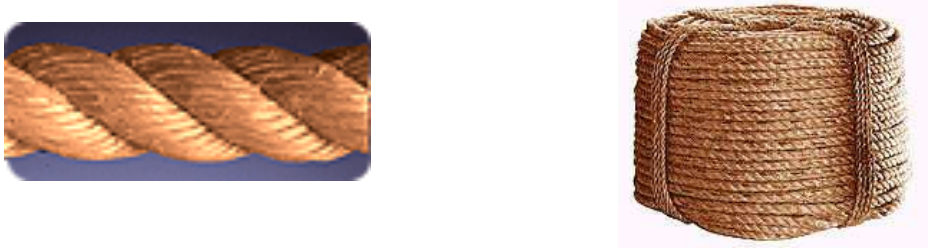
Natural fibres are generally resistant to UV degradation and they do not melt. However, they are very susceptible to rot because they absorb water which causes them to swell when wet and they do not float. They are also vulnerable to chemicals and are scarce because the supply of plant fibre depends almost entirely on the whether or not crops have been planted.

Man-made synthetics on the other hand are susceptible to UV light but virtually rot proof and, because they are manufactured and mostly by-products of the petroleum industry, supply is virtually unlimited.

Some rope is still made from natural fibres despite the dominance of synthetic fibres since the 1950s and indeed in some applications, such as man-ropes, natural fibre ropes are a necessity.

Natural Fibres

Manila rope is obtained from the Abaca plant that grows chiefly in the Philippines. It is the strongest of all natural fibre ropes. It is golden brown in colour and pliable to use. It is mainly used where safety is of the essence e.g. pilot ladders. Manila has a poor resistance to some acids, bleaches, detergents and some solvents.



Manila rope

Sisal is obtained from plants belonging to the cactus family. It is not as strong as manila. It has a pale or white appearance and is 'hairy' and rough to touch. It is a general purpose rope. It absorbs water very quickly and swells more than manila although it can be treated with waterproofing chemicals. Its resistance characteristics are similar to those of to manila.

Coir is the fibre of the coconut. It is very elastic, red in colour, rough to handle, floats very easily, and is extremely resistant to sea water rotting. It is often called grass or bass line. It is about one half the weight of manila and roughly one sixth as strong. As a cable laid rope, coir will stretch between 60 and 100%. As a three or four stranded rope, its elasticity is about 45%.

Hemp is mainly used for the cores of wire ropes. It generally has strength one fifth greater that top-grade manila. It however has been superseded by manila and is now found as sea as boltrope, small cordage and high-grade twine. The advantage of hemp rope is that it is impervious to water and does not shrink or swell when wet.

Synthetic Fibre Rope

Polypropylene is the most economical and lightest synthetic fibre, 60% stronger than Manilla. It stretches 40%, absorbs only 0.1% water and melts at 165°C. An advantage of this rope is that it floats and is used extensively for mooring lines. It has high resistance to chemicals.

Polythene absorbs only 0.01% of water and will float almost indefinitely. It is unaffected by most industrial chemicals and microorganisms. It offers good resistance to sunlight and abrasion. As a rope its strength lies midway between manila and nylon.

Polyester is heavy compared to, but not as strong as, nylon. It is more resistant to acids, oils and organic solvents than its nylon counterpart, while its strength remains the same whether in a dry or wet condition. It will not float. Splices must have four full tucks and may draw more easily that with a natural fibre rope when under stress. It should be surged on drum ends. The melting point is between 230° and 250°C.

Nylon is a generic name for a family of synthetic polymers that can be melt-processed into fibres. It is among the strongest of the man-made fibres, has good elasticity, stretching up to 30%, and is widely used when great stress is expected and shock loads need to be absorbed such as in the case of mooring lines. Nylon ropes are light to handle, impervious to water, have a high melting

Nylon rope

point of 250°C, do not float and in cold climates they tend to stiffen up and become difficult to handle. They should not be left exposed to strong sunlight or excessive heat. They are difficult to render on a set of bitts, and should never be allowed to surge. When nylon rope parts, no audible warning is given.

High Modulus Polyamide (Aramid) fibres are heat-resistant and very strong, sold under trademarks such as **Kevlar**, **Twaron** and **Technora**. Probably best known for their use in body armour fabric, Aramid fibre ropes are also used in the heaviest marine applications, e.g. 156 mm diameter Technora with a breaking strain of around 1 300 tons.

They are unaffected by water, exhibit some creep under continuous load and are about three times stronger than Nylon or polyester of the same weight. Typical elongation is about 1.2% at 30% of breaking strain. Melting cannot be used to fuse the ends and the rope sinks in water.

High Modulus Polyethylene (HMPE) rope is sold under the brand names **Spectra** and **Dyneema** and the fibres are tough with excellent abrasion resistance and slippery having a very low coefficient of friction, but kinking or compression damages them relatively easily.

Their melting point is relatively low (144 to 152°C) and operating temperatures should not exceed the boiling point for water, they are very resistant to water, moisture, most chemicals, and UV radiation, retaining 60% of their breaking strain after five years. Ropes are typically 40% stronger than Aramid fibres of the same weight and HMPE ropes float in water.
HMPE fibres dislike compression and kinking and sharp angles and knots can weaken the rope by 70% to a mere 30% of its breaking strain and usually trusted knots slip undone easily at loads as low as 15% of the breaking strength.
Suitable swaging can create secure eye splices that achieve 90 - 95% of the rope's breaking strength but when a knot must be tied it should be stitched for security. Some knots work better than others: the Double Fisherman's or, even better, the Triple Fisherman's, can be used to join two ropes and the Buntline Hitch makes a secure attachment to a sail or shackle.

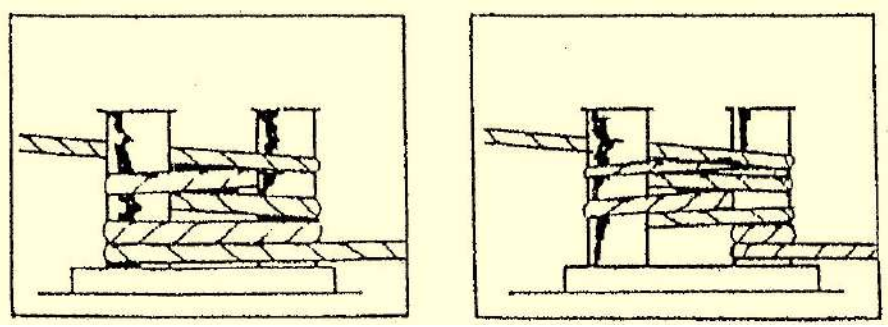
High Modulus Polyester (LCAP - Liquid Crystal Aromatic Polyester) is sold as **Vectran** and is somewhat similar to Aramid rope but has a high melting point. Vectran exhibits no creep even at high temperatures loaded to 50% of its breaking strain. It tolerates kinks, bends, and knots better than the HMPE ropes and exhibits good knot holding properties.

Melting point is 330°C, LCAP fibres are very resistant to water but poorly resistant to ultra-violet radiation. Typical elongation is about 0.77% at 30% of breaking strain and LCAP ropes sink in water.

Poly-p-phenylenebenzobisoxazole (PBO) is sold under the name **Zylon**. It is expensive and degraded by light - even artificial light - so, it requires a sheath e.g. polyester. PBO carbonizes before it melts. It has good resistance to most chemicals and to UV-light and sinks in water.

Synthetic Fibre Rope Precautions

1. Rope should be carefully inspected both internally and externally before use. Man-made fibre ropes show deterioration after excessive wear by high degree of powdering the strands.
2. Ropes should be kept out of direct sunlight. When not in use they should be covered by canvas or other shield or stowed away.
3. When putting a splice in a synthetic fibre rope, use four full tucks followed by two tapered tucks.
4. A stopper should be of the same material as that of the rope being stoppered off and should preferably be of the "West Country" type.
5. A minimum number of turns should be used when leaving man-made fibre ropes about winch barrels or capstans. Friction-generated heat should be avoided, and to this end not more than three turns should be used on drums.
6. Never surge man-made fibre rope on winch drums.
7. When making fast to bitts, make two round turns about the leading post, or two turns about both posts, before figure-eight. See figure below.



Making fast to Bitts

Care of Rope

The common causes of rope failure are:

- Excessive abrasion
- Cutting on a sharp object
- Exposure to sulphur dioxide fumigation gas
- Bad storage with inadequate ventilation, particularly in the case of ropes stored away in a wet condition.

Careful inspection of the rope – shows wear/tear and rope damage

Examine all ropes regularly and frequently for chafe, cutting, internal wear, deterioration of fibre, dryness (in a wire rope) and opening of the lay or long jawing.

All sheave grooves should be at least as wide as the diameter of the rope. The diameter of sheaves should be 10 times the diameter of fibre ropes and 20 times the diameter of wire rope. Rope, whether of fibre or wire, should not be used for pulling at an angle to the direction of load lift so that the ropes chafe on the block side-plates. Keep fibre ropes in store away from damp or heat. Hang them up if possible.

Encourage good ventilation. Rope rot often commences internally and is difficult to detect. Dry any wet ropes naturally and not with artificial heat. If ropes cannot be hung up, stow them on gratings. If they are to lie in store for long periods make sure there are no rats present since they will use the rope fibre for their nests. Wire ropes must be condemned if the total visible number of broken wire strands exceeds 10% of the total number of strands.

Storage of rope

Strength of Rope

Fibre-ropes vary in strength, according to the method of manufacture, the type of fibre used etc, an approximate breaking stress may be calculated from the formula below, sisal and hemp being similar to manila, but coir rather less.

Material	Size Range	Breaking Stress
Grade1 Manilla	7mm to144mm	$2D^2$ /300 tonnes
Polythene	4mm to 72mm	$3D^2$ /300 tonnes
Polypropylene	7mm to 80mm	$3D^2$ /300 tonnes
Polyester (Terylene)	4mm to 96mm	$4D^2$ /300 tonnes
Polyamide (nylon)	4mm to 96mm	$5D^2$ /300 tonnes

Rope Breaking Stress according to Size

The formulae below give the breaking stress in tonnes in terms of the diameter of the ropes in millimetres. Knots and sharp nips will substantially weaken ropes. The factor of one sixth for the safe working load should be increased as a rope ages.

Examples of finding the breaking stress of the following ropes:

Manilla rope diameter 15mm

$\frac{2 \times D^2}{300}$ = Tonnes = $\frac{2 \times 15mm \times 15mm}{300}$ = 1, 5 Tons B/S

Polypropylene = diameter 30mm

$\frac{3 \times D^2}{300}$ = Tonnes = $\frac{3 \times 30mm \times 30mm}{300}$ = 9 Tons B/S

Nylon Rope diameter 35mm

$\frac{5 \times D^2}{300}$ = Tonnes = $\frac{5 \times 35mm \times 35mm}{300}$ = 20.4 Tons B/S

Safe working load of all ropes = 1⁄6 of breaking stress

Eg. 9 Tons ÷ 6 = 1.5 Tons SWL

Substance	Manila or Sisal	Nylon	Polyester	Poly- prop
Sulphuric (battery) acid	None	Poor	Good	V good
Hydrochloric acid	None	Poor	Good	V good
Typical rust remover	Poor	Fair	Good	V good
Caustic Soda	None	Good	Fair	V good
Liquid Bleach	None	Good	V good	V good
Creosote crude oil	Fair	None	Good	V good
Phenols Crude tar	Good	Fair	Good	Good
Diesel Oil	Good	Good	Good	Good
Synthetic detergents	Poor	Good	Good	Good
Chlorinated Solvents, e.g. trichloroethylene (Used in some paint and varnish removers)	Poor	Fair	Good	Good
Other organic solvents	Good	Good	Good	Good

The resistance of the main rope types to chemicals

It goes without saying that the safety of the ship or an individual crewmember is often dependent on the rope that is being used. Each has different properties and different resistance to contamination by substances in use around the ship, which may seriously weaken the rope.

The table above is a guide to the resistance of the main rope types but is indicative only of the possible extent of deterioration of rope. In some cases, damage may not be apparent even on close visual inspection.

Ropes should be stored away from heat and sunlight, if possible, in a separate compartment which is dry and well ventilated, away from container of chemicals, detergents, rust removers, paint strippers and other substances capable of damaging them. Mooring ropes should be covered by tarpaulins or, if the ships are on a long voyage, stowed away. Any accidental contamination should be reported immediately for cleaning or other action.

Man-made fibre ropes have high durability and low water absorption and are resistance to rot. Mildew does not attack man-made fibre ropes but moulds can form of them. This will not normally affect their strength.

Polypropylene ropes, which have the best all round resistance to attack from harmful substances, are generally preferred. However, they may be subject to degradation in strong sunlight ("actinic degradation") and should not be exposed for long periods. They should also be of a type providing grip comparable to that of manilla or sisal ropes.

New ropes, 3 strand fibre rope and wire should be taken out of a coil in such a fashion as to avoid disturbing the lay of the rope.

Rope should be inspected internally and externally before use of signs of deterioration, undue wear of damage.

Characteristics of Man-Made Fibre Ropes

Man-made fibre ropes require different handling techniques to those for handling natural fibre ropes. Man-made fibres are relatively stronger so thinner line can be used for a given breaking strain, but wear or damage will diminish strength more than the same amount of wear or damage on a natural fibre rope. Recommendations for substitution of natural fibre ropes by man-made fibre ropes are given in the following table:

Manila		Polyamide (Nylon etc.)		Polyester (Terylene etc.)		Polypropylene	
Diameter	**Size**	**Diameter**	**Size**	**Diameter**	**Size**	**Diameter**	**Size**
48mm	(6)	48mm	(6)	48mm	(6)	48mm	(6)
56mm	(7)	48mm	(6)	48mm	(6)	52mm	(6.5)
64mm	(8)	52mm	(6.5)	52mm	(6.5)	56mm	(7)
72mm	(9)	60mm	(7.5)	60mm	(7.5)	64mm	(8)
80mm	(10)	64mm	(8)	64mm	(8)	72mm	(9)
88mm	(11)	72mm	(9)	72mm	(9)	80mm	(10)
96mm	(12)	80mm	(10)	80mm	(10)	88mm	(11)
112mm	(14)	88mm	(11)	88mm	(11)	96mm	(12)

Comparative strengths of natural and man-made fibre rope

Careful inspection of man-made fibre ropes for wear externally and internally is necessary. A high degree of powdering between strands indicates excessive wear and reduced strength. Ropes with high stretch suffer greater inter-strand wear than others. Hardness and stiffness in some ropes, polyamide (nylon) in particular, may also indicate overworking.

Unlike natural fibre ropes, man-made fibre ropes give little or no audible warning of approaching breaking point.

Rope of man-made material stretches under load to an extent, which varies according to the material. Polyamide rope stretches the most. Stretch imparted man-made fibre rope, which may be up to double that of natural fibre rope, is usually recovered almost instantly when tension is released. A break in the rope may therefore result in a dangerous back-lash and an item of running gear breaking loose may be projected with lethal force. Snatching of such ropes should be avoided; where it may occur inadvertently, personnel should stand well clear of the danger area. The possibility of a mooring or towing rope parting under the load is reduced by proper care, inspection and maintenance and by its proper use in service.

Man-made fibre ropes may easily be damaged by melting if frictional heat is generated during use. Too much friction on a warping drum may fuse the rope with the consequential sticking and jumping of turns, which can be dangerous.

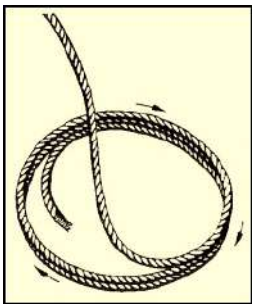
Polypropylene is more liable to soften than other material. To avoid fusing, ropes should not be surged unnecessarily on winch barrels. For this reason, a minimum of turns should be used on the winch barrel; three turns are usually enough but on whelped drums one or two extra turns may be needed to ensure a good grip; these should be removed as soon as practicable.

- Polyamide (nylon) and polyester fibre ropes need four full tucks in the splice each with the completed strands of the rope followed by two tapered tucks for which the strands are halved and quartered for one tuck each respectively. The length of the splicing tail from the finished splice should be equal to at least three rope diameters. The portions of the slice containing the tucks with the reduced number of filaments should be securely wrapped with adhesive tapes or other suitable material.
- Polypropylene ropes should have at least three but not more than full tucks in the splice. The protruding spliced tails should be equal to three rope diameters at least.
- Polythene ropes should have four full tucks in the splice with protruding tails of three rope diameters at least.

Mechanical fastenings **should not be** in lieu of splice on man-made fibre ropes because strands may be damaged during application of the mechanical fastening, and the grip of the fastenings may be much affected by slight unavoidable fluctuations in the diameter of the strands.

Man-made fibre stoppers of like material (but not polyamide) should be used on man-made fibre mooring line, preferably using the ‘West Country’ method (double and reverse stoppering).

Coiling of a rope



When storing a rope it should be coiled neatly and stored in a dry storage area on a shelf or pallets to keep them off the deck surface. This helps with air circulation and prevents the rope from getting wet and rotting.
Who should inspect ropes and when?

- Only trained personnel should carry out an inspection of wire ropes.
- Inspect wire ropes before usage every working day.
- Keep records of inspections.

Check for abrasions, corrosion, pitting, and lubrication inside rope. Insert a wooden fid beneath two strands and rotate to lift strands and open rope.

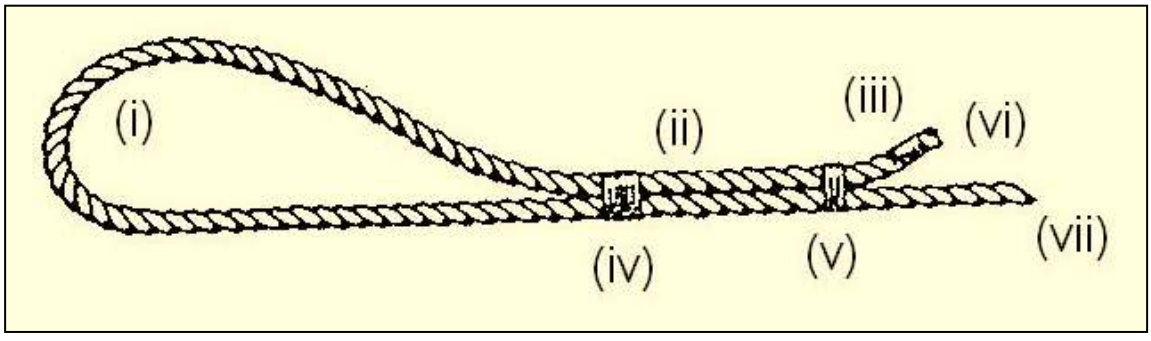
KNOTS, BENDS AND HITCHES

There is a broad distinction between:

- **A knot**, tied in the length of a line without incorporating anything else.
- **A bend**, used to join two lines together.
- **A hitch**, used to attach a line to something.

Because knots bends and hitches evolved over a long period of time, these classifications are not definitive and there are exceptions and in everyday use they are all generically known as *knots.*

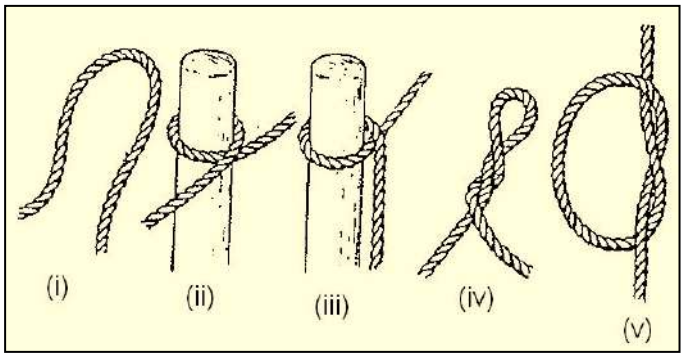
Every seaman must be able to make various knots with a rope before he can be of any use to his vessel. Various bends, hitches, and knots as means of making fast lifting and hauling, securing of cargo and should be made in a seamanship manner. These knots should be made fast so that the rope can hold under strain, yet easily untied when it is required to do so. A good knot is a one that will stay together and is also easily untied.



Key		
(i)	Bight or eye	This is part of a length of rope and also refers to a loop of rope
(ii)	End	The short length at either end of the rope
(iii)	Whipping	Binding the bare end of a rope to prevent the stands from unlaying
(iv)	Seizing	Used to fasten two ropes or two parts of the same rope to prevent them moving in relation to each other
(v)	Stop	A light fastening holding the rope in place temporarily. It is not meant to bear any strain
(vi)	Fag end or bare end	The extreme end of a length of rope
(vii)	Standing part or bight	The part of bight of a rope nearest the eye bend or hitch

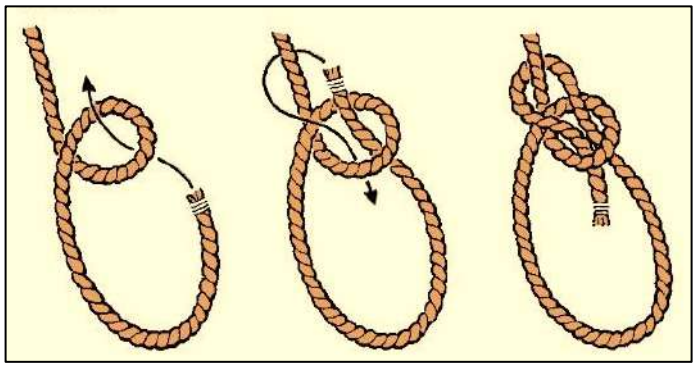
Most knots, bends and hitches consist of a combination of the following elements:

(i) A bight
(ii) A round turn
(iii) A half hitch
(iv) A twist
(v) An overhand knot.



Bowline

Sometimes referred to as the King of Knots as it has so many uses, it can take great strains and is easily untied. Remember, the rabbit comes out of the hole, around the tree and back into the hole again.



Reef Knot or Square Knot

Essentially a bundling knot, it used to tie the ends of the same line together but it can also serve to join two identical lines. The way to remember it is: “Left over right and under, right over left and under”,

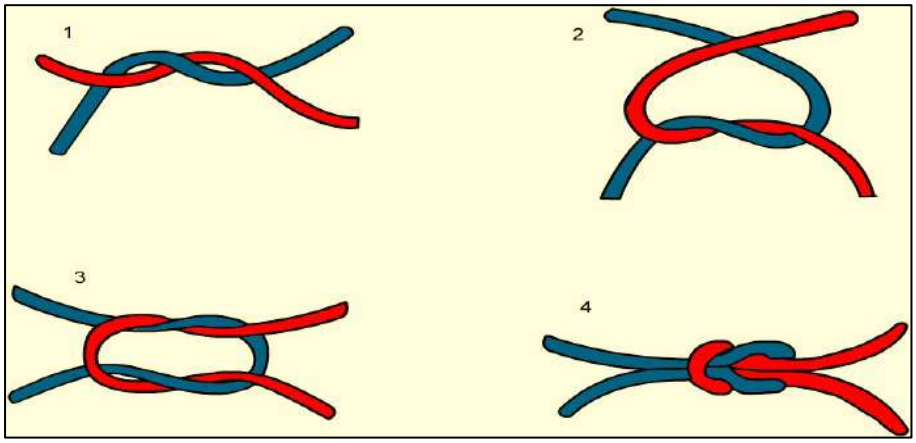
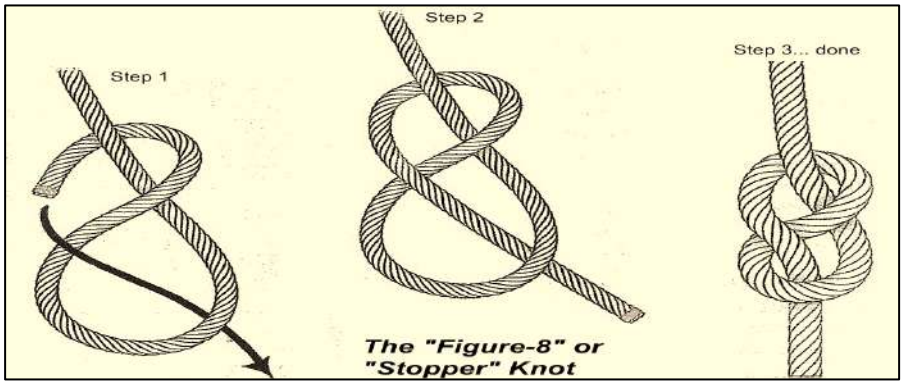


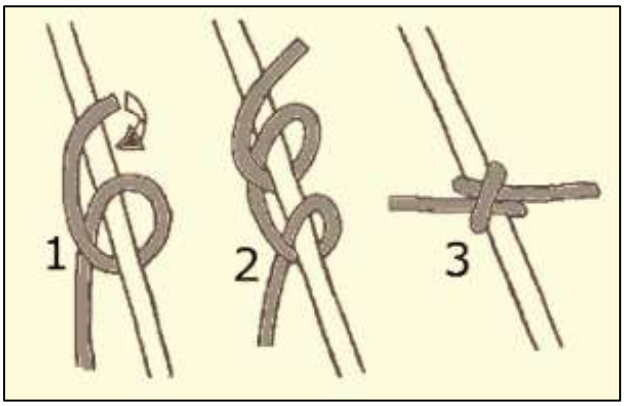
Figure Eight

A stopper knot which can also be used to temporarily prevent the end of a line from fraying or un-laying.



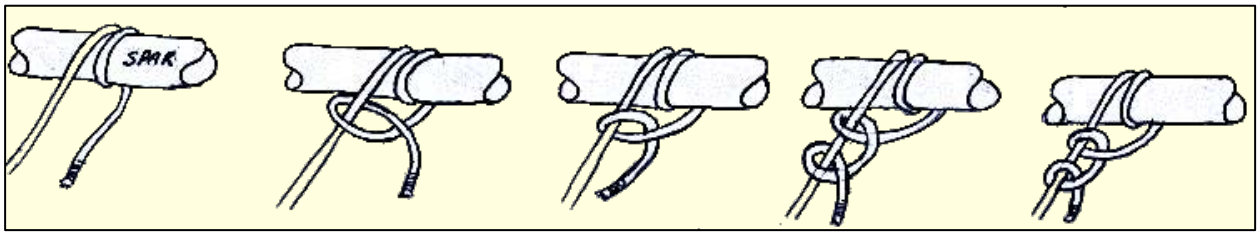
Clove Hitch

Used when the direction of pull is at right angles to the object to which the line is attached. An advantage is that it can be adjusted without being untied, such as when changing the height of fenders, but it is unreliable when subjected to intermittent loads.

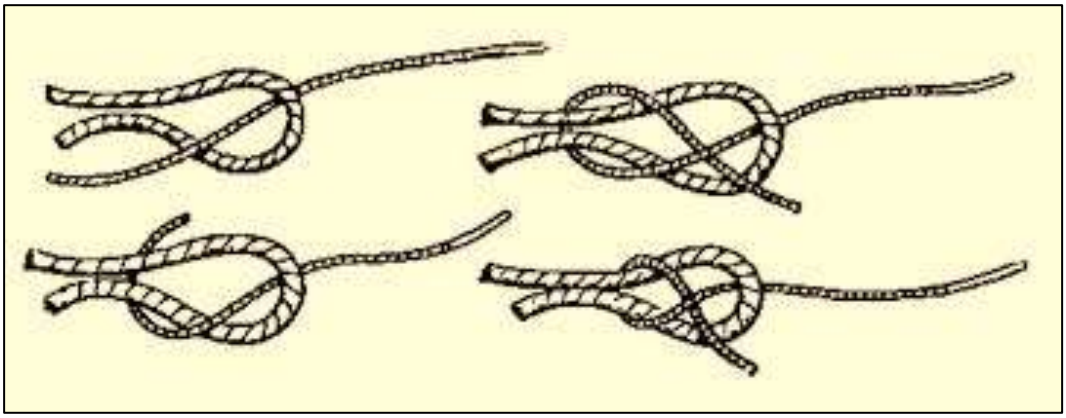


Round Turn and Two Half Hitches

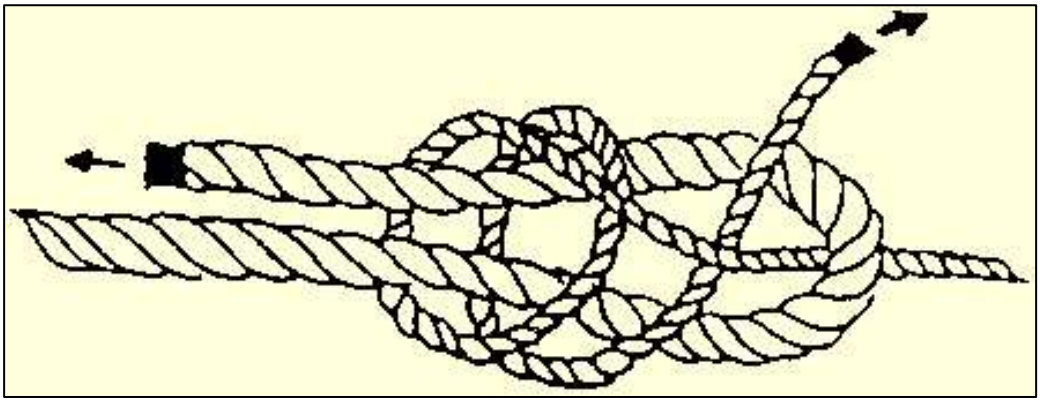
A very reliable means of attaching a line to the likes of a spar or railing. It can be tied and released under load and, unlike the clove hitch, it is completely reliable under intermittent load. Used, for example, when the height of fenders is known.



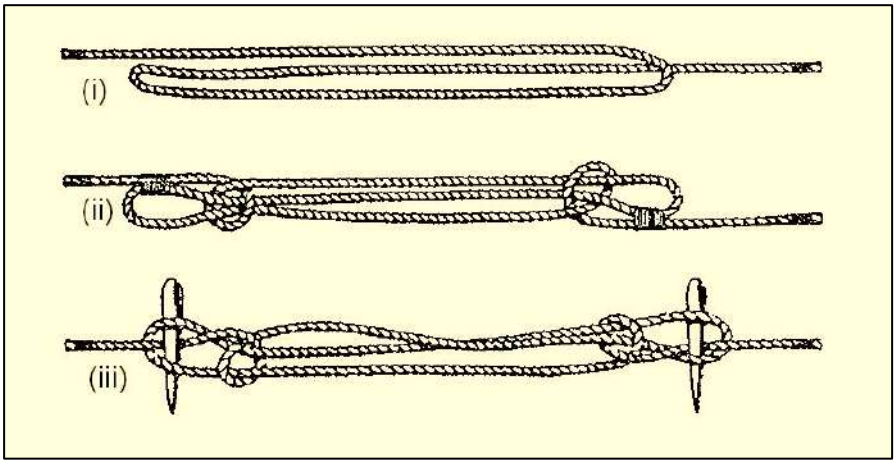
Sheet Bend
Used to join two lines of unequal diameter.



A **double sheet bend** is used when the difference in thickness of the lines is extreme.



Sheepshank
A means of temporarily shortening a line or temporarily relieving the strain from a damaged section of a line. Must be secured if not to be kept under constant load.

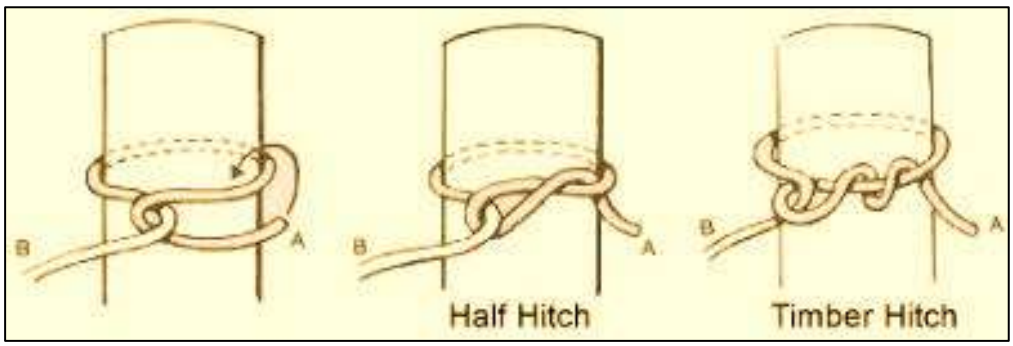


Bowline on a Bight

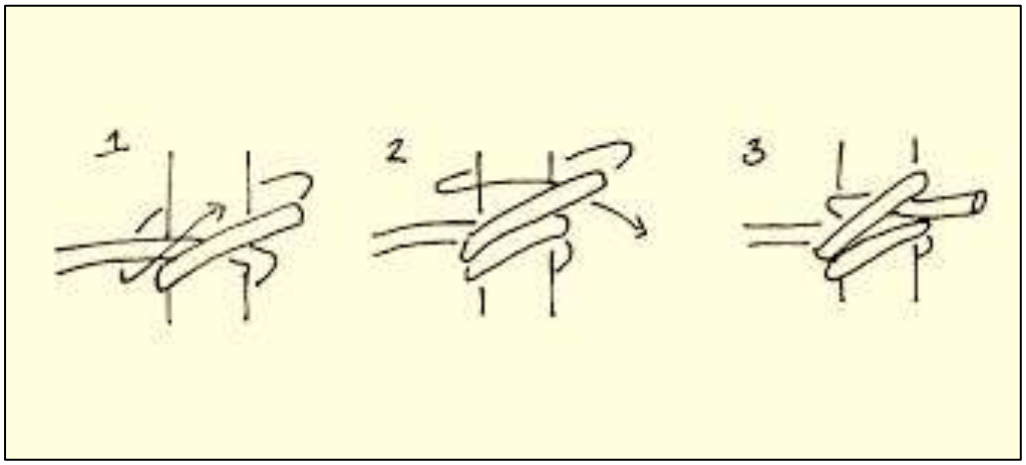
A knot which makes a pair of fixed-size loops in the length of a line. Its advantage is that it is reasonably easy to untie after being exposed to a strain. This knot can replace the figure-eight knot when tying into a climbing harness.

Timber Hitch

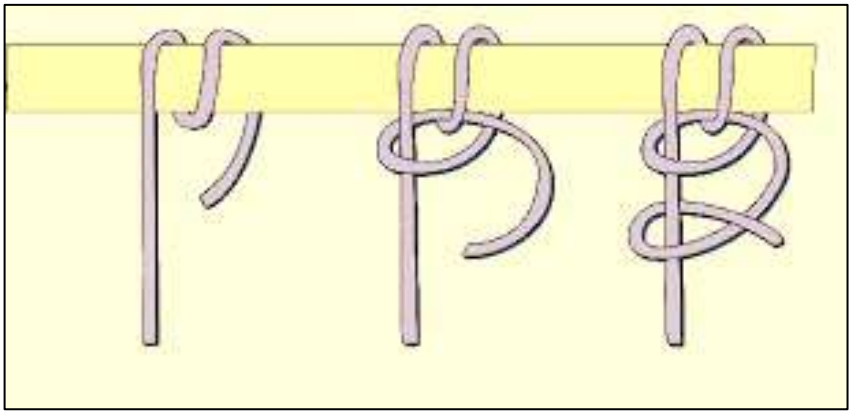
Used to attach a single length of line to a cylindrical object. Secure while tension is maintained, it is easily untied even after heavy loading.



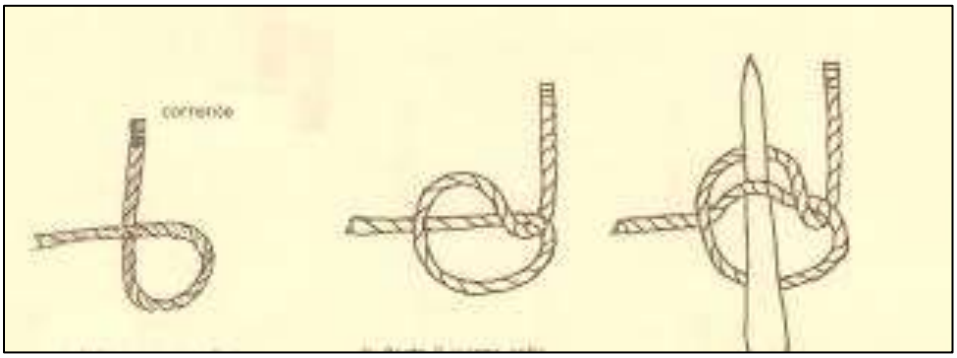
The **Rolling Hitch** is used to attach a rope to a rail, spar or another rope when the direction of pull is parallel to the object. It is tied differently for each direction of pull. Commonly used for stoppers.



A **Fisherman's Bend** Use for more permanent attachment of a line. Difficult to undo once it has been under load, it also often referred to as the Anchor Hitch.

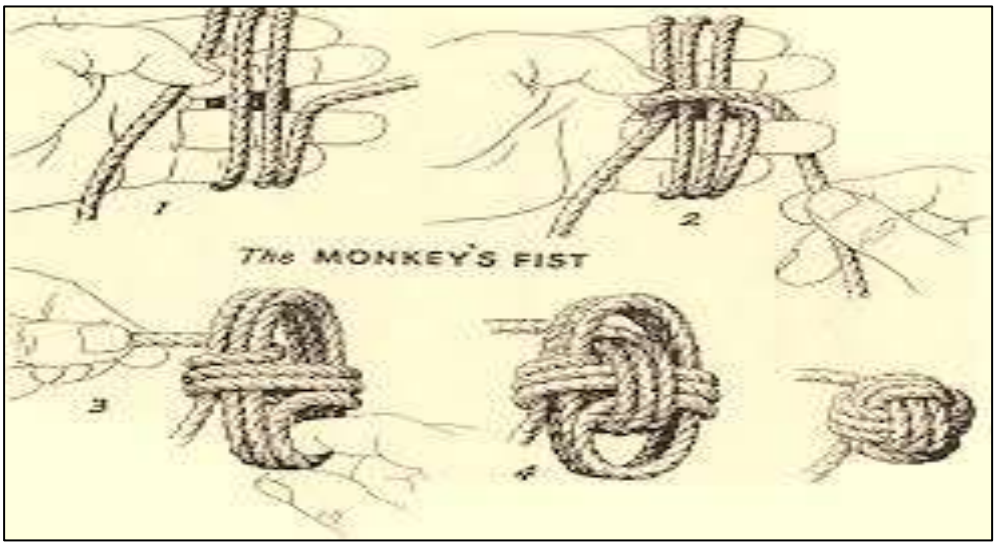


The **Marlinspike Hitch** is used to temporarily attach a rod to a rope in order to act as a handle. This allows more tension than could be produced by gripping the rope with the hands alone.



Monkey's Fist

Also known as a monkey paw, this knot is most often used as the weight in a heaving line but also as an ornamental knot.



Completed monkey's fist

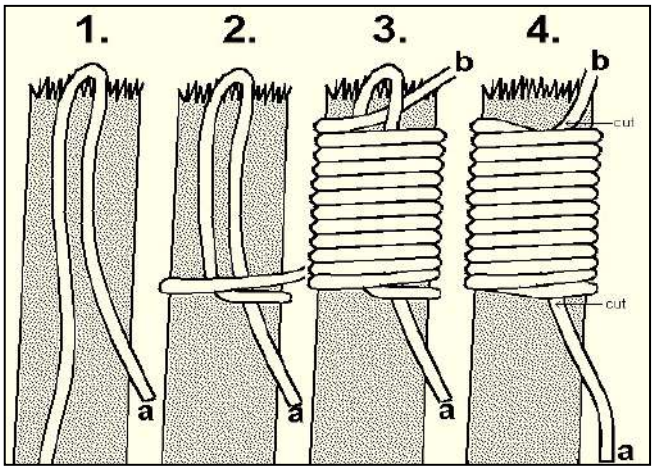
WHIPPING

Whipping is used to stop a line end from unlaying its strands. There are many different ways of whipping but the most often used are:

1. **Common whipping**
2. **Sailmakers whipping**
3. **West country whipping**
4. **American whipping**
5. **Palm and needle whipping**

Whippings should be about one-and-a-half times as long as the rope is thick.

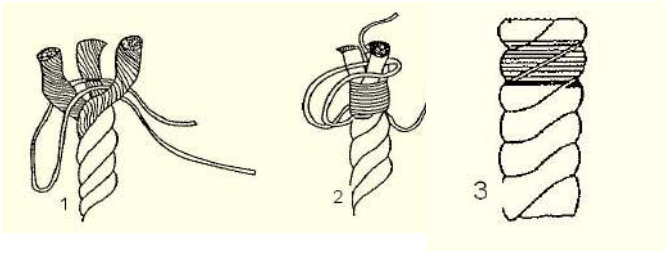
Common Whipping



1. Lay the head of the twine along the rope, make a bight back along the rope.
2. Work the whipping against the lay of the rope wrapping the twine around the rope and start from the inside towards the end.
3. Once you have achieved a width of around one and a half times the thickness, slip the working end of the twine through the bight.
4. Carefully pull on the standing end of the twine until the bight and working end are pulled under the whipping.
5. Cut the twine flush with the edges of the whipping and the rope end not less than half its width from the whipping to give the rope end a finished look.

Sailmakers Whipping

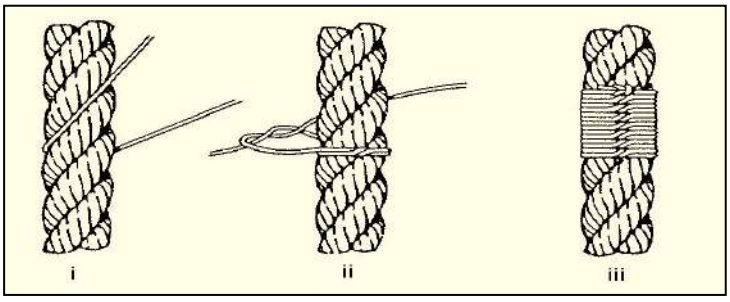
This whipping is the most secure and will not work adrift. This is a permanent whipping at the end of the rope.



1. Open the strands of the rope.
2. Put the loop of the whipping over one strand and close.
3. Wind the twine around the rope and pull tight.
4. Bring the bottom end up and tie the two ends with reef knot in the centre of the rope.

West County Whipping

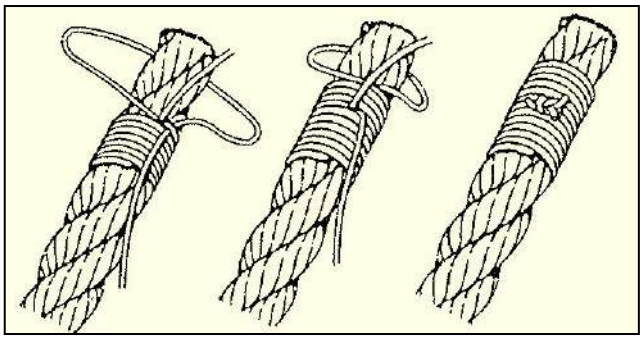
Because this whipping can be used in the length of a rope, it is often used for marking rope at various intervals. It is made by a series of overhand knots which are pulled tight. It is secure due to the tightness of the overhand knots and their interlocking action.



1. Wrap the whipping twine around the rope and tie an overhand knot, leaving both ends of the twine the same length.
2. Continue by taking the two ends of the whipping cord around the back of the rope and tying another overhand knot.
3. Keep repeating overhand knots, front and back, until the required length is achieved.
4. Tie each overhand knot either **right over left** or **left over right** so that the knots lie snug against each other to give a smooth finish.
5. The whipping is completed with a square knot and the excess cord is trimmed.

American Whipping

Similar to the common whipping, except that the first end of the line is left out clear between the first and second half turns. The two ends are secured together with a reef knot and cut off.



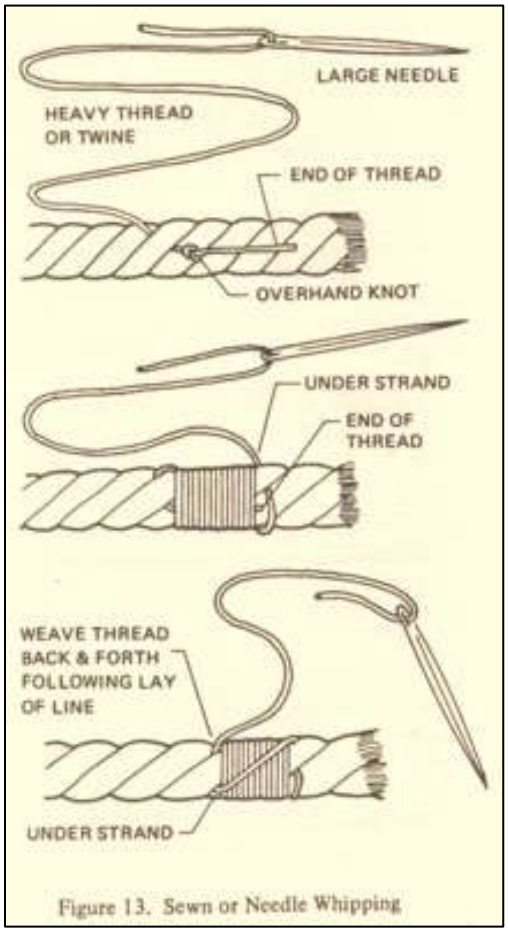
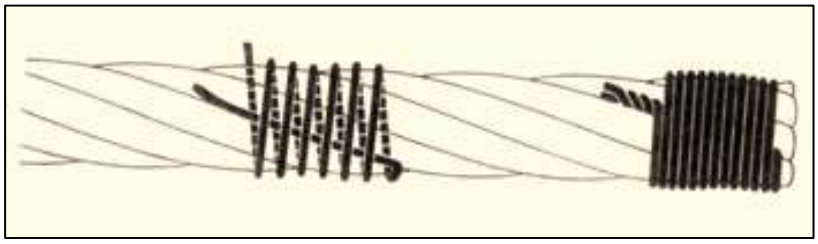


Figure 13. Sewn or Needle Whipping

Palm and Needle Whipping

1. Begin by threading the needle with a suitable length of twine
2. Push the needle and twine clear through the centre of the rope and making sure you have an overhand knot to prevent the twine from pulling through.
3. Add the whipping turns around the rope making sure to cover and bury the loose ends of the twine under the whipping turns.
4. Push the needle through one strand of the rope making sure the point emerges in the 'contline' between the strands.
5. Pass the twine up and over the whipping diagonally in line with the contline and stitch back through the next strand emerging in the next contline.
6. Continue working your way right around the rope.
7. If the rope is braided rather than twisted, the diagonal lines can still be added.

Seizing of a rope and wire.

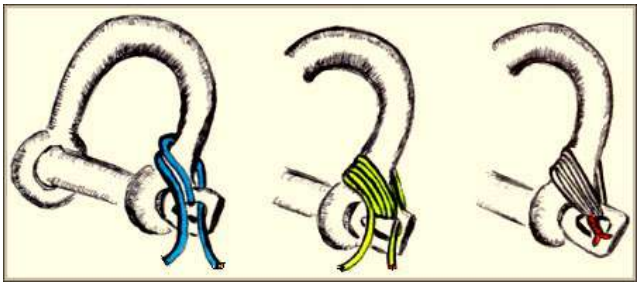


1. One end of the seizing wire is placed between the valleys of two strands.
2. Turn another end around the rope and the fixed end of seizing wire closely and tightly at right angles.
3. Stop turning after the proper length of seizing has been applied.
4. Twist two ends of seizing wire together and make sure they are seizing the rope tightly using nippers.

Seizing wire should be soft or annealed wire or strand. Seizing wire diameter and the length of the seize will depend on the diameter of the wire rope. The length of the seizing should never be less than the diameter of the rope being seized.

Mousing

Is used to secure the pin of a shackle to prevent it from unscrewing.

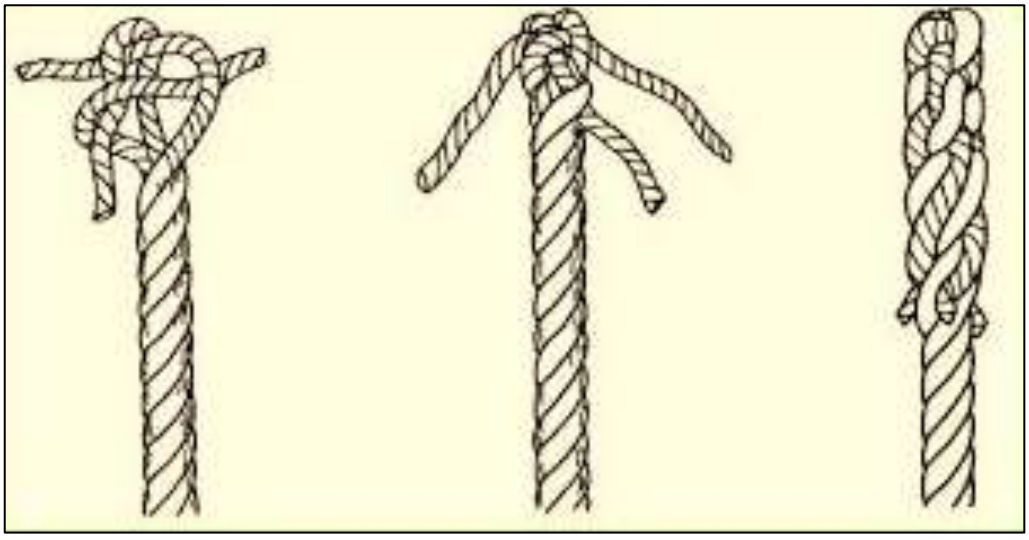


Splicing can be used to neatly end off a fibre rope, permanently join the ends of two fibre ropes or form a permanent loop or an eye in the end of a rope. It is important to preserve the strength of a splice, take care that the tucks lie neatly as rope strength can be lost if the strands are twisted incorrectly. Knots can decrease a line's strength by up to 50% while a splicing maintains as much as 90% of new line strength, Three-stranded splices are the most common and simple to perform,

Back Splice

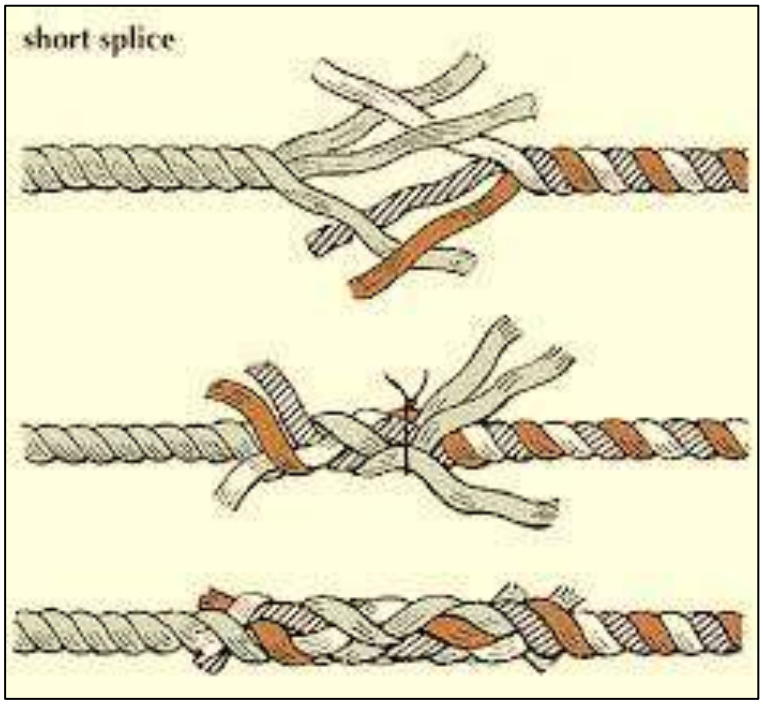
Where the end of a fibre rope is to be spliced to prevent unlaying and a slight enlargement of the end is acceptable, use a back splice:

1. Tape the main body of line 6 crowns from its end to keep it from unravelling
2. Unlay the strands and tape the ends. Using different coloured tape is a help.
3. Unlay to the 6th crown and spread the strands evenly. You will see one strand will be at the back and two will be in front
4. Make a crown knot by taking the one strand at the back and lay it on the front part of the rope with a loop, take the right strand and partially through the loop of the front strand, take the left strand and put it through the loop of the right strand.
5. Pull the crown knot into shape by pulling tight on the lines until it is equally tight and the crown knot is formed.
6. Start with the left strand; go over one strand, tuck under the next one, and pull the strand tight.
7. Turn the line and tuck each strand. Three complete tucks are required for each strand.
8. Trim off the ends of the strands. Then lay the splice on the deck and roll it back and forth under your foot. This will tighten up and smooth out the splice.
9. It is important to keep the strands twisted so as not to lose the shape of the line.



Short Splice

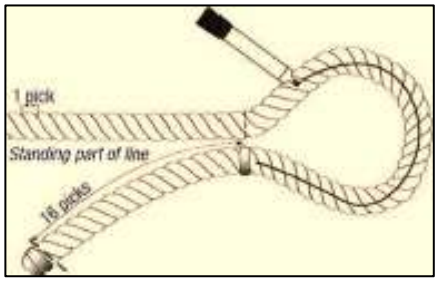
Used to join two lengths of fibre rope together, the short splice is as strong as the rope of which it is made. It will however increase the diameter of the line at the splice and can be used only where this increase in diameter will not affect the operation. Use the short splice to repair damaged lines. The damaged parts of the line are cut out and the short splice re-joins the line. Only lines of the same size can be joined together using the short splice.



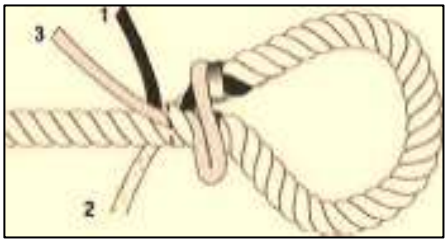
1. Count 12 crowns back on the ends of both lines to be joined and tape them to prevent further un-laying.
2. Un-lay the ends of the lines to the tape and tape the ends of the strands with different colour tape.
3. The strands will have a natural lay to them, with one strand in the front and two at the back, “marry” the strands into one another and bring them as snug as possible to one another.
4. Tape the one side so as to keep the married pieces tight.
5. Start from one side and take the first strand and tuck it under the strand immediately to its left and pull it up tightly.
6. Rotate the splice and tuck the next strand and repeat for the third strand.
7. Continue for 5 complete tucks and make sure that each time the tucks are pulled up tight and the strands do not un-twist.
8. Remove the tape from the other side and repeat the same over under, over under for 5 tucks.
9. Make sure the splice is tight and roll it underfoot or in your hands to make sure it is secure.

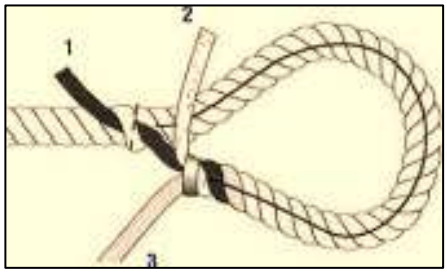
3 Strand Eye Splice

Putting a loop in a line with a splice retains between 90-95% of the line strength, compared to a loss of 60% of a lines strength with a bowline.



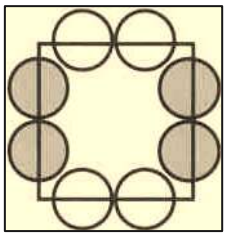
1. From the end of the rope count back 16 pricks and tape at this section, un-lay the line up to the tape and then tape the end of each strand.
2. Form the eye and mark a line around the standing part of the rope that will touch all 3 strands.
3. The mark will be where each of your individual taped strands will tuck under.
4. Tuck the middle strand under the nearest marked prick.
5. Tuck the second strand under the marked prick behind the first strand that you have just tucked.
6. Turn the entire piece over and tuck the one remaining strand under the remaining marked prick.
7. Remove the tape and tighten by pulling up on the strands.
8. Continue to alternately tuck the taped strands counter to the lay of the line, over one prick and tuck under the next.
9. Continue for a total of 5 tucks.
10. Trim the ends of the strands.





8 Strand eye splice

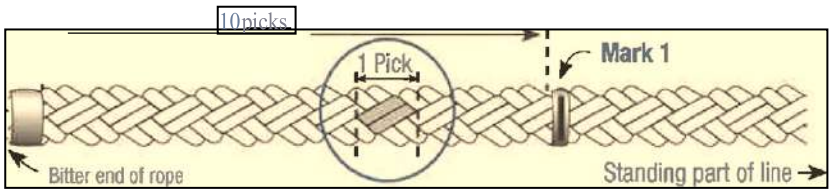
Getting started



8-strand ropes, also known as plaited ropes, are composed of 8 strands grouped into 4 pairs, 2 of these pairs turn to the left, shown in grey, and 2 pairs turn to the right, shown in white. Seen in this cross-section, the 4 strand pairs form the sides of a square. The strands that are on opposite sides of the square will rotate in the same direction

1. **Counting and Marking**

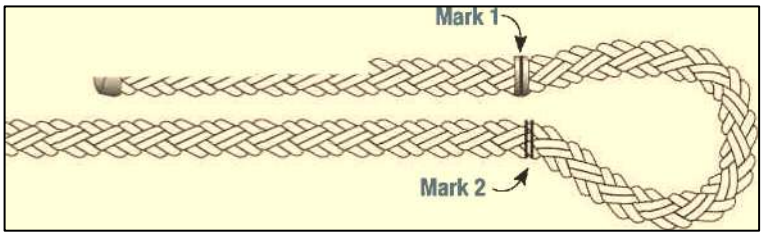
From the end of the rope, count a distance of 10 picks and apply tape securely around the rope immediately after the 10th pick, as shown in the illustration. This is **Mark 1**. Apply the tape securely enough so that it will not move during the splicing procedure.



Counting back 10 picks

2. Making the eye and marking the rope

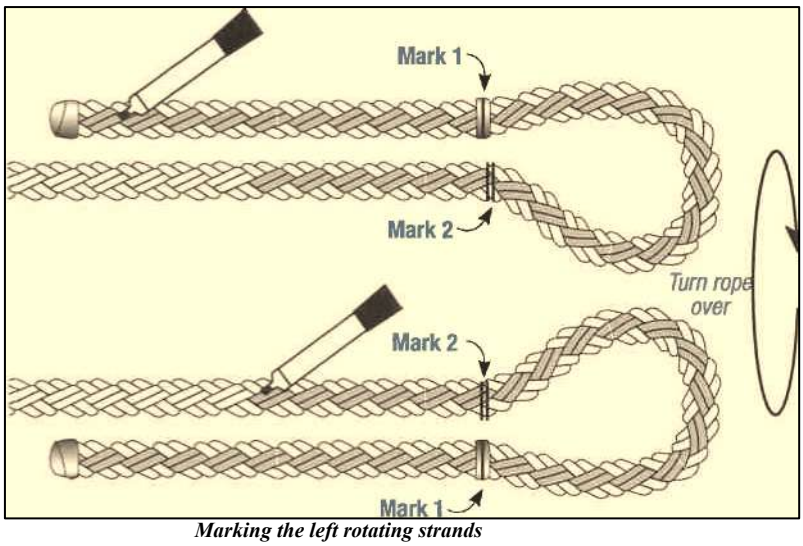
Form the desired size of the eye being careful not to add twist to the rope. Mark the rope adjacent to the tape. This is **Mark 2**.



Marking point 2

3. Marking the left- rotating strands

From the end of the rope ,mark the first 10-picks up to the tape at Mark 1. Continue marking the length of the eye at least an additional 6 picks past Mark 2. Mark all strands that rotate left on both sides of the braided rope. The strands that rotate left grey can be marked for improved visual reference. 8-strand ropes are composed of 4 pairs of 2 strands each. 2 of the strand pairs rotate to the left, and 2 pairs rotate to the right. When marking the left- rotating strands, be sure to tum the rope over and mark the left-rotating strands on the opposite side of the braid.



Marking the left rotating strands

4. Taping the ends and unlaying the rope

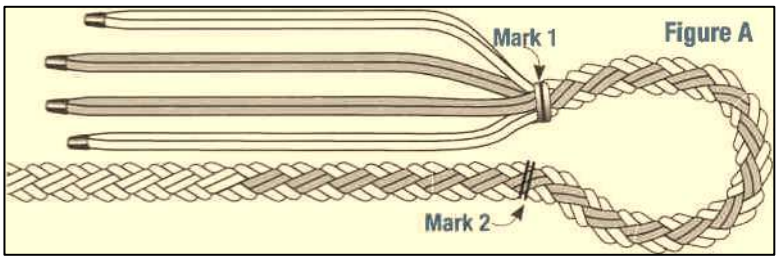
i. Tape the ends of each of the 8 strands individually

ii. Unlay the strand pairs all the way back to the tape at Mark 1. Keep the pairs of strands together while unbraiding.

iii. When unlayed, the strands in a pair will be twisted around each other. Untwist each strand pair so the 2 strands lie parallel to each other, rather than twisting around each other. Tape the ends of each pair together.

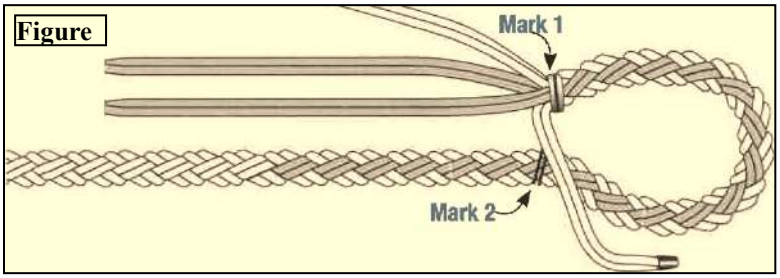
5. Positioning the Strands

Arrange the strand pairs as shown in the diagram on right. One set of the marked grey strands is on the top, and the other marked grey strands are on the bottom. The unmarked white pair will be on the left and right.



6. Forming the eye

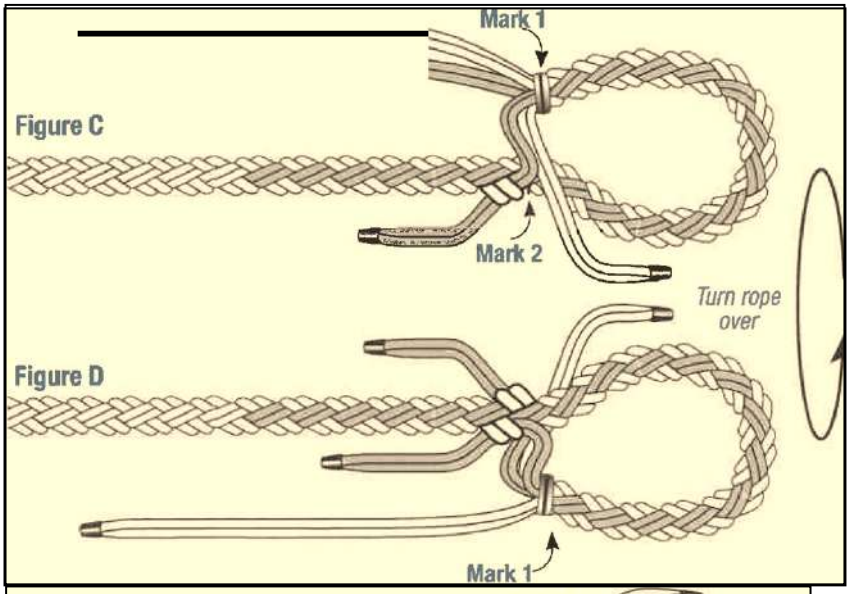
Physically form the eye, making certain there is no twist in the rope. Place the (white) pair that is closest to the standing part of the rope over the rope, at Mark 2, as shown in diagram, being careful not to add twist to the rope.



7. Route tucking the strand pairs

i. Beginning with the left rotating marked **grey** pair of strands on top, make your first tuck under the right rotating **white** pair of strands closest to Mark 2. Pull the strands completely through, making sure that the strands don't twist

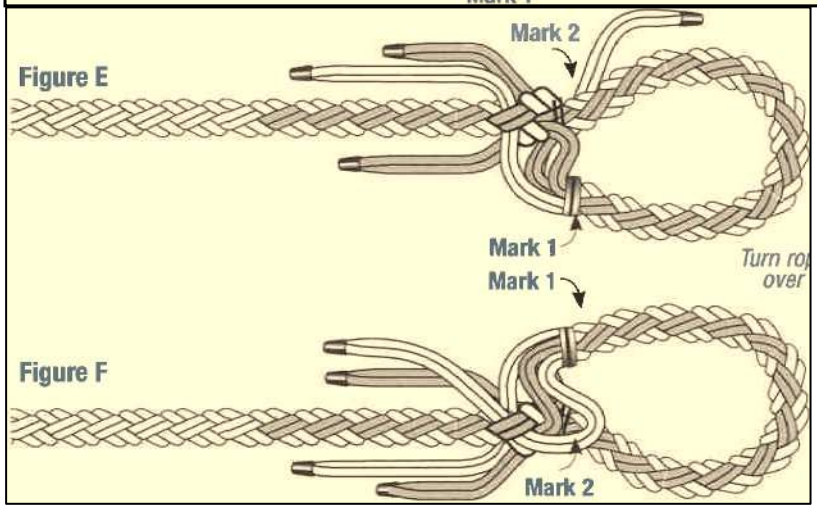
ii. Turn the eye over and tuck the other marked **grey** pair of strands under the **white** pair of strands directly opposite the previous tuck.

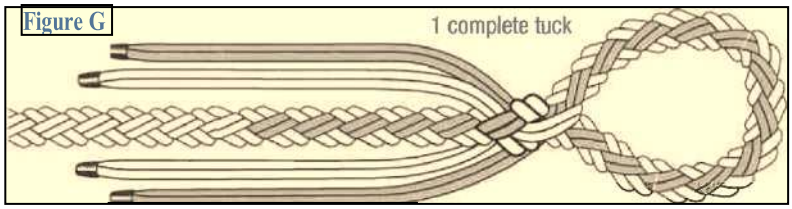


iii. Tuck the white pair of strands under the **grey** pair of strands closest to the first 2 tucks. Pull the strands snug, but not tight to avoid distorting the strands in the eye area. Again, make sure there is no twist in the strands.

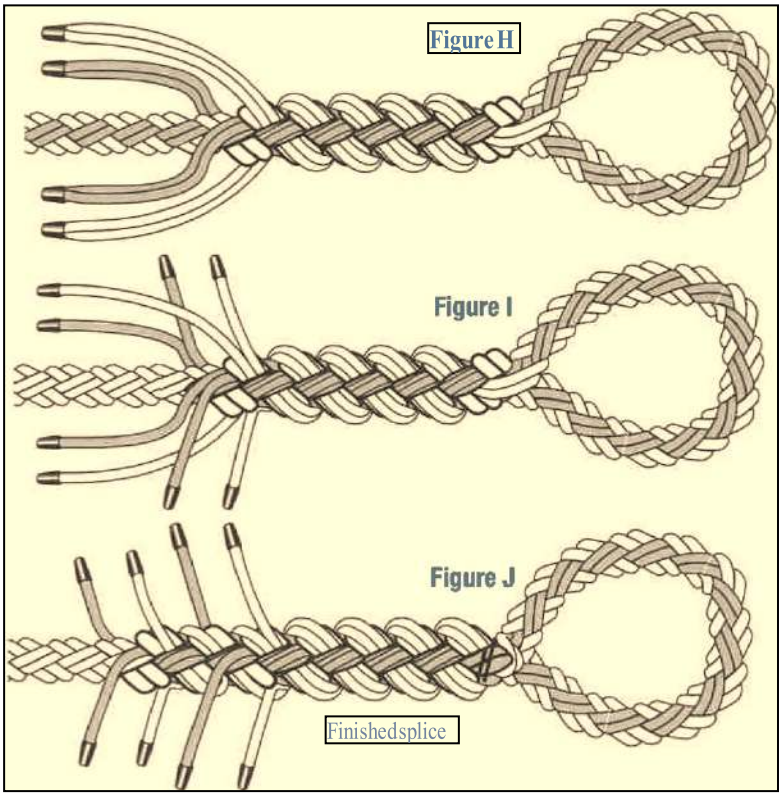
iv. Turn the eye over and tuck the remaining **white** pair of strands under the remaining **grey** pair of strands in the standing part of the rope.

v. Remove tape and pull all 8 strands snug and correct any twist that may have been introduced during the tucking procedure. The first tuck is now complete. A full tuck includes all 4 pairs of strands.





8. Completing the tucks and finishing the splice



i. Continue tucking the **grey** strands under the **white** strands and the **white** strands under the **grey** strands until at least 4 full tucks (with all 4 strand pairs) have been completed.

ii. After each round of tucks, pull each strand to make sure they are snug and there is no twist.

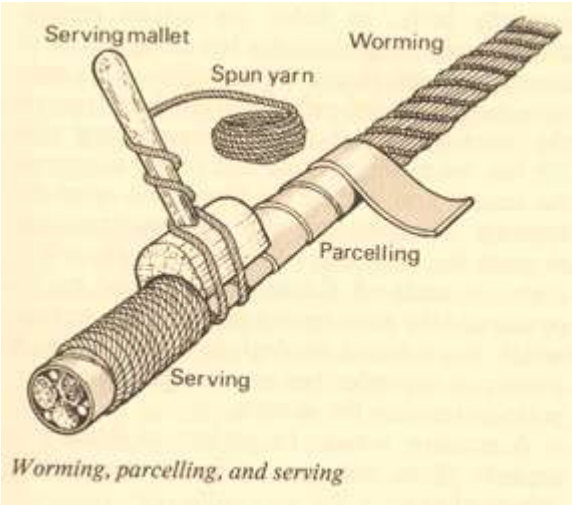
iii. Locate the strand closest to the eye in each strand pair. Tape and cut off, leaving enough of the end protruding so it does not slip back into the rope when loaded.

iv. Continue tucking the remaining strands, with the **grey** strands under the **white** strands, and vice versa, for 2 more full tucks.

v. Tape and cut off the remaining strands. The finished splice should look like the bottom picture

Worm, Parcel and Serve

This is to provide multi-layered protection against chafe and weather deterioration, applied only to traditional twisted rope, either natural fibre or steel wire-rope



Worming, parcelling, and serving

Worming comprises a thin line following the twist so that they spiral round the main line running in the channels (contlines) between the strands to keep water out and allow tighter, smoother wrapping of the next layers.

The line is then parcelled by wrapping with long overlapping strips of thin canvas. Canvass is wound from bottom to top, the edge of the progressing strip slightly overlapping each layer to prevent water from entering. Tar is painted over the whole to fill any remaining gaps in the contlines as well as creating a waterproof seal overall. As with worming, parcelling is applied in the same direction as the twist of the line being covered. The rule is "worm and parcel with the lay; turn and serve the other way".

Serving is when the final layer of protection is provided by marline wrapped tightly around the line to cover the whole with the turns being tight together. A serving mallet is used to get the outer twine as tight as possible.

Stockholm tar is a Pine tar used to treat ropes, its name comes from Scandinavia where it has been produced since Viking times.

CHAPTER FIFTEEN
HEAVY WEATHER PREPARATION

Securing the Vessel for Heavy Weather

All ships proceeding to sea should be set up and ready to face heavy weather. There are a number of checks required before the onset of bad weather and these include:

- Scuppers clear and open, freeing ports clear
- Tank vents closed
- Deadlights fitted
- Shell doors checked
- Watertight doors closed
- Pools emptied - free surface effect on stability
- Toys secured, tied down to chocks, covered and loose items inside secured
- Double lash anything that may be particularly exposed
- Emergency equipment in readiness

Specifically check and action the following:

- No crewmember on deck unless master unless master given okay
- Any work on deck must be authorised by master and bridge watch informed
- Check and double, if necessary, all cargo lashings on deck
- Batten down all hatches, manholes etc.
- Tighten all lifeboat gripes
- Remove all ventilator heads, plug the entry ports and fit covers on them
- Secure all movable items on deck, inside accommodation and in E/R spaces, including under-deck passages and steering flat. Unsecured items in heavy weather risk not only being damaged themselves, but could also pose a danger to vessel safety by violent contact with sensitive equipment or fittings.
- Any stores or spares received in port must be stowed at their designated positions. In extreme circumstances, when it is impracticable to do so immediately, they must be protected and lashed very thoroughly.
- Securing of cargo is as per the requirements laid down in the Cargo Securing Manual
- Cranes, trolley hoists, davits are housed and well secured
- Windlasses, mooring winches, hawsers, wires and any associated mooring equipment are free from damage and ready for use
- Motors, electrical equipment and hydraulic piping are well protected
- Power supplies and distribution boards for mooring equipment, especially those remotely located, are protected from damage
- Anchors, pilot ladders and gangways are properly stowed and secured

Steering Control

- In open sea it is advisable to change over to hand or manual control to avoid excessive hunting of the rudder.
- Check oil levels, linkages and other important parameters of the steering gear.
- Run both motors to get maximum available torque to turn the rudder.
- Sufficient manpower including senior officers to be present in the bridge.

Machinery Control

- If engine room is in unmanned space (UMS) mode, man the engine room and make sure sufficient manpower is available.
- Monitor all the parameters of the main propulsion plant and auxiliary power plant machinery.
- Properly lash and stow all spares in the engine room.
- Engine controls must be manned to counter fluctuations in RPM caused by the propeller coming out of the water.
- Ensure sumps of all machinery are at a high enough level to avoid false or automatic shut-down caused by the ship's motion.
- Maintain tank levels so as not to lose suction at the delivery pipe.
- Stand by generator is to be kept on load.
- Water tight doors, skylights and other openings to be closed.

Other Precautions

- Crew to avoid going out on the open deck if possible.
- All openings in the deck to be kept shut.
- Elevators should not be used.
- Always wear appropriate PPE.
- Be alert and work as a team.

CHAPTER SIXTEEN
MOORING AND TOWING

General Understanding of Mooring Operations

Mooring operation is one of the *most* important tasks that seafarers have to perform on ship's deck. However if not carried out in a correct manner it can be very dangerous. Deck crew must, through training on a regular basis, understand fully the various safety precautions and working of deck machinery and systems, along with cargo operation equipment. When it comes to mooring operations, additional precautions need to be taken to ensure personal and crew members' safety.

Rules for Mooring

1. Always wear the correct personal protective equipment (PPE), which is an important part of proper preparation considering that PPE is the last line of defence.
2. Always consider whether you are in a snap back zone and never stand on either an open line or a closed bight of line. Keep an eye out for all members of the team. If you think they are in an unsafe position, alert them.
3. All operations need to be carried out calmly without rushing about. Rushing leads to slips, trips and falls.
4. Never lose sight of what is going on around you and have an escape route from any likely danger (that is, avoid being trapped against the bulwark or other obstacle when a line parts).
5. Always put an eye onto a bollard or bitts by holding the eye either on its side or by a messenger line to avoid getting fingers trapped against the bollard if the line suddenly snaps tight.
6. Never heave blindly on a line when no one is watching what is happening at the other end.
7. Never try to be heroic by jumping onto a line that is clearly running over the side and out of control as you are likely to go overboard with it.
8. Never run more than one line around a fairlead sheave as the lines chafe through faster and the sheave is really only strong enough to take the load of a single line under tension.
9. Never use any equipment that is obviously faulty. If you notice damage, then it should be reported and an alternative arrangement for the mooring line used.
10. Never let go of a mooring line under heavy load without determining first why the load is so heavy and then taking the proper precautions if it must be let go.

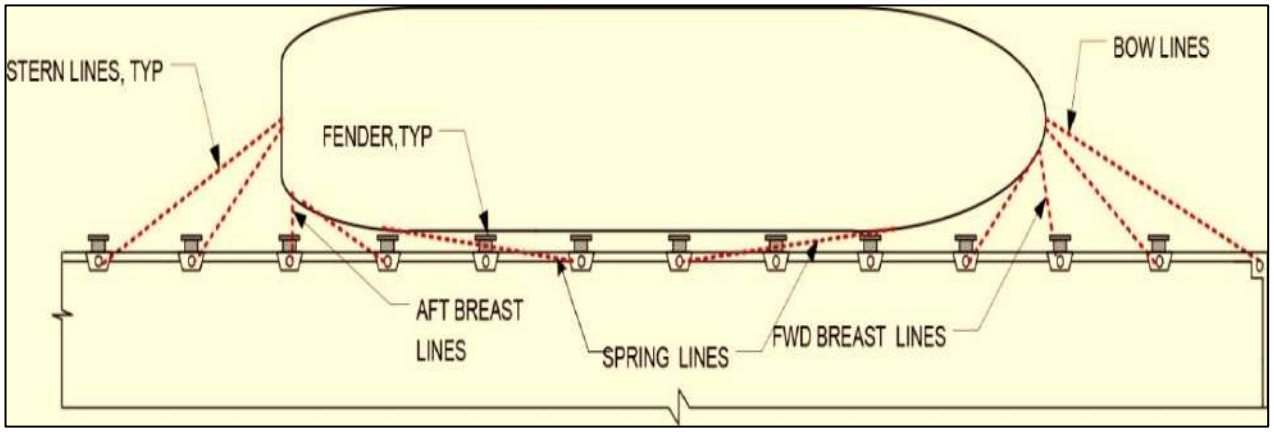
Functions of Mooring/Tug Lines

When a ship comes into port, the type of arrangement and number of lines that it will put out depends on the dock type and load condition of the ship. Most ships will often double up on all of their lines.

Bow lines: typically run through the bull nose on the bow and run forward down the dock, leading ahead of the ship. When backed against, these lines will help to bring the ship in toward the dock.

After bow spring: From the bow leading aft, these lines prevent the ship from surging forward should a ship's wake or wind force the ship ahead. Also, when run forward against, they will help to kick the stern out away from the dock

Forward bow spring: From the after section of the bow leading forward, these help to prevent the ship from surging backward should a wake or wind force the ship astern. When backed against, they will help to pull the ship in to the dock.



Breast lines: usually put out from the bow or stern, and occasionally amidships, these lines hold the ship alongside the dock. They do not prevent surging in any direction other than away from the dock, and are usually the last lines sent out and the first brought in.

After Quarter Spring: the lines run from the quarter aft and prevent the ship from surging forward. When pulled forward against, these lines help to pull the ship in toward the dock.

Forward Quarter Spring: These lines run from the stern forward, and prevent the ship from surging aft. When pulled astern against, these lines help to push the bow out away from the dock.

Stern lines: These lines run from the stern, usually run through the centreline chock, and run aft of the ship. When pulled forward against, these lines help to bring the ship alongside the dock.

Securing to Bitts
This can be done in two ways:

- Figure –of-eight
- Loading the Barrel

Figure-of-Eight which is standard. Usually a full turn is taken round both bitts before the figure-of-eight turns

"Loading the Barrel" actually increases the amount of friction as there is more contact with the bitts than with the figure-of-eight.

Safe Handling of Moorings

One of the principal hazards associated with mooring operations is that lines can and do part, and with synthetic fibre ropes there may be little or no audible indication prior to this occurring. Due to the inherent elasticity in synthetic lines when they part they may travel some considerable distance as they snap back.

Wires may give some audible warning that they are about to fail as individual wires and strands part, but due to the lack of elasticity will not travel as far as a synthetic fibre rope once parted. However they can still impart fatal or significant injury.

Personnel must therefore always ensure that they stand in a position of safety away from where a line may snap back if it parts whilst under tension. If a line comes under excessive strain appropriate action should be taken to safely reduce the tension so far as this is possible.

Personnel should not stand on the bight of a rope at any time and all crew should look out for each other and alert their colleagues if they see that they may be standing in an unsafe position.

Lines should be led, so far as possible, without sharp changes of direction.

Wires and synthetic fibre ropes need to be kept separate and not allowed to cross or be led through the same lead.

Where synthetic fibre ropes and wires are available, the same type and size of lines should be used for the same service. For example all springs may be made of wire and all head lines made of synthetic fibre. The mixing of synthetic and wire ropes in the same service is not recommended.

Many vessels use both wires and synthetic lines to make the vessel fast alongside and many wires are fitted with rope tails to give the mooring line some elasticity. However, due to the limited elasticity present in a wire or wire and rope tail mooring line when compared to the elasticity of a synthetic line, it is recommended that wires are not run as the first lines when coming alongside to heave the vessel into position.

Modern mooring winches help in avoiding the need to constantly monitor the mooring winches when the ship is berthed alongside. It is essential to tension or slacken the mooring wires according to the flow of the tides and the change in the draught that takes place due to cargo operations. The modern mooring assemblies act as an automatic self-tensioning unit, which provides for paying out or recovering mooring lines when a pre-set tension is not present.

Load sensors are used on the mooring winches to control the tensioning or slackening of the lines. It is important that these load sensors are adjusted properly to get accurate results.

Winches may also be fitted with strain gauges that sense the load. This strain gauge produces a small voltage when load is applied on it. The voltage produced will be different for different loading condition. This voltage is then calibrated to give out the readings on the panel of the winches. These gauges are required to be calibrated time to time.

It is recommended that these are **not** used in the self-tensioning mode when connected to a shore manifold or when space ahead and astern is limited, as there have been instances of vessels creeping along berths due to the prevailing environmental conditions.

Self-tensioning mooring winches are no longer favoured by many because of the possibility of a vessel ‘creeping’ along docksides and jetties as a winch pays out and heaves when the ship is affected by some external force. Instead, many vessels now apply rotating drum style winch brakes while secured alongside.

Berthing

The bridge will advise which side the vessel is to berth alongside, the number of headlines/stern lines, breast lines and springs that are to be deployed, which line will be the first line to be sent ashore, both forward and aft and how this is to be sent ashore: by line boat or heaving line.

Anchor lashings need to be cleared away along with hawse and spurling pipe covers and the anchors made ready for letting go.

Sufficient lengths of mooring line for the intended operation should be taken from the winch drums or loose coiled ropes and be flaked on deck prior to arrival ready for running to the berth. When running lines it is bad practice to attempt to stand on a line to stop it running away.

When heaving lines are to be thrown to the berth the linesman ashore should be alerted to the fact. When heaving lines are being returned those on the deck must be alerted that a heaving line is being thrown back to the deck.

When line boats are used to run lines, care must be taken when lowering ropes that these are lowered under control at all times and are not let go to fall uncontrollably into the line boat.

When drum ends are used to tension lines, two personnel should be engaged in the operation, one tending the line on the drum end and one coiling the rope on deck as it is heaved in.

Three turns around the drum end should suffice for heaving; however, on whelped drums more turns may be necessary. The rope should not be surged on the drum end to prevent the rope melting and fusing on the drum end. Once adequate tension has been achieved, the rope should be stoppered and laid up on the mooring bitts.

When laying up the line onto the mooring bitts, the first one or two turns should be taken directly around the first post of the bitts or around the outside of both posts before the rope is laid up in figures of eight around the bitts. Once a rope is laid up on the bitts the stopper should be released from the rope. Ropes should never be left on drum ends when not being tensioned; they must always be laid up on the bitts.

Split drum winches are designed so that the line under tension is on the first wrap on the drum providing maximum holding power. When transferring the mooring line from the storage side of the drum to the tensioning side, care has to be taken when manoeuvring the line through the gap in the drum divider. Personnel should stand so that they are pulling the line from the storage side towards the tension side rather than pushing, which has the risk of the line springing back towards the crewmember pushing it and possibly causing injury.

Once the vessel is all fast alongside, the anchors need to be secured by placing the guillotine bars in place across the anchor cables

Mooring Line Commands:

Pass One: send the first line over to the pier but do not take a strain

Slack: pay out the line so that it is not under tension and it forms an easy bight

Take a strain: heave on a line until it is under tension

Take in the slack: heave on a line until the bight is removed, but do not take a strain

Ease: pay out just enough slack to remove the tension from the line

Avast heaving: stop heaving a line, but hold whatever tension currently exists

Check: hold the current tension on a line by either paying out or heaving in as appropriate

Hold: take enough turns about the capstan or bitt so that the line will not slip

Double up: run additional lines or bights of lines as needed to make the mooring secure

Single Up: take in all lines except whichever the captain specifies (usually the springs)

Stand by the lines: man the lines, be ready to cast off or moor

Take in: retrieve a specific line from the pier

Cast off: remove the lines from the bitts or bollards

Unmooring

When letting go the lines should be released and heaved on board in accordance with instructions received from the bridge.

Once the order is given to let go the remaining lines these should be promptly slacked and then heaved in once let go by the linesmen. Once they have been let go from the shore bollards the bridge should be advised of the fact. The bridge must also be advised once the lines are clear of the water and it is safe to use the propelling machinery and thrusters.

Anchors are to be secured once the order to do so is given by the bridge, and the bridge informed once the anchors have been made fast with all lashings for the sea passage applied and hawse and spurling pipes covered.

TOWING

Prior to towing operations being undertaken, the master should establish suitable means of communication, exchange relevant information (e.g. speed of vessel) and agree a plan for the tow with the tug master.

All crewmembers involved should be adequately briefed in their duties and safety precautions to be taken. They should be equipped with personal protective equipment including safety helmets and safety shoes.

Personnel standing by forward and aft will be advised by the bridge when tugs are to be utilised, they will be informed when and where tugs are to be made fast and whether a tug's line or ship's line is to be used. In most instances a tug's line will be used, but if a vessel's mooring line is to be utilised it has to be confirmed that this has a minimum breaking load (MBL) that is at least twice the bollard pull of the tug; this will allow for any possible dynamic snatch loadings that may be imparted during the towage operation. Vessels' lines used for towage must be in good condition with sound splices and without short splices in their length.

When heaving lines are used to pick up the tug's messenger line or to run lines to the berth these should be made up with a Monkey's Fist **that does not contain any additional material or weight**. This is to reduce the risk of injury in the event of it striking personnel on the tug or ashore. Personnel on the tug must be directed to stand clear whilst the heaving line is being thrown to the tug's deck.

A messenger should be used to heave the tug's tow line on board by a winch, and then a stopper used while the eye is placed around the bollard. Only enough turns of the messenger should be used on the warping drum end to heave in the tow line.

Once the towing line is made fast the tug must be informed that the line is fast and that weight can be applied. All crew must be standing clear in a position of safety as tension may come on the towing line suddenly with little warning.

Tugs' lines used for towing the vessel must be placed with the eye over the post of a mooring bitt, and vessels' lines used for towing should be laid up on bitts. The bitts used must have a safe working load in excess of the expected dynamic loads in the towline. The safe working load of the bitts should be prominently marked.

Whilst engaged in towing operations, crew should keep well clear of the tow line as it may come under tension suddenly and crewmembers must ensure they remain in a position of safety clear of bight of rope or wire and the area where the line would snap back in the event of it parting whilst under tension. Lines will generally snap back in an area based along the line in which it was leading. If led around a bollard or pedestal the line may snap back and whip around the bollard or fairlead in a much wider arc.

During operations, communications should be maintained between the tug and both the bridge team and the tow crew on the foredeck of the vessel under tow; communications rely on clear identification of the parties communicating to prevent misunderstandings. The Tug Master should be kept informed of engine movements, proposed use of thrusts etc. Persons in charge of the mooring party should monitor the tow line to give warning to the crew if the tow line should become taut, for whatever reason.

Tugs' lines should only be let go when the order to do so is received from the bridge. When letting go the tow, no attempt should be made to heave in the tow line slack before making positive communications with the tug's crew and they have indicated that they are ready to receive their line. Use the tug's attached messenger to heave in the slack and then stopper it off before taking the eye off the bollard. Use turns of the messenger around the bollard to control the speed at which the tow line goes out and is retrieved on board the tug. If the tow line is allowed to run out uncontrolled, it could whiplash, and strike a crewmember, causing severe injuries.

Once the tow line eye has been removed from the bitts the tug should be signalled that recovery of the line can commence. The tug's line should be lowered under control with the messenger tended carefully whilst the tug heaves in his line.

The crew tending the messenger must ensure they are standing clear of the loose messenger line flaked on the deck. Once the tug has recovered his towing line on deck, the messenger should be tended so far as possible whilst the tug crew are recovering it on deck.

Towing lines and messengers should not be let go and dropped into the water.

Mooring to a Buoy

The mooring operation demands a high degree of teamwork; it is of great importance that all crew involved in mooring operation are properly trained and equipped and must have a clear understanding of the duties of all the team as well as their own role and responsibilities.
To be a safe and efficient team on ship, the mooring operations must be properly planned. For most ships, mooring plans are developed and agreed prior to vessel arrival, and roles and responsibilities of each crew and officers are explained.

During the process of mooring to a buoy from a ship's boat, crew engaged in the operation must wear lifejackets. A lifebuoy with an attached lifeline should be available in the boat.
Means should be provided to recover a man overboard. Usually a boarding ladder but weighted so the lower rungs remain below the surface.

While mooring to a buoy from the ship, a lifebuoy with an attached line of sufficient length is to be available for immediate use.
When slip wires are used for mooring to buoys or dolphins, the eyes of the wires should never be put over the bitts, because at the time of unmooring it may not be possible to release the load sufficiently to lift the eye clear. To prevent accidental slippage of the wire eye(s) over the bitts or other obstruction, the eyes should be seized, partially closing the eye.

Procedure for Mooring to a Buoy

When the ship is about 1 000 metres from the mooring buoy, the boat containing a buoy party of three or four crew, in addition to the boat's crew, is lowered with all crew in the boat with life jackets and must be qualified swimmers.

The ship then comes to rest with the bow directly over the buoy; the boat pulls alongside the buoy and two members of the buoy party get on the buoy. The other crew takes the ends of the dip rope (like a throwing line), a messenger, and a mooring wire with a mooring shackle that is large enough to attach to the ring on the buoy. The shackle pin should be secured to the shackle with a lanyard to prevent its loss. The wire is shackled to the ring on the buoy. All the buoy party re-enter the boat which stands away from the buoy.

The capstan hauls the mooring/buoy taut; the mooring buoy wire now holds the bow of the ship in position.

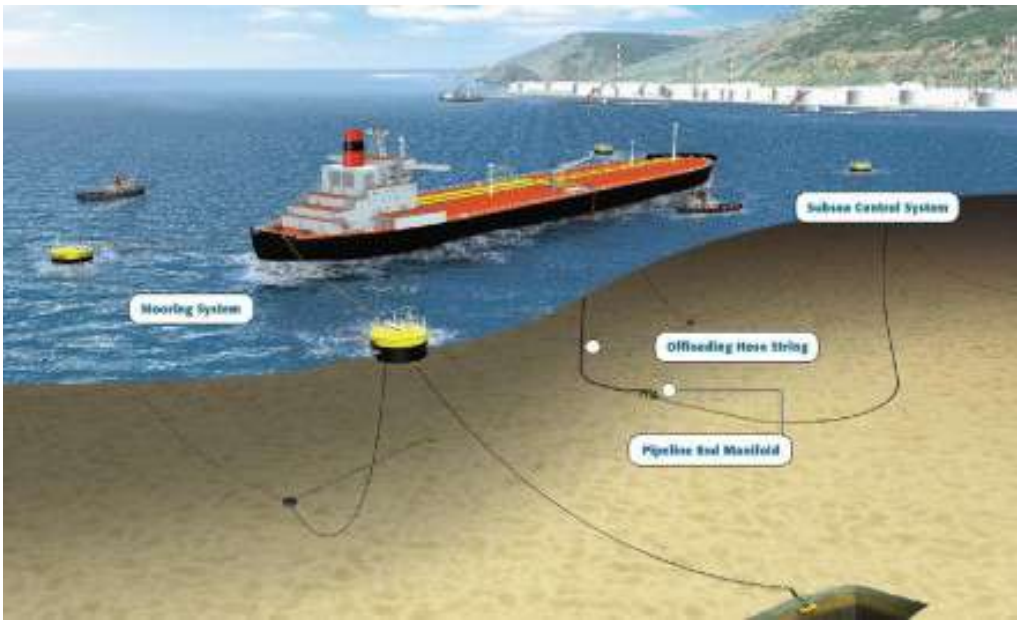
On the forecastle, the anchor is disconnected from its chain and another mooring shackle is secured to the anchor chain. The dip rope is fastened to the chain a short distance above the shackle. The chain with shackle is lowered into position by walking out the chain to the buoy where the buoy party again gets on the buoy and secures the shackle to the ring. Then the mooring buoy wire rope is slacked off, unshackled brought back aboard and the moor is complete.

Procedure for Slipping a Mooring

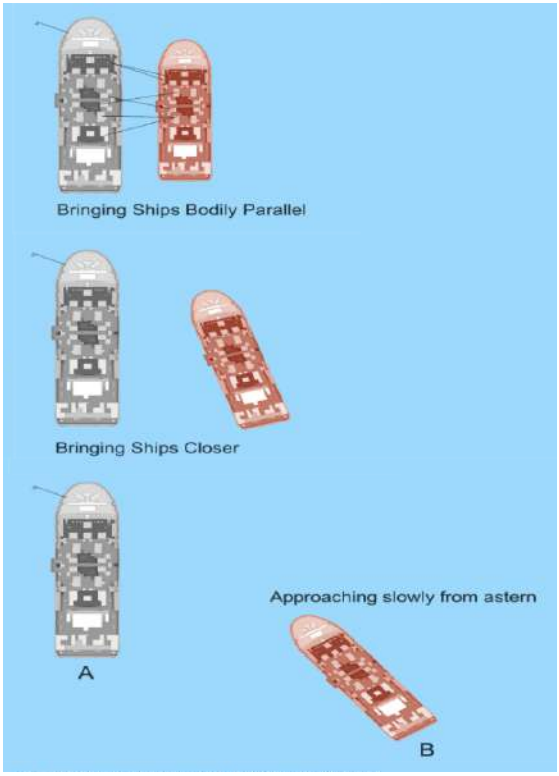
The mooring buoy wire rope is reconnected to the through the buoy ring and back on deck for use as a slip rope. A strain is taken on it, and the chain is unshackled. Should the ship be riding to a bight of the chain, an easing-out line is used to ease the chain through the ring while the chain is being hauled in. The ship now rides to the slip rope, and unmooring is completed by letting the end of the slip rope go and bringing it through the buoy ring back on board.

A **single point mooring buoy** consists of a buoy that is permanently moored to the seabed by means of multiple mooring lines. The buoy contains a bearing system that allows a part of it to rotate around the moored geostatic part. When moored to this rotating part of the buoy with a mooring connection, the vessel is able to freely weathervane around the geostatic part of the buoy. These serve as a mooring point and interconnect for tankers loading or offloading gas or liquid products.

A **multi buoy mooring (**Conventional Buoy Mooring (CBM)) system includes multiple buoys that are fixed to the seabed by means of mooring lines and marine anchors. The three to six buoys are permanently installed in a rectangular pattern that allows safe mooring of a vessel which is positioned between the buoys with tug assistance.



Ship to ship mooring is used for cargo transfer usually when one of the ships is at anchor. The mooring arrangement depends on the size of the ships. The anchored vessel is approached by the manoeuvring ship at an angle of approach as smaller as practicable. The approach is usually abaft the beam to draw alongside. Once there with fenders out, lines are attached.



Towing

There two main types of towing operations. One is '**deep sea towage**' as a result of a salvage operation or when the vessels engines have failed and she requires to be towed to a port. The other is '**harbour towage**' by a harbour tug which is normally during assistance of berthing a vessel.

Chain tow

Deep sea emergency tow connection

Ask the tow master of the tug the following questions:

- Can my anchor be stored on the deck of the tug boat (weather permitting)?
- Can the towage be performed with the anchor still connected to the chain - by connecting the tow wire to the anchor chain just above the anchor?
- Shall the anchor be disengaged from the chain while waiting for the tug?

1. Lash the anchor - if not already lashed.
2. Make sure that the chain stopper is engaged and locked.
3. Lash the chain so that it cannot slip back into the chain locker.
4. Disengage at the first Kenter link, which should be located quite close to the anchor – on the windlass side of the chain stopper. If no shackle is there; cut the chain by O_2/Acetylene.
5. Release the anchor lashing.
6. Ask personnel to step aside.
7. Unlock and release the chain stopper – with due regard to safety.
8. The anchor is thereby sacrificed.
9. Tie a strong mooring rope to the free end of the anchor chain.

10. Lower the chain to deck level.
11. When a tug boat is ready, lower an appropriate length of the mooring rope through the anchor pocket for the tug to catch it with minimal exposure.
12. When the tug has caught the rope, slack off the chain as requested by the tug, enabling her to connect the tow wire.
13. Engage and lock the cable stopper when the required length of chain has been paid out.
14. Repeat step 1 to 13 to the other anchor, if two tugs are engaged or if a tow bridle is required.
15. Tell the tug boat(s) slowly to start up towing – not to overstress the gear.

Safety

- The equipment used for towing should be adequately maintained and inspected before use to ensure that it is suitable for the towing operation.
- The ropes and wires used for a tow should be of adequate strength and free of defects and excessive wear.
- Non-essential persons should keep clear of the tow area.
- Seaman involved in a towing operation should be briefed in their duties and safety precautions to be taken.
- All those involved should wear suitable protective clothing, safety shoes, gloves and hard hats.
- Care must be taken to keep clear of bights of ropes and the 'snap back' zone should a tow line part.
- When letting go a tow line, seaman should keep well clear of the eye which should be lowered in a controlled manner using the messenger to reduce risk of injury.
- Suitable means of communication must be available between the deck and bridge of the vessel being towed when connecting, and, between the towing vessel and vessel being towed.

Harbour towage

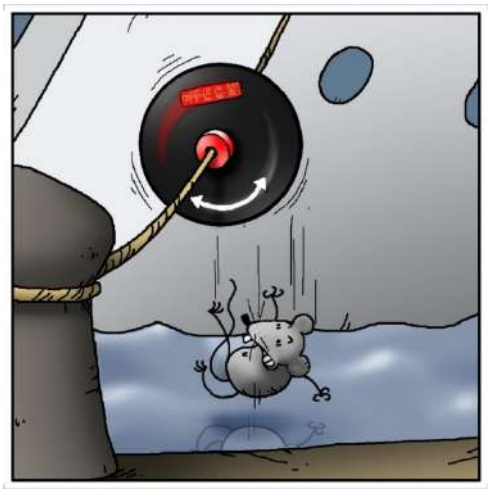
For harbour tow connection using a tow line supplied by the tug, you just pull the tow line on board using the messenger and place the eye of the tow wire over a strong suitable bollard located on board. Some tugs do not supply a tow line and then a suitable strong mooring rope or wire must be supplied to the tug from the cargo ship. This mooring line must have a strong eye which is placed in a quick release towing hook on board the tug.

Safety

- Never stand in the vicinity of a harbour tow line, especially when it is under a great deal of strain.
- Towlines should always be let go in a controlled manner using the messenger provided. **Do not** just drop the tug's tow line overboard.
- Sharp angle leads must be avoided.
- Chaffing of the tow line must be prevented by using fairleads or 'Scotchman'.
- When a tow line given to a tug by a ship is released, it should be retrieved as quickly as possible so as to ensure it does not foul the propeller.
- Always be aware of tow lines parting under strain and therefore remain outside of the 'snap back' zone.
- Ensure you have good communication between the deck and the bridge.

Rigging Rat Guards

Required by all port authorities to prevent the spread of diseases by rats. All lines ashore should be rigged with guards as well as power cords and hoses.



CHAPTER SEVENTEEN
WINCHES AND WINDLASSES

Safety

As with all work on ships the appropriate PPE must be used:

- Coverall
- Safety boots
- Safety helmet
- High visibility vest
- Gloves
- Buoyancy vest if working near shipside or quayside

A winch is a rotating drum driven by anything from a hand crank to a large prime mover that hauls on a rope, wire, or chain; it also allows the operator to pay out the line.

Anchor Winch/Windlass

A windlass on the other hand is a special version of a winch or capstan used to recover or pay out a heavy weight, such as an anchor windlass, which on merchant ships are frequently doubled up, to recover either anchor with one device.

The recovered chain is stored in a chain locker below the deck, forward of the collision bulkhead, and the bitter end of the chain is connected to a pad eye, to avoid letting all the chain disappear into the ocean. The anchor is stored against the hull by the hawse pipe, with the anchor stock stored in the hawse pipe.

Mooring winches

Mooring winches secure the shipboard end of mooring lines, provide for adjustment of the mooring line length and compensate for changes in draft and tide.

Winches can be categorised by their control type (automatic or manual tensioning), drive type (steam, hydraulic or electric), by the number of drums associated with each drive, by the type of drums (split, undivided) and by their brake type and brake application (band, disc, mechanical screw, spring applied).

Automatic tension mooring winches are self-tensioning winches designed to heave-in automatically whenever the line tension falls below a certain pre-set value. Likewise, they pay out if the line tension exceeds a pre-set value. The use of the self-tension winches is not recommended except for mooring deployed at 90° to the ship axis.

Manual tension mooring winches always requires a person to handle the controls for heaving or rendering.

Non-split drum mooring winch. Undivided drum winches are commonly found on smaller ships. It is often difficult to spool and stow the wire on such a drum satisfactorily; when wires are handled directly off the drum, the final turns of the outer layer when under tension tend to bite into the lower layer. This could result in possible wire damage and difficulties when releasing the line. To reduce this problem, the winch with non-split drum should be placed at a sufficient distance from the fairlead to ensure that the wire can be properly spooled.

Split drum mooring winch. A winch with a drum divided by a notched flange into a tension section and a line storage section.

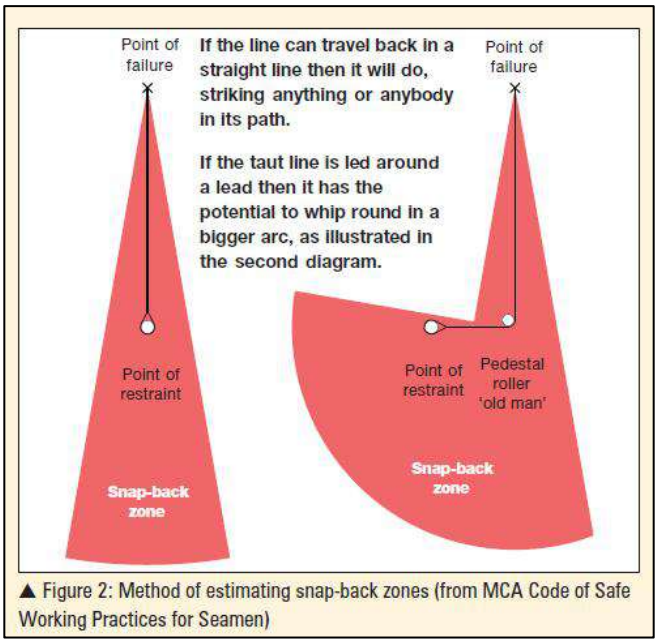
Safe use of winches requires that all line handlers are thoroughly trained in their use and have an understanding of what can go wrong, especially about positioning all handlers to avoid accidents such as snap backs when lines part underload.

Safe handling of winches
The maximum number of turns on a Drum should be 2 to 3 for rope and 5 to 6 for wire

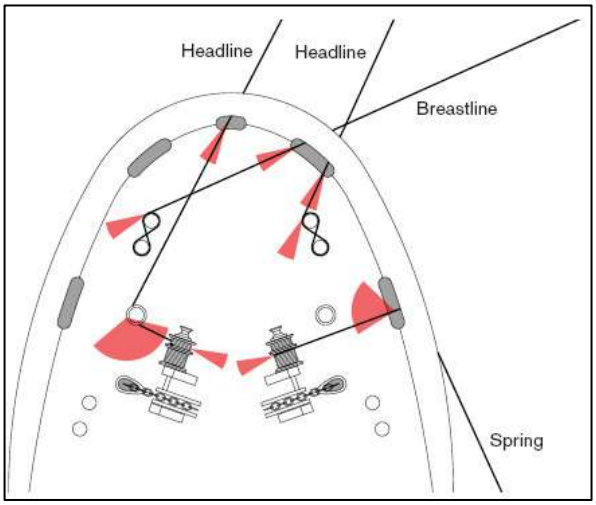
Know how to let the line ride on a drum when it is turning
Identify safe working practices around the winches with the help of the crew.
Train all deck on how to work around the winch safely and the hazards that are involved.
Ensure that crewmembers are continuously trained.
Safeguards:

- Guard winches where possible; use automatic guide-on gear where possible.
- Put non-slip paint or decking around winch operation areas;
- Keep the area clean, tidy and free of obstructions.
- Make sure that all brakes, levers and safety devices are inspected and operational.
- Do not allow the winch to be operated without someone within reach of the controls.
- Ensure that a dedicated winch operator is available when a rope is being worked
- Make sure you are trained in managing the hazards associated with the winch.
- Take into account whether you are part of the operation or not.
- Stand in the correct position.
- Stand on a solid platform when working around the winch.
- Watch where your feet are and where the wires/ropes are.
- Be aware of the dangers from vessel movement in rough weather.
- Make sure that when working a rope on a drum end the rope is flaked out and clear of the working area before commencing the operation.

- Make sure all slack is taken up before taking the required number of turns to avoid riding turns on the drum. Have no more than three turns around the drum end.
- Care must be taken to avoid excessive surging on the drum end.
- Signs should be posted to warn of danger areas.
- Everyone should be aware of the snap back zones.



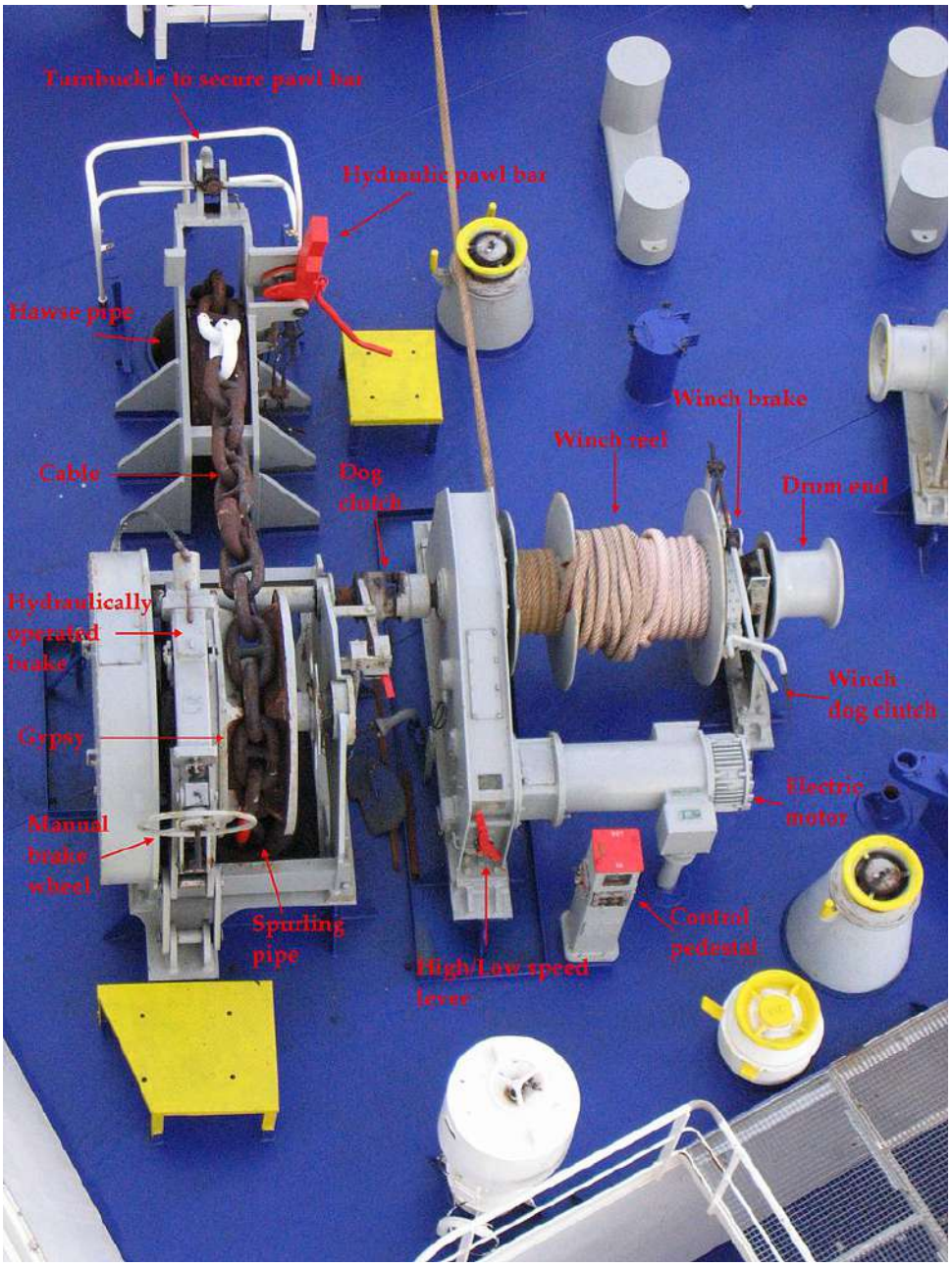
▲ Figure 2: Method of estimating snap-back zones (from MCA Code of Safe Working Practices for Seamen)



CHAPTER EIGHTEEN
ANCHORING AND ANCHORS

Use and Operation of a Windlass

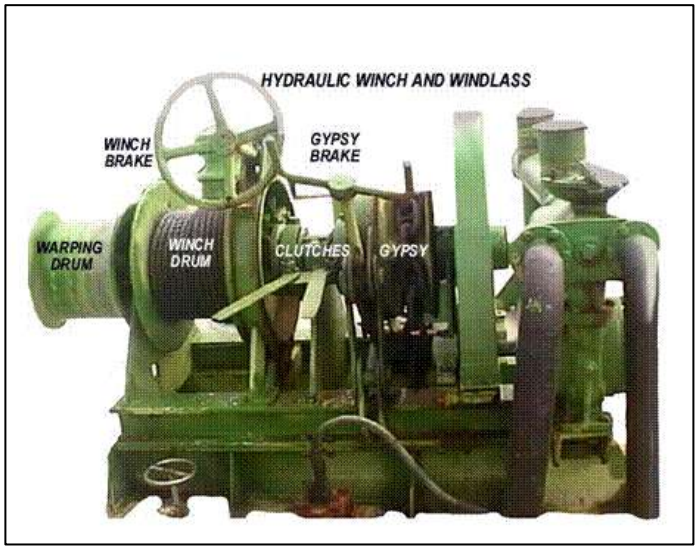
The anchoring process requires the crew on the foredeck to be trained and competent to reduce the chances of accidents occurring. All vessels should have an anchoring plan.

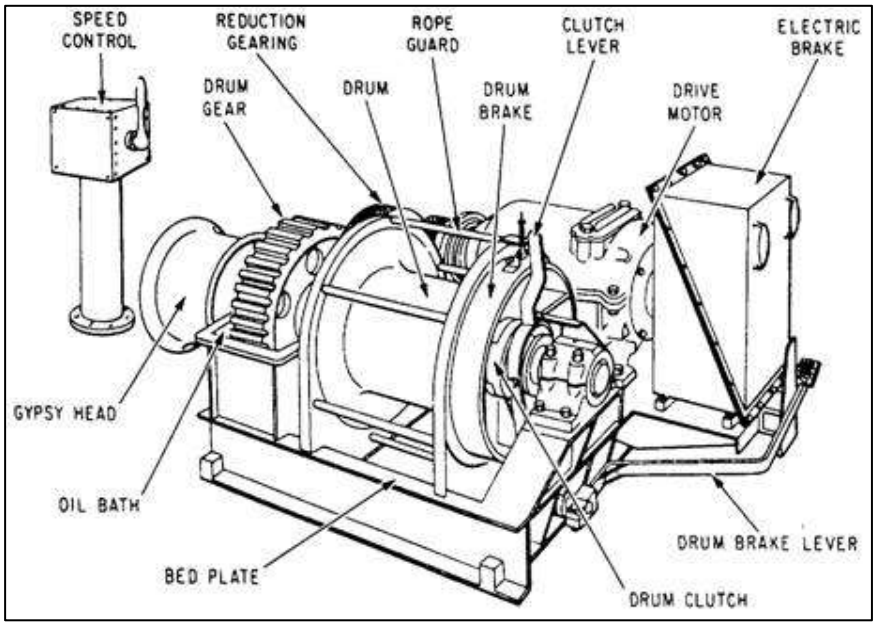


They must wear the correct PPE and also have good communications with the bridge.

The anchoring party should wear protective clothing, including safety helmet, safety shoes, gloves and goggles, to protect from injury by rust particles and debris that may be thrown off the cable during the operation. Where the noise levels generated may be harmful, hearing protection may be considered; however, the time exposed and the greater risk from impaired communication should be taken into account

Parts of a Windlass





The foredeck is the centre of operations and the anchor party must know its layout and the equipment thoroughly.

The necessary equipment available should include:

- Detachable link toolbox set
- Chain stopper wrench
- Chain cable jack or anchor bar
- Maul (Large hammer)
- Radios/Telephones
- Anchor buoy and line

Planning for Anchoring

The Master located anchoring position before entering the anchorage area and his planned approach includes speed reduction in ample time and orienting the ships head prior anchoring to stem the tide or wind whichever is stronger.

Decide on which method of anchoring to be used and the number of shackles depending on the depth of water, expected weather and holding ground.

It is suggested the use of radar parallel indexing technique, an effective tool in manoeuvring approach to anchoring position. A fix reference point is necessary in establishing the intended anchoring position relative to this fix point.

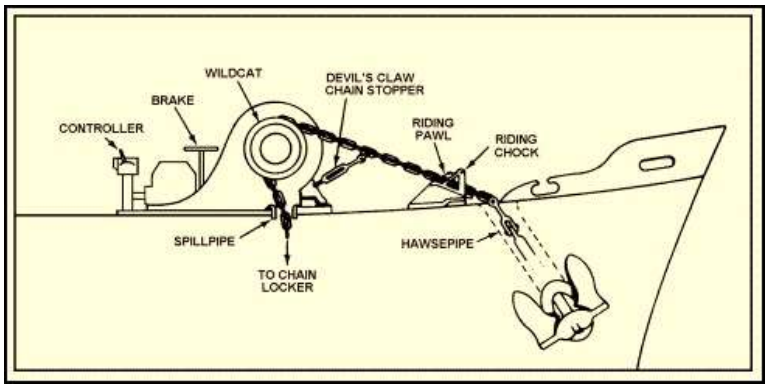
Emergency Anchoring

Anchors should be ready for letting go on arrival and departure port, when in anchoring depths. As a minimum, any wire lashings are to be removed and the anchors held on brake. In critical situations, to arrest the movement of the vessel, after stopping/reversing the main engine, it is preferable to let go both anchors simultaneously instead of one.

Anchoring

- The party must be briefed with emphasis on safety.
- The chain locker is checked for any loose gear that may become wedged in the chain pipes or come flying out, endangering the personnel on deck.
- Before using an anchor the brake must be securely on.
- All securing devices must be removed.
- The windlass is tested; the anchor in the hawse is freed.
- The deck office and anchoring party must have communication with the vessel's bridge.
- During anchoring, they should stand aft of, or at a safe distance from, the windlass/capstan and be mindful of the potential risk of snap-back.
- Where the means of communication between bridge and anchoring party is by portable radio, the identification of the ship should be clear to prevent confusion caused by other users on the same frequency.

- The brake is set and the gypsy/wildcat is disengaged.
- All but one stopper is taken off, and the anchor buoy is shackled to the chafing chain or pendant.
- Before the anchor is let go, a check must be made that there are no small craft or other obstacles under the bow.
- It is recommended that the anchor is 'walked out' clear of the pipe before letting go. For very large ships with heavy anchors and cables, the anchor should be either walked out at intervals or all the way to avoid excessive strain on the brakes (and on the bitter end) if the brakes fail to stop the anchor and cable.
- When the anchor is let go from the stowed position, if, on release of the brake, the anchor does not run, seafarers should **not** attempt to shake the cable. The brake should be re-applied, the windlass placed in gear and the anchor walked out clear prior to release.
- Cable should stow automatically. If, for any reason, it is necessary for seafarers to enter the cable locker, they must first take proper precautions for entering an enclosed space. They should stand in a protected position and be in communication with the windlass/capstan operator.
- Anchors that are housed and not required should be properly secured to prevent accidental release.
- On ships with two chain gypsies/wildcats both anchors should be made ready for letting go. Bridge communicates to the foredeck information which anchor to use, depth of water, type of bottom, scope of chain to be used, and any other information pertinent to the operation.
- When letting go by the stopper, two Seaman take stations at the stopper. When the command "let go" is given, one crew pulls the pin from the stopper tongue. The other with a maul, knocks the bail off the tongue of the pelican hook and steps clear, and the chain will pass through the hawse.
- On the bridge the anchor ball is hoisted.
- When the anchor is dropped and hits bottom, the brake should be set to help prevent piling. Reports are made to the bridge informing them on the initial status of the anchor, how much chain is out, what position it tends, and what strain it has on it. The bridge is also informed of whether the anchor buoy is watching. (This means that the buoy has surfaced and marks the location of the anchor.)



Anchor being prepared for release

- As the ship gains sternway, the anchor chain is veered out by the brake about a shot at a time to control the speed of the chain. This is continued until sufficient chain is out to ensure that the pull on the anchor is horizontal on the bottom. The brake is now applied, and the anchor is set by the ship's backing down and riding on the chain.
- When the desired scope of chain is out the brake is set, and the stoppers are applied and evened up. The brake is taken off; then the chain is slacked between the windlass and the stopper. The brake is set, and the gypsy/wildcat is left disengaged.

Anchor Watch

An anchor watch is always to be kept when the ship is at anchor. Anchor Watch Checklist is to be used.

Scope of Chain

Under normal conditions, a ship usually anchors to a scope of chain between four and seven times the depth of the water. This usually depends on the type of anchor rode :

- if chain then a ratio of 4:1
- if chain and line then 5:1
- if line the ratio of 7:1 is used

Dragging

The main reasons for a vessel dragging its anchor are:

- Not enough cable used for the depth of water
- Weather conditions including wind and tide
- Wrong anchor type for the bottom
- Poor holding.

It is extremely important for the bridge to contact the port authorities in case of assistance required sooner rather than too late.

Actions in the Event of Dragging

- Master to be informed without hesitation.
- Inform engine room and start the main engine with the permission from the master and give power to windlass if it is not already given. Make the vessel ready for manoeuvring
- Stop all cargo operations and prepare vessel for manoeuvring. Let go cargo barges and crane barges if they are alongside
- Inform and alert Vessel traffic system (VTS) and other vessels nearby about the condition and inform about the actions taken. Seek permission for re-anchoring

- Start heaving up the anchor and once the vessel's manoeuvrability is restored, shift the anchorage position where drifting can be safer or take to the open sea
- Deploy more cables or drop a second anchor (not recommended for big vessels) before the speed of dragging of the vessel increases. This can stop the small vessel from dragging anchor at very early stage before the ship is pressed to leeward side with increasing speed
- Use bow thrusters, main engine and steering to manoeuvre. It becomes more difficult to weigh anchor when the vessel is pressed more to the leeward side and takes considerable amount of time. Use bow thrusters for stemming the wind. Do not override the anchor especially in shallow waters as the vessel may impact on the anchor during pitching.
- If the scenario permits, let the vessel drag in a controlled manner. But this is not recommended in areas where offshore work such as oil and gas operations are being carried out, which can result in damaging the submerged pipe lines, cables etc.
- Release the bitter end and let go the anchor completely, when weighing of anchor is not possible. A ship without minimum of 2 anchors is not considered to be sea worthy, a careful assessment is to be made prior making this decision
- Call (tugs) for assistance if the weather permits

Most accidents collision or grounding happens while the vessel is at anchor mainly because of no early prediction of dragging anchor. Time plays a vital role in area of high vessel density and this time lapse results in

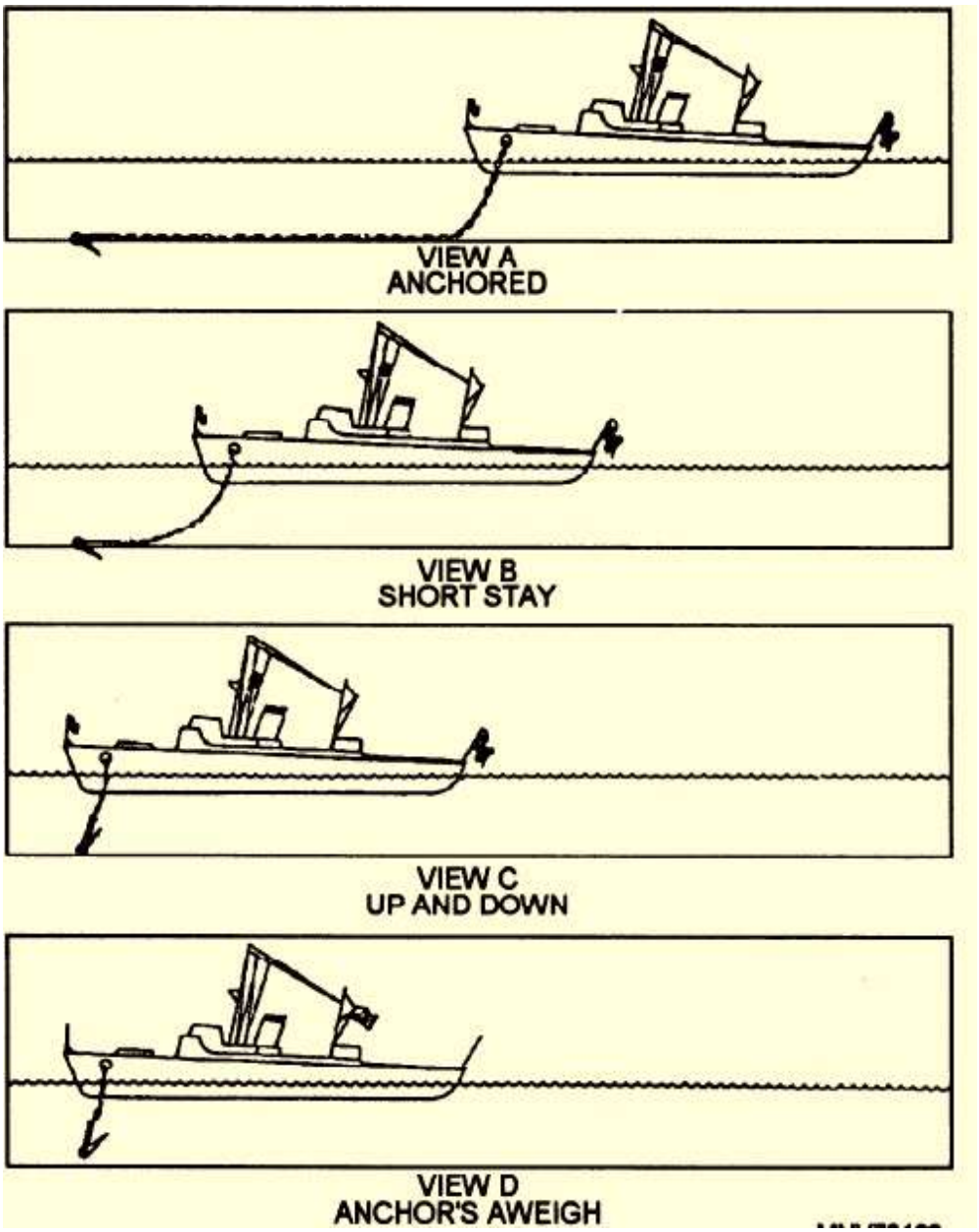
Weighing Anchor

For weighing anchor, the same crew should be available on the forecastle.

As well as the equipment for anchoring, there must be a grapnel for retrieving the anchor buoy, and a saltwater hose must be rigged to wash mud from the chain and the anchor.

- The windlass is tested.
- Brake is set, and the riding stopper removed from the chain. The anchor is now engaged, held by the brake and backed up by the housing stopper.
- Bridge is informed the foredeck is ready to haul in
- The ship will be riding on its anchor chain, as shown in view A
- If the wind or current is strong, the ship may power ahead to take the strain off the ground tackle.
- The brake is taken off and the chain is heaved in enough to take the strain off the stopper which is cast off.
- Reports are made on the direction that the chain is tending, the amount of chain out, and what kind of strain is on the chain.
- The chain is heaved in just short of breaking out the anchor, as seen in view B. The bridge is notified when the chain is at "Short stay".

- When the flukes of the anchor have broken out and the crown still rests on the bottom, the bridge is notified “Anchor breaking ground”, and then “Anchor is up and down”, as seen in view C .
- When the anchor is free from the bottom, the bridge is notified “Anchors aweigh”, as seen in view D and the anchor ball will be hauled down.
- When the anchor comes into view and its condition can be noted, the report “Anchor in sight” is made and told if the anchor is clear, fouled or shod (meaning caked with mud and bottom).
- The anchor is reported as housed when the shank is in the hawsepipe and the flukes are against the ship’s side.
- The anchor buoy is recovered as soon as possible, and the report is made to the bridge when the anchor buoy is on board.
- The anchor is again made ready for letting go and kept that way until the anchor detail is told to secure it after the ship is outside the harbour or channel.

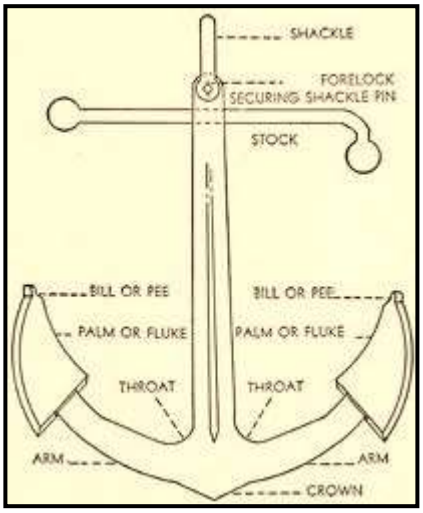


- To secure the anchor for sea, the brake is set; then the stoppers are passed and evened
- up (meaning that they take equal strain). The brake is taken off; then the chain is slacked between the wildcat and the stopper.
- The brake is set and the wildcat is disengaged. To prevent water from entering the chain locker, the buckler plates are secured over the chain pipes (on some ships, canvas chain pipe covers go over the plates).

TYPES OF ANCHOR

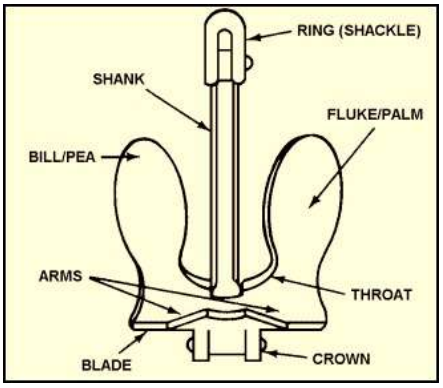
Admiralty Pattern Anchor

The admiralty pattern anchor, sometimes also known as a 'fisherman's anchor', has been in use for many years. It is difficult to stow this anchor because it contains a stock. It has very good holding power roughly three to four times its own weight.



Admiralty or fisherman anchor

Stockless or Patent Anchor



Stockless or Patent anchor

The stockless or patent anchor is by far the most common anchor used in use today on large ships. The head of the anchor is secured to the shank with a hinged bolt, which allows the arms to form an angle with the shank of 45°. Because the arms and flukes can swivel between vertical and 45° it makes it very neat and easy to stow these anchor when not in use. The head of the anchor is manufactured from cast steel or forged iron. The hinged bolt and the shackle are made of forged iron.

THE USE OF ANCHORS IN EMERGENCIES

Emergencies that require the use of anchors include, loss of engines or steering, drifting towards a lee shore or the possibility of grounding. They can also be used to turn tightly when there is not enough turning room for the ship.

In the event that the vessel risks being driven ashore or grounding then the anchors should be prepared and lowered into the water as soon as possible to minimize damage.

Emergency anchoring to repair engines or steering will require that the depth is not too great.

Snubbing Round

Used for a tight turn when there is not sufficient sea room. This is achieved by using one of the ship's anchors as follows:

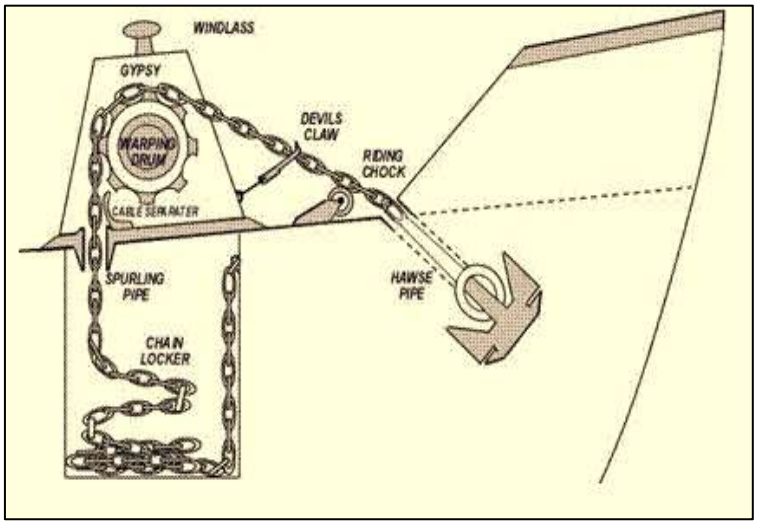
- The anchor party must be carefully briefed beforehand.
- PPE worn as appropriate.
- The anchor party must be clear of the foredeck while the turn is made as the strain will be great on the cable and may possibly break if things go wrong
- The manoeuvre requires the speed of vessel to be reduced to as slow as possible but maintaining steerage way.
- Depending on which way the turn is planned either the port or starboard anchor should be let go at short stay. Use the anchor on the side the turn is planned, ie port if the turn to port is required.
- Allow the cable to lead aft dragging the anchor along the bottom. The cable will act as a spring reducing headway and pulling the bow towards the side on which the anchor has been dropped.
- Use maximum helm and enough engine power to bring vessel through 180 degrees, this may require "backing and filling" i.e. going ahead and astern.
- Where and how much brake is important so as not to part the cable
- Once the turn is complete the Bridge will instruct the anchor party to retrieve the anchor.

Stowage of Chain Cable and Securing of Anchors

The anchor chain is fed from the capstan along the deck of the foc'sle head through a pawl and down through a hawse pipe in the deck exiting at the ships bow. From here the chain drops downwards and is connected to the anchor using a shackle whose hardened steel pin passes through a hole drilled in the anchor central shank.

The anchor chain is stored in the chain locker; where its end is secured to a ring bolt welded to the chain locker bulkhead. This is known as the anchor chain's "bitter end".

Chain lockers are usually self-stowing which means that no one is required to tend the chain as it is stowed. In any event if someone has to enter the locker it is to be treated as an enclosed space entry and the procedures in the COSWP Chapter 15 should be followed and the correct PPE used.



The chain locker is arranged in the position forward of the collision bulkhead. To separate the locker into port and starboard compartments a centre line bulkhead is fitted. This bulkhead does not extend to the crown of the locker, but allows working space above the two compartments.

Each cable is fed to the appropriate locker compartment through port and starboard chain pipes from the forecastle deck.

Securing the anchor for sea requires the hawse pipes and spurling pipes to be covered and the anchors made as follows:

1. the brake is set
2. the stoppers are passed and evened up (meaning that they take equal strain)
3. the brake is then taken off
4. the chain is slackened between the wildcat and the stopper
5. to prevent water from entering the chain locker, the buckler plates are secured over the chain pipes

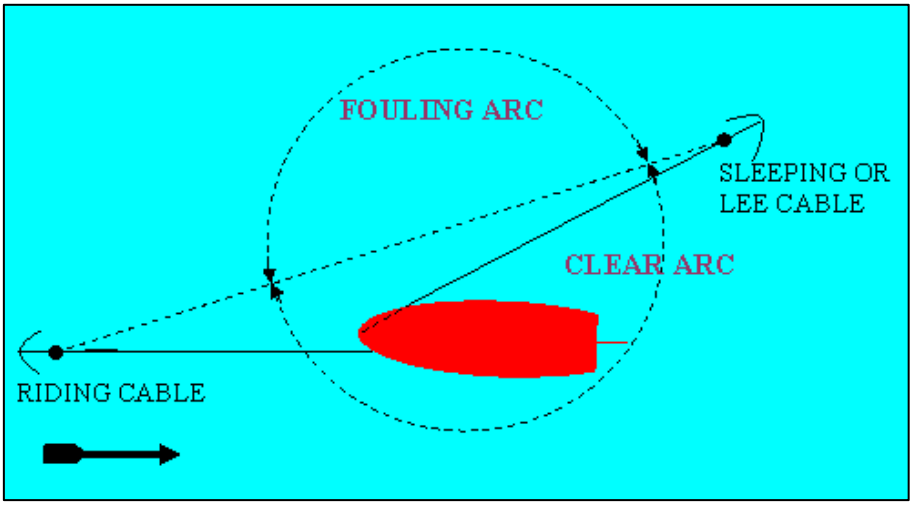
ANCHORING OPTIONS

Running or Bahamian Moor

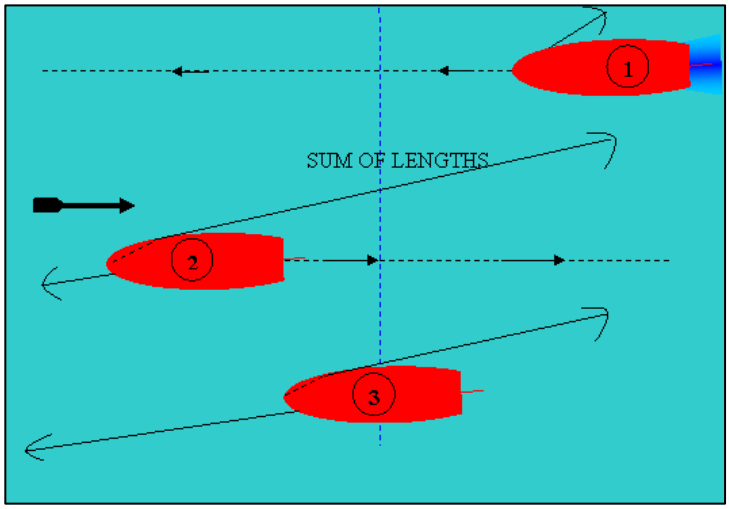
The diagram shows how this works to restrict swinging room.

The mooring location should be approached and the first anchor let go about 4 or 5 times from the final position of the bow. The chain is allowed to run out while the vessel continues on its course. The amount of chain should equal about 2 times the final amount needed.

Once that is reached the second anchor should be deployed and then the vessel is hauled back by the anchor windlass shortening the first anchor chain. Once both chains are about equal the chains should be made fast normally. Each anchor should be marked by an anchor buoy.



Bahamian moor



Running moor

Open Moor

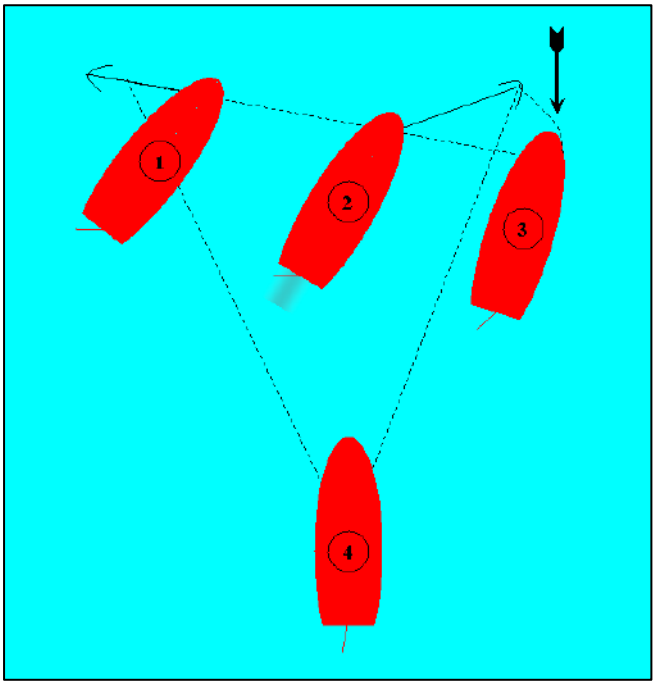
Used when holding may not be very good or in the event of heavy weather. The vessel is anchored with both anchors leading ahead.Both the anchors are set about 1 point on each bow

Procedures

1. Approach the anchorage with wind or current on one bow.
2. Weather anchor or upstream anchor is let go on the run (1).
3. The headway continued and cable is laid up $^{1}/_{3}$ rd of the final length of the cable.
4. The second anchor is let go (2).
5. First anchor snubbed at the gypsy.

6. The vessel brings-to on her weather cable. It gradually grows taut to windward.

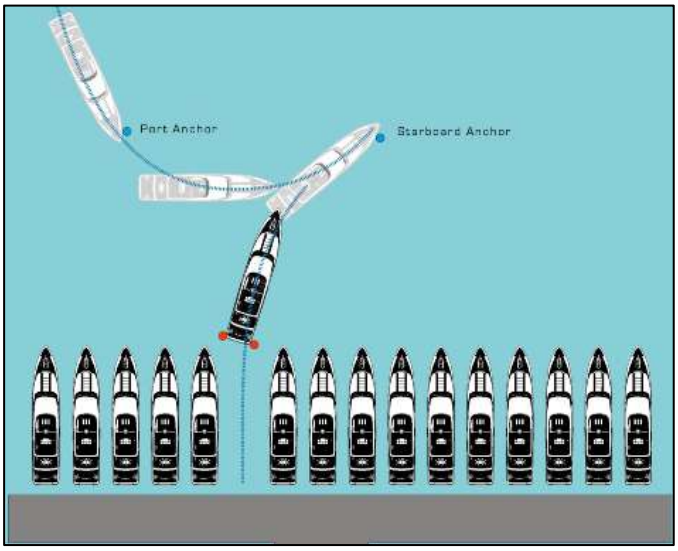
- Both the anchors are veered, positioned about 1 point off each bow



Open moor

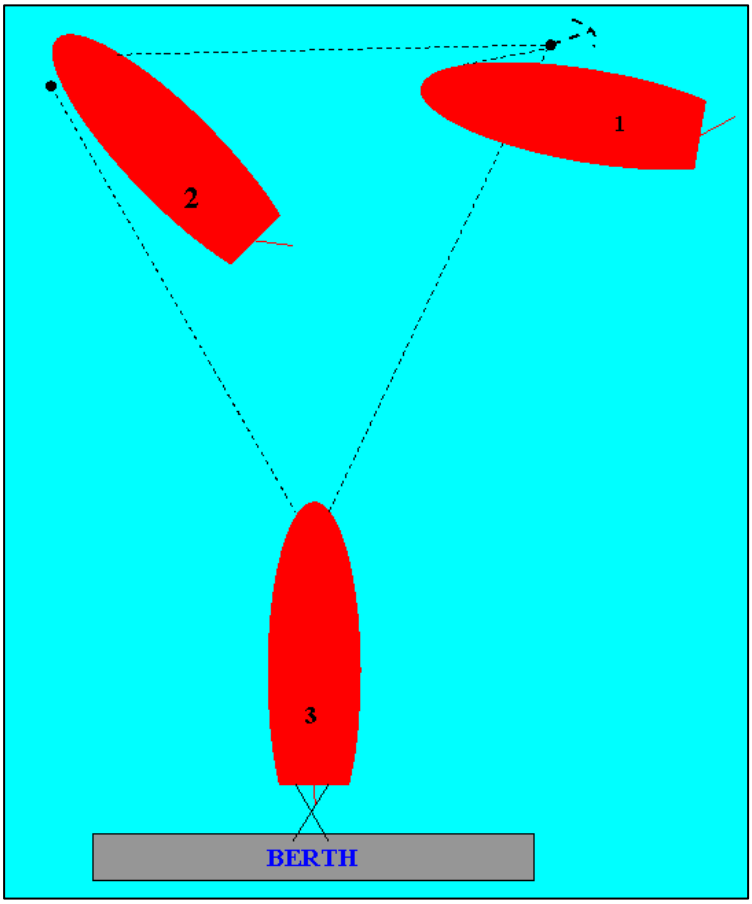
Mediterranean Mooring

Used when there is not enough space at the wharf for a number of ships or boats to be moored, very common in marinas in the Mediterranean. The vessel will usually be moored perpendicular to the wharf with its stern transom in to the jetty. (It can be done bows to also, but for ease of access stern to is the norm.



The disadvantage of Mediterranean mooring is that it is more likely to result in collisions; it is not practical in deep water or in regions with large tides.

After lining up, the vessel is backed into the space and the anchor is dropped in such a way so that the scope is about 4/7:1. The cable must be paid out as the vessel moves astern but the anchor should be snubbed to allow it to dig in.
The anchor must be dropped away from the other anchor lines or the lazy lines, which are used to retrieve heavy pre-embedded bow lines substituting the anchor.



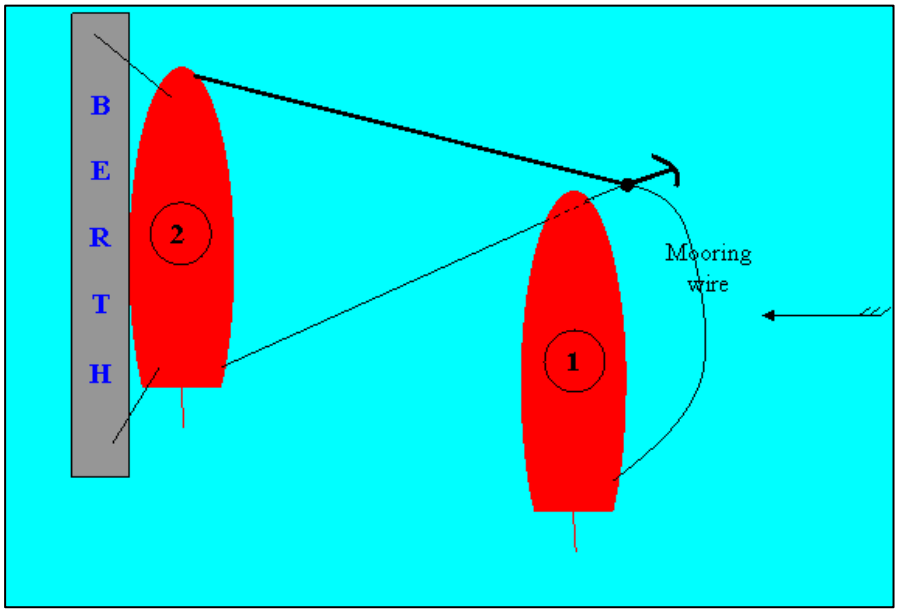
Fenders are arranged along the sides to protect the hull of the ship/boats; crew with roving fenders also need to be available.

When the wind is abeam, the first line ashore will be the one to the windward.

The stern lines are usually crossed to help reduce potential lateral movement.
Once the vessel is firmly moored the passerelle can be deployed.

Baltic Mooring

This can be used with a strong on shore wind for berthing without tugs. It will also assist leaving a dock with an onshore wind. The master or the pilot will use the ship's anchor and mooring wire as a stern line to the anchor.



This is achieved by shackling a wire mooring line to the anchor to be deployed which is led aft to the stern mooring position.

During the approach to the berth, anchor is deployed approximately abeam of the final docking position; the ship then manoeuvres to the dock controlling its speed downwind by slowly easing on the anchor cable and stern wire.

The process is:

- The stern wire is passed from the aft deck on the offshore side outside of the hull and clear of any protrusions like the gangway, the pilot ladder etc.
- The anchor is released a little from the hawse pipe, and a man is lowered with a bosun's chair shackle the wire to the anchor. An anchor buoy should also be attached to mark its position.
- The other end of the wire is taken 'on turn' upon a mooring winch through a bight.
- When the ship is abreast of the berth and falling beam on downwind, the anchor is dropped and the position is controlled by use of engines rudder and thrusters.
- When the anchor is snubbed, the wire from the stern is controlled and with the chain is paid out simultaneously while the on-shore wind pushes the vessel horizontally to the berth.

- As soon as the vessel is alongside springs, head and stern lines are passed ashore with the heaving lines and the scope of the anchor adjusted accordingly so as to bring the ship slowly alongside the berth.
- Normally the anchor is dropped 30 to 40 metres feet upwind of the berth but will vary with ship type and conditions.
- Anchor ball is then hoisted.

ANCHOR CABLES

Care of Anchor Cables

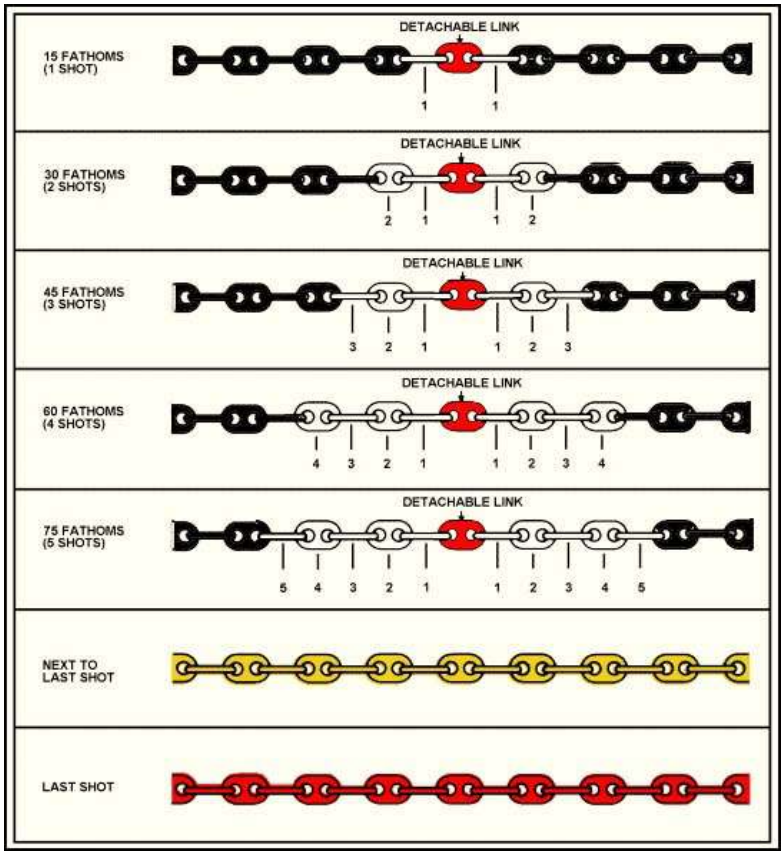
During a survey both anchors cables are laid out and a visual inspection takes place. Firstly, all loose rust particles, dirt and old seizing wire is removed using high pressure water washing or sand blasting. The surveyor will then check the thickness of the anchor cable at various positions and if it is found to be worn or wasted more than 11% then this shackle length must be replaced. The joining shackles are normally also opened, inspected for excessive wear, re- assemble the chain and mark it as explained below. In many cases to extend the life of the chain it is common practice to end for end the chain.

Preparing the anchor chain for marking

Marking of the Anchor Cable

Shackles or Standard Shots of chain are connected to make up a ship's anchor cable. A standard shackle/shot is 15 fathoms in length = 90 ft/28m

1 Shot Red (15 fathoms) 1 Turn of wire
2 Shots White (30 fathoms) 2 Turns of wire
3 Shots Blue (45 fathoms) 3 Turns of wire
4 Shots Red (60 fathoms) 4 Turns of wire
5 Shots White (75 fathoms) 5 Turns of wire
6 Shots Blue (90 fathoms) 6 Turns of wire
Next to last shot is painted yellow
Last shot is painted red



CHAPTER NINETEEN
HATCHES

Cargo storage spaces on any type of vessel, need to be well protected in order to preserve the cargo and prevent any kind of spoilage. Cargo spaces need to be air and water tight for conserving the cargo goods for a longer time.

They also need to be watertight for the integrity of the ship and be able to withstand green water coming aboard.

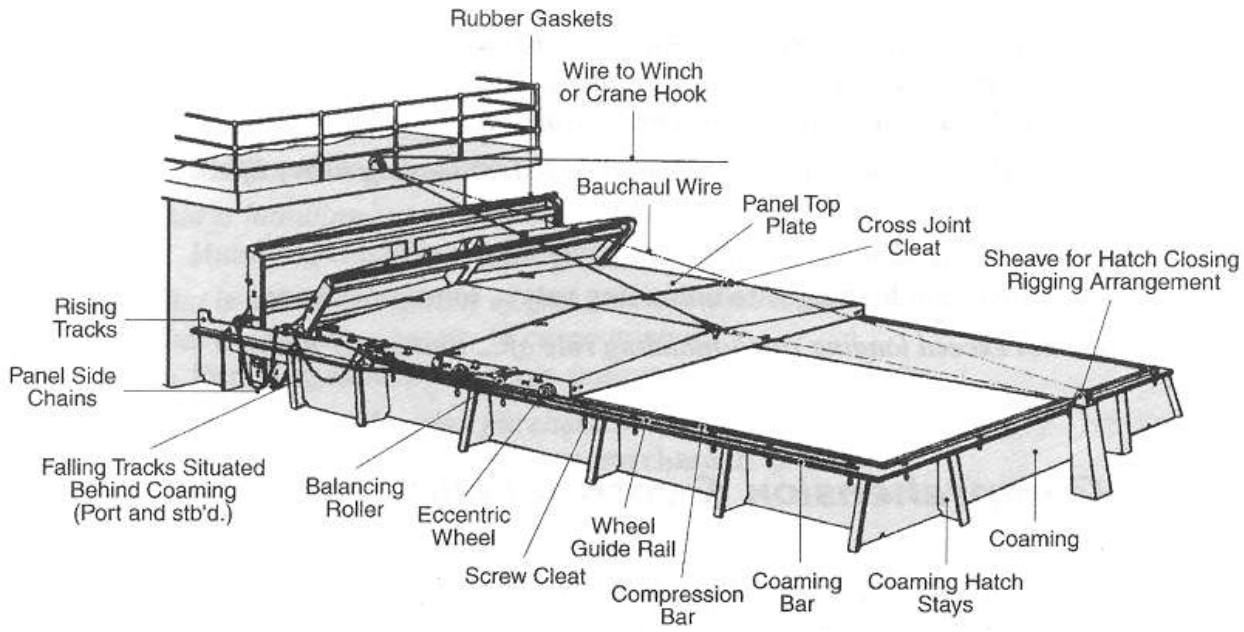
Tight-fitting hatch covers are extremely important to protect cargoes from moisture and adverse weather conditions, especially rain. Failure of the covers leads to spoilage of goods.

Hatch covers close off the hatch opening and makes it water tight.

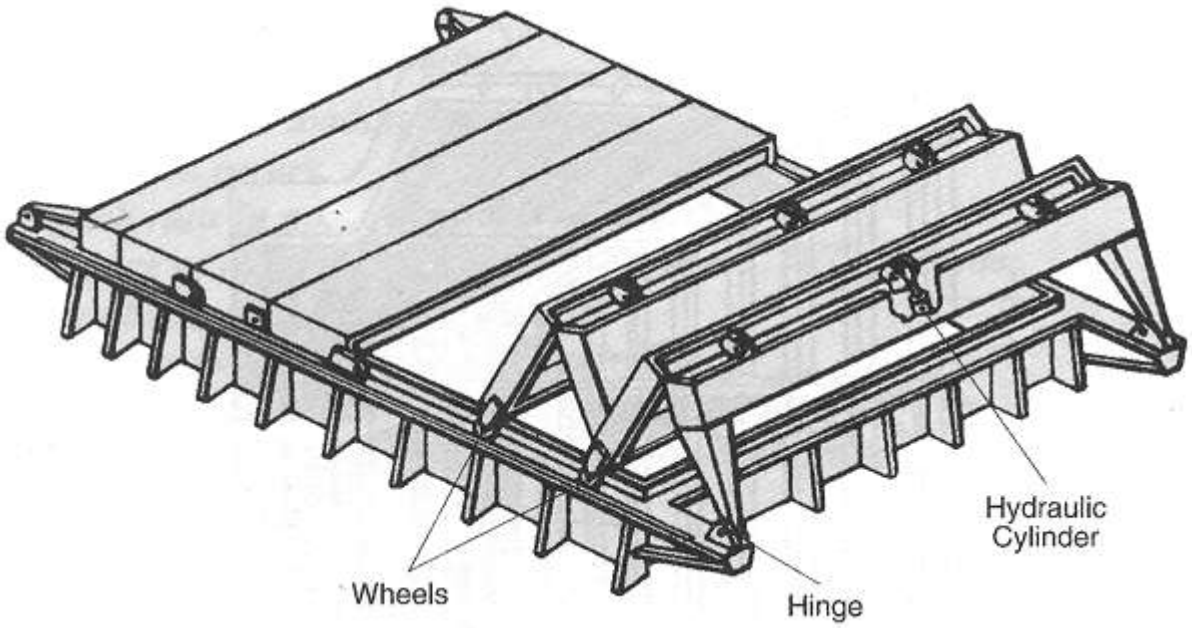
Steel hatch covers are mostly used; they consist of a number of steel covers linked together and made to make the opening and closing of the covers as quick as possible in order to facilitate faster cargo handing process.

Single pull hatch cover

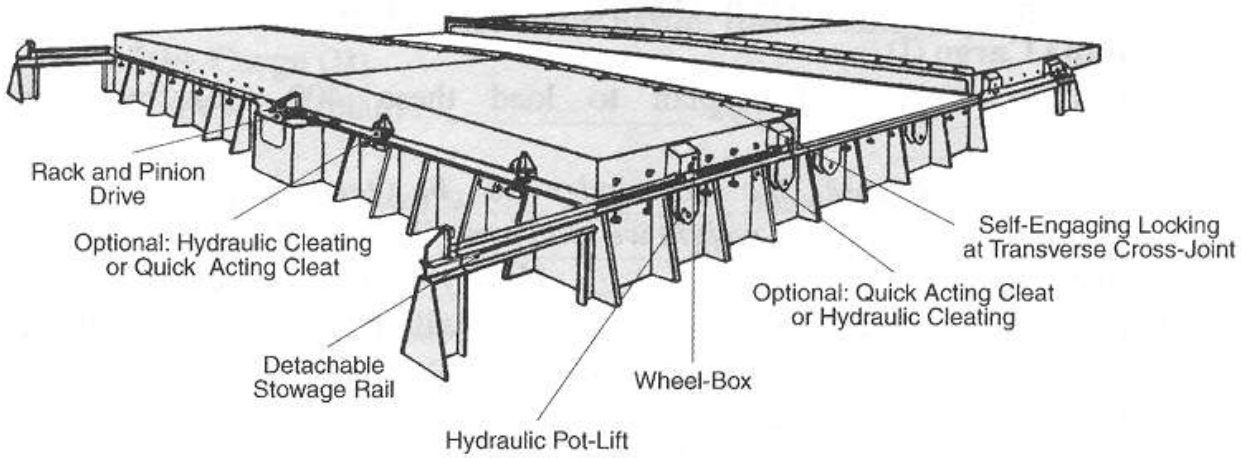
The hatch cover moves on rollers attached to tracks fixed on the hatch coaming. The whole comprises series of steel covers linked together by chains. When the cover is opened, the individual steel covers ride up and tip onto a stowage tank at the hatch end. Most of the hatch covers found on board a ship are controlled hydraulically.



A single pull cover showing the principal fittings



Multi-panel end-folding hydraulic cover for weather deck use



Side-rolling covers with rack and pinion drive and hydraulic lifting and clearing

Hatch Cover Maintenance and Safety Inspection

Covers and coamings should be well painted and free from significant corrosion, cracks and distortion.

During an inspection look for:

- Holes and permanent distortion in the plating
- Distortion of beams and/or stiffeners on the underside of the top plate
- Corrosion around welded connections of beams or stiffeners
- Cracking of connecting joints and welds

Other Checks

- Hatch movement should be smooth. If violent movement is observed, investigate and remove the cause.
- Towing and back haul wires should be free of kinks or broken strands. Repair or replace damaged or worn wires. Use extreme care when handling wires to avoid injury.
- Hydraulic system for leaks
- Hinge pins: look for wear, particularly at cross joints and hydraulic cylinders. Worn hinge pins can cause hatches to slew and misalign at the cross-joint(s).
- Misaligned hatch panels which will leak.
- Condition and adjustment of drive chain tensioners
- Check cleats and wedges for physical damage

Regular adjustment and repair 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.

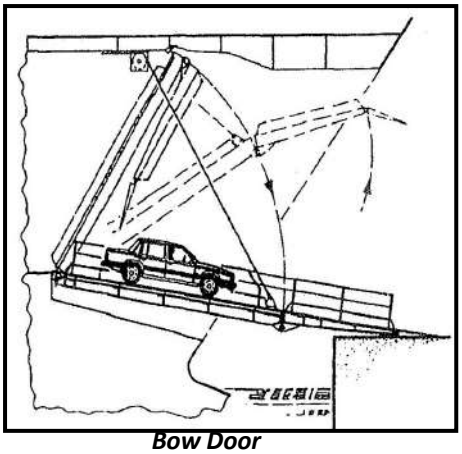
Always follow proper fire prevention safety procedures. Make sure that cargo spaces are free of cargo and combustible material. When conducting extensive structural repairs, remove the hatch covers to shore.

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.

Ramps and Side Doors

On ro-ro vessels and car carriers you will find bow doors, stern doors, side doors and ramps. These are used to load the cargo which is normally driven on board. As these doors and ramps form part of the vessels watertight integrity they are normally only operated by a senior ship's officer like the chief officer. You may assist and the primary responsibility is to ensure that these doors are closed tightly and well-sealed. This is normally indicated by the activation of micro switches to indicate that they are correctly closed. A visual inspection after closing of these doors is also advisable so as to ensure they are sealing correctly. Due to the size of these doors on larger vessels they are hydraulically operated. Side doors could also be found on vessels like large container vessels and passenger vessels and are utilised for pilot access to the vessel.



Bow Door

Stern Door

CHAPTER TWENTY
CARGO GEAR

General Understanding

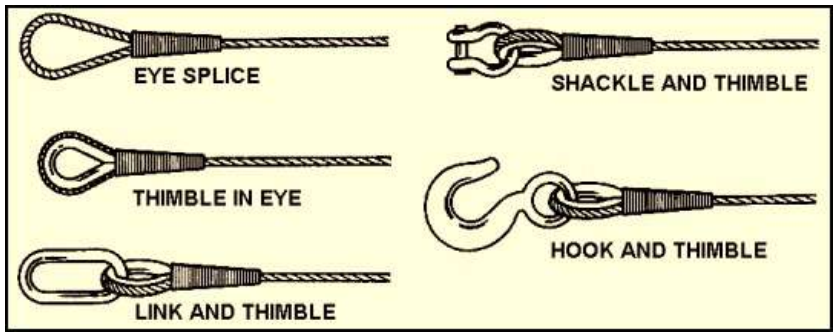
Cargo-handling gear is used to secure cargo while it is being raised or lowered by the ship's gear. It also moves cargo to and from its stowage position in the ship. Proper training in the selection and use of cargo-handling gear is necessary for safe and efficient cargo operations.

Because there are so many shapes, sizes and types of cargo the equipment used for attaching this to the cranes and derricks is diverse. All cargo handlers must be fully trained and of course go through familiarization too. The correct PPE must always be worn and work will be done under supervision based on Permits to Work.

General Purpose Gear

General-purpose gear is used with many types of cargo and includes:

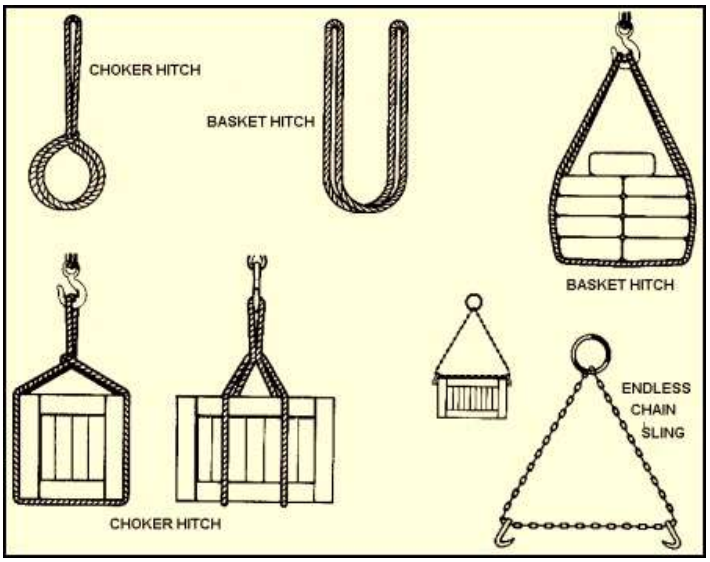
- Endless slings.
- Single slings.
- Combination slings.
- Chain slings.
- Canvas slings.



The ends of slings are usually made up into eyes, either with or without thimbles. The eyes fit on the cargo hook and attach to the drafts or loads of cargo. Using the eyes, a sling is joined to another sling, a hook, or a ring, either directly or by using a shackle. Thimbles in the eyes strengthen the sling by protecting it from sharp bends around pins, hooks, shackles, links, rings, and similar objects.

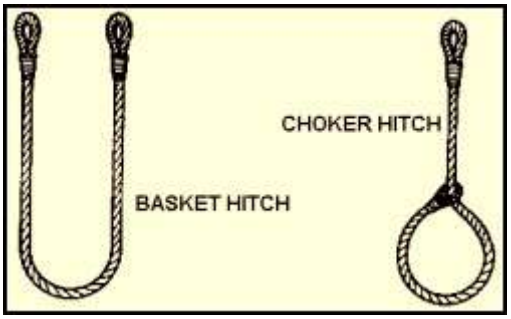
Endless Slings

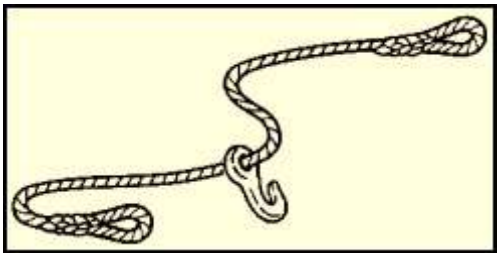
The endless sling is most commonly used as a choker hitch – where it is passed around the draft or cargo forming a loop on top of the draft. The other end is passed through this loop, pulled tight and attached to the cargo hook. To balance the load, spread apart the two parts of the sling on the bottom of the draft. Splicing the ends of a length of wire or rope makes an endless sling. It is simple to handle and can be used in several different ways to lift loads.



Single Slings

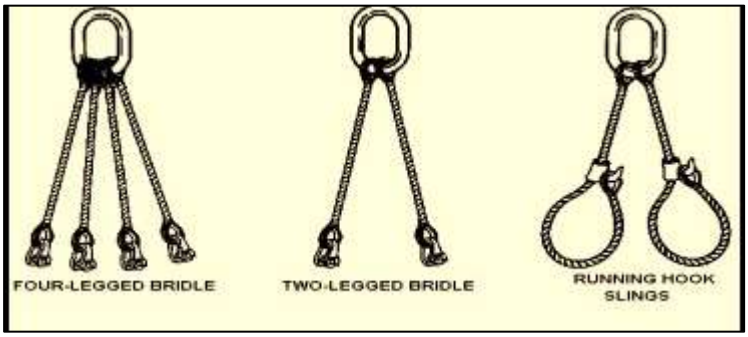
Each end of the single sling is made up with an eye, a hook, a ring, or a thimble, depending on the intended use of the sling. A single sling may be used as a vertical sling, a basket sling, or a choker sling with a choker hitch. Single slings made of fibre rope are used for light loads and for cargo that might be damaged by wire slings.





Combination Slings

Combination slings combine two or four single slings to form a bridle, basket, or choker sling. Combination slings can lift virtually any type of load. When several slings are passed under large crates or boxes to form a basket sling, cargo handlers should use spreader bars to prevent crushing.

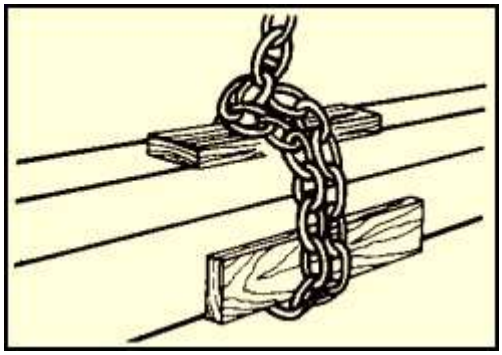


Chain Slings/ Chain choker slings

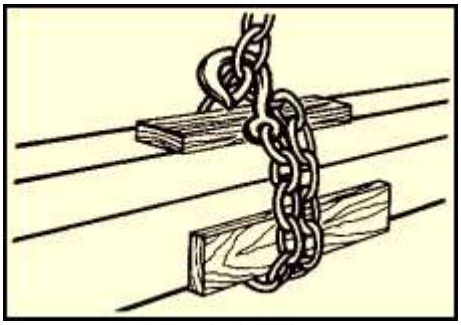
These slings are used mainly for handling steel rails, pipes, beams, and angles. Chain slings are used in bridles or single legs.

Handlers should use dunnage between the chain and the draft to prevent slipping. If necessary, dunnage also should be used between individual pieces.

When hoisting cargo of this type, cargo handlers should make a round turn (complete) with the chain around the draft.



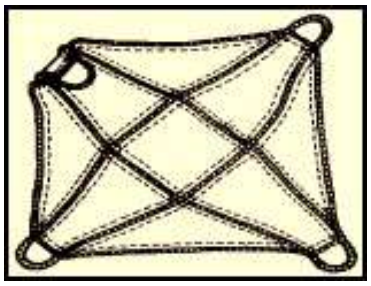
Chain sling



Chain choker sling

Canvas Slings

A canvas sling is a rope sling with a section of canvas sewn between the ropes. The main type of canvas sling in use is the dirt sling. In commercial practice, canvas slings similar to dirt slings are used for handling cargo such as nitrate.



Special-Purpose Gear

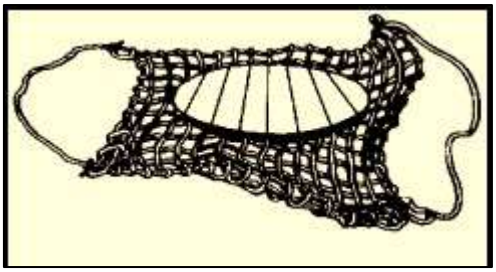
Special-purpose gear is made for use with certain types of cargo. It includes:

- Cargo nets
- Pie plates
- Pallets
- Bridles
- Plate-handling clamps

Cargo Nets

Cargo nets are usually made of manila rope, but nets of wire rope are used for special cargoes. Cargo nets are used to handle loose packages that are not all the same size. The package must be strong enough to withstand pressure. When making up a draft in a cargo net, cargo handlers should stack the cargo so that the crushing effect of the net is kept to a minimum.

Pie Plates

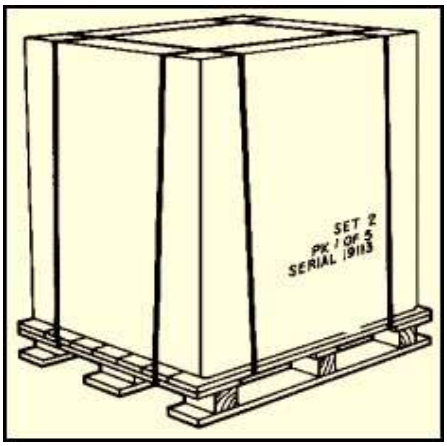


The crushing effect of a cargo net may be reduced by using a round "pie plate"; the pie plate of timber is centred in the centre of the net so that all the weight is on the pie plate.

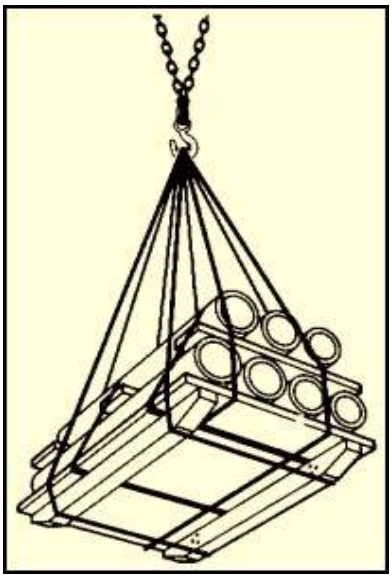
Pallets

Pallets allow for stacked goods to be loaded in smaller loads which can be deployed by fork lifts. There are different types but essentially they give cubes for ease of stowing.

When items of cargo are palletized, the tiers are laid so that one tier ties together with another to give stability to the unitized load and to keep the cargo from falling off the pallet while it is being moved.



General-purpose pallet

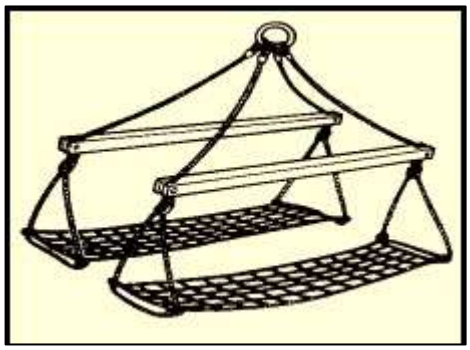


Sled Pallet

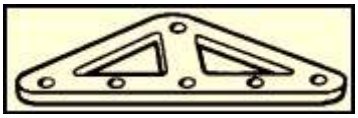
Spreaders

A spreader is any device used to keep the side pressure of the sling legs away from the load being hoisted. Some commonly used spreaders include:

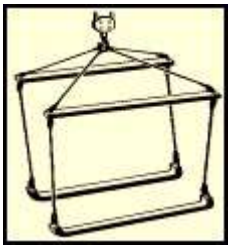
- Vehicle spreaders with wheel nets
- Heavy-lift spreaders
- Barrel sling spreaders
- Pallet bridle spreaders

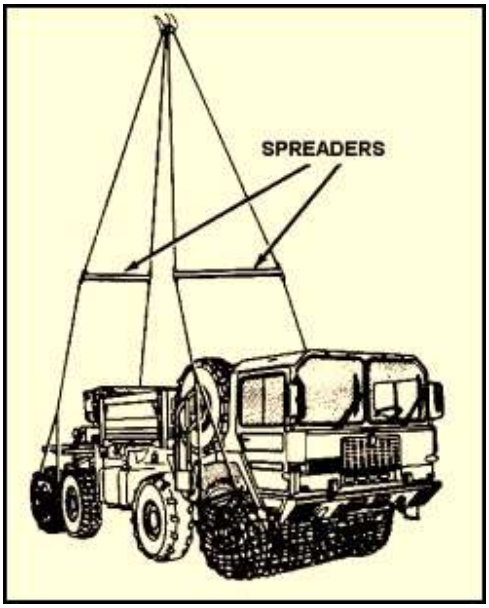


Barrel sling spreader



Pallet bridle spreaders



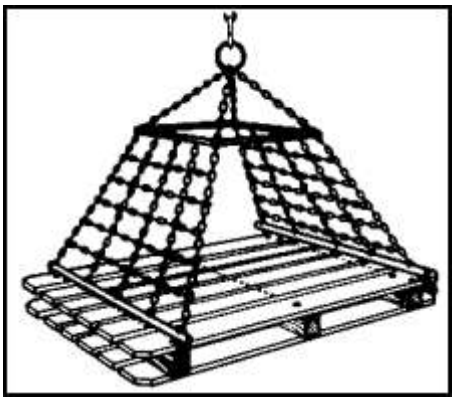


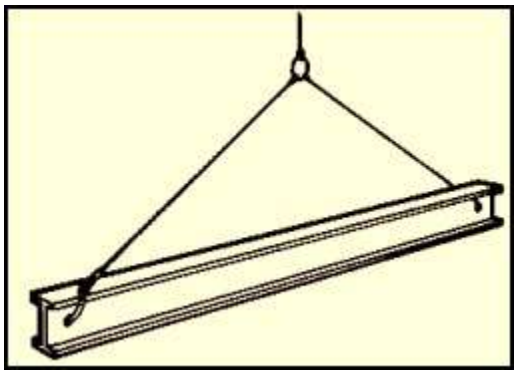
Heavy-lift spreader

Bridles

Bridles are lifting devices designed to hoist special types of cargo. They may be used in conjunction with spreaders.

Pallet bridles are used for quick, efficient handling of palletized cargo.



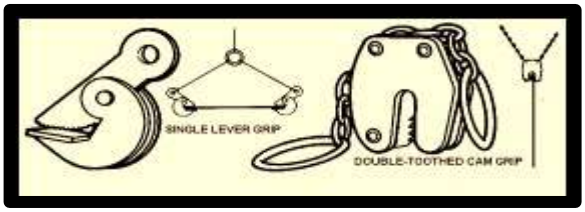


Beam bridles are used to remove hatch beams from their sockets

The hooks are placed on opposite sides of the beam in the lightening holes or rings as provided. The beam will then ride level and straight up and down. Tag lines are attached to the bridles for control and safety.

Plate-Handling Clamps

Plate-handling clamps are designed exclusively for handling steel plates.



CHAPTER TWENTY-ONE
DERRICKS, CRANES, CHAINS, SHACKLES, HOOKS AND BLOCKS

Cargo winches, cranes and derricks are used in shipping for loading and unloading cargoes. Commercial ports have cranes which are used to load and unload ships. Yachts also require a form of crane for lowering and hoisting the tenders and toys.

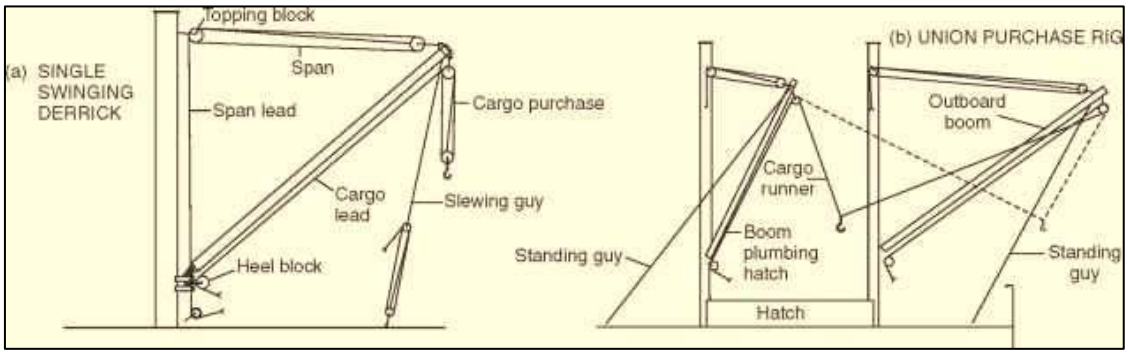
Cranes are basically classified by their method of working:

1. Cargo Winches or Derricks
2. Jib Cranes
3. Gantry Cranes

Cargo Winches or Derricks

A derrick is a kind of crane with a movable pivoted arm for moving or lifting heavy weights, especially on a ship for cargo handling.

The unit is rated according to a safe working load. It will have at minimum one guyed mast which may be articulated over a load by adjusting its guys. Most derricks have at least two components, either a guyed mast or self-supporting tower, and a boom hinged at its base to provide articulation.



The most basic type of derrick is controlled by three or four lines connected to the top of the mast, which allow it both to move laterally and cant up and down. To lift a load, a separate line runs up and over the mast with a hook on its free end.

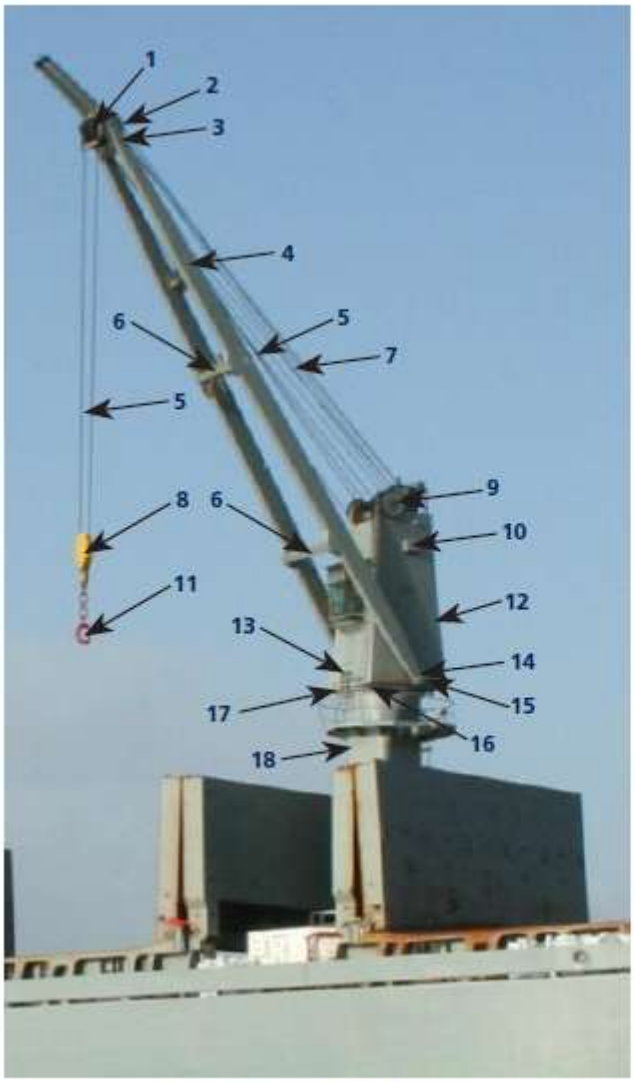
Manually operated band brakes may be fitted, and the drive motor will have emergency braking that operates if there is a failure; it will hold the load if power fails or the machinery is stopped.

Jib Cranes

Cranes have replaced derricks on many modern ships. Positioned between the holds on platforms which can be rotated through 360 degrees, deck cranes provide an immediately operational unit requiring only one man to operate it. Double gearing is a feature of most designs, providing a higher speed at lighter loads. Various types of cranes exist for particular duties, for example, a general duties crane uses a hook and a grabbing crane is for use with bulk cargoes.

A general cargo crane has three separate drives that provide the principal movements:

1. A hoisting motor for lifting the load.
2. A luffing motor for raising or lowering the jib.
3. A slewing motor for rotating the crane.



1. Jib head
2. Jib head sheaves
3. Luffing sheaves
4. Main chords of jib
5. Cargo hoist ropes
6. Transverses or cross-members of jib
7. Luffing ropes
8. Hook block
9. Slew column head sheaves
10. Jib stop
11. Hook
12. Slewing column, upper post or housing
13. Machinery deck
14. Jib heel
15. Jib heel pin
16. Slew ring bearing
17. Slew ring bolts
18. Pedestal

Typical rope luffed crane

Luffing is the movement of jib up and down.

Hoisting is the up and down movement of the hook from the jib by means of running wire.

Slewing is the rotation of the whole crane through 360^{o} with all the machinery. The aft-most crane near to the accommodation can be rotated only 180^{o}.

A slack wire limit switch protects the wire and other parts from damage caused by irregular winding on the drum.

Gantry Cranes

A gantry straddles the ship's holds with each pair of legs resting on rails switch run the length of the deck to port and starboard.

Maintenance of Cranes

The maintenance required for cargo gear generally includes regular greasing and oiling and inspection of wire ropes, sheaves, and other moving parts. The hydraulic piping units are to be checked and tested periodically for leaks.

Testing of derricks and cranes

SWL of derrick or crane, in tonnes	Test load, in tonnes
Up to 20 t	1,25 x SWL
Exceeding 20 t but not exceeding 50 t	SWL + 5
Exceeding 50 t	1,1 x SWL

Notes

1. Hand operated pulley blocks are to be proof tested to 1,5 x SWL.
2. For initial testing, the appliance is to hoist, luff and slew the test load, but not simultaneously. This is also recommended for subsequent re-testing.
3. As an alternative to test weights, certified water bags are permitted.

Proof loads for loose gear

Item	Proof load, in tonnes
Single sheave block	4 x SWL
Multi-sheave blocks:	
SWL ≤ 25 t	2 x SWL
25 < SWL ≤ 160 t	(0,933 x SWL) + 27
160 < SWL	1,1 x SWL
Hooks, shackles, chains, rings, swivels, etc:	
SWL ≤ 25 t	2 x SWL
25 < SWL	(1,22 x SWL) + 20
Lifting beams, spreaders, frames:	
SWL ≤ 10 t	2 x SWL
10 < SWL ≤160 t	(1,04 x SWL) + 9,6
160 < SWL	1,1 x SWL

Notes

1. The safe working load (SWL) for a single sheave block including single sheave blocks with beckets is to be taken as one half of the resultant load on the head fitting.
2. The safe working load for a multi-sheave block is to be taken as the resultant load on the head fitting.
3. Where the item is to be used in diving operations, the proof load is to be 1,5 times the proof load value given above for the particular item.

Table above extracted from Lloyd's Register's Code for Lifting Appliances in a Marine Environment, 2009, available from www.webstore.lr.org

Chains, Hooks, Shackles and Blocks

Chains, hooks and shackles form a large part in winch operations. They all require certificates and need to be properly maintained and inspected

Chains

Chains are used in cargo-handling operations for slinging loads and lashing cargo and as part of the ship's rigging. Chain size refers to the diameter of the metal link. Chains will stretch due to overloading and the individual links will bend slightly. Bent links are a warning that the chain has been overload. Overloading could cause the chain to fail. If a chain is equipped with the correct hook, it should start to fail first, indicating that the chain is overloaded.

Chains are much more resistant to abrasion and corrosion than wire rope; therefore, chains are used where this type of deterioration is a problem. They are used for anchor gear plus are also used as slings to lift heavy objects with sharp edges which would cut wire. A number of grades and types of chains are available.

Determining safe working load of chains

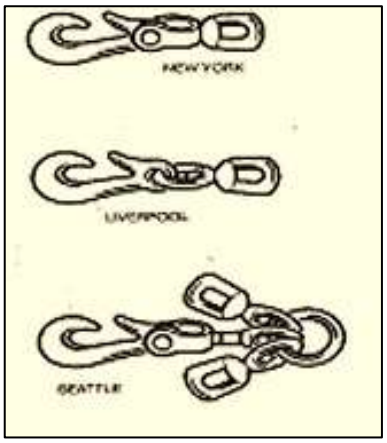
- Breaking stress is the load applied to break the chain link.
- SWL is the safe working load that the chain link can handle and is normally 1/6 of the breaking stress.
- D is the diameter of the link in mm.

Chain	Breaking stress in MT	SWL in MT
Grade 1	$20D^2/600$	BS/6
Grade 2	$30D^2/600$	BS/6
Grade 3	$43D^2/600$	BS/6

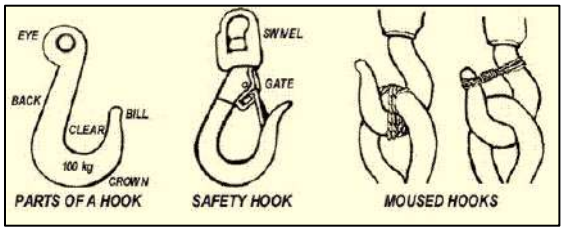
Safe working loads of chains

Hooks

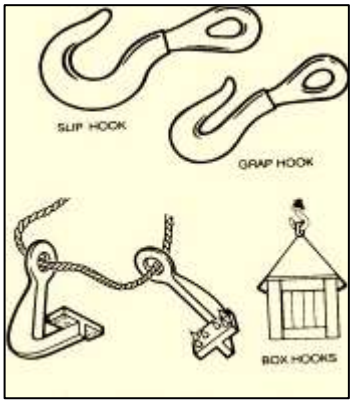
There are various types of hooks in use for cargoes:
Cargo hooks are shackled to the cargo runners for lifting and lowering drafts of cargo.



The hooks most frequently used in cargo-handling operations are the New York cargo hook, the Liverpool hook, and the Seattle hook.

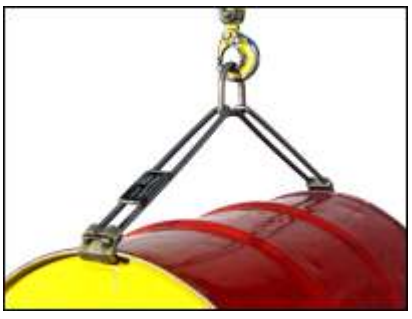


Sling hooks can be used a number of ways. They can be shackled, moused or spliced into an eye, placed on the sling before the eyes have been spliced to permit the hook to slide, or used with chain slings. Four general types of hooks available for slings are the slip hook, grab hook, box hook, and the chime or drum hook.
Cargo handlers may use slip hooks with wire rope, chains, and fibre rope. Chain links can slip through a slip hook so the loop formed in the chain will tighten under a load.



Grab hooks have an inside curve which is nearly U-shaped so the hook will slip over a link of chain edgeways but will not permit the next link to slip through. Grab hooks have a more limited range of use than slip hooks. They are used when the loop formed with the hook is not intended to close up around the load.

Box hooks are heavy steel hooks with a studded steel plate on one end and an opening on the other end through which a sling can pass. Cargo handlers should use box hooks in pairs by attaching them to the sling in such a way that the studded plates are facing each other. When the hooks are positioned on a case or a box and the ends of the sling are placed on the cargo hook, the sling draws the studded plates tightly against the case as it is lifted. Box hooks are designed to lift heavy cases high enough to permit easy slinging. Cargo handlers should never use box hooks on fragile cases.



Chime or drum hooks are forged steel flat hooks with an opening in one end through which a sling may pass. The hooks are used in pairs and placed on the sling so that they face each other. The hook end is designed so that it fits the chimes of barrels or drums.

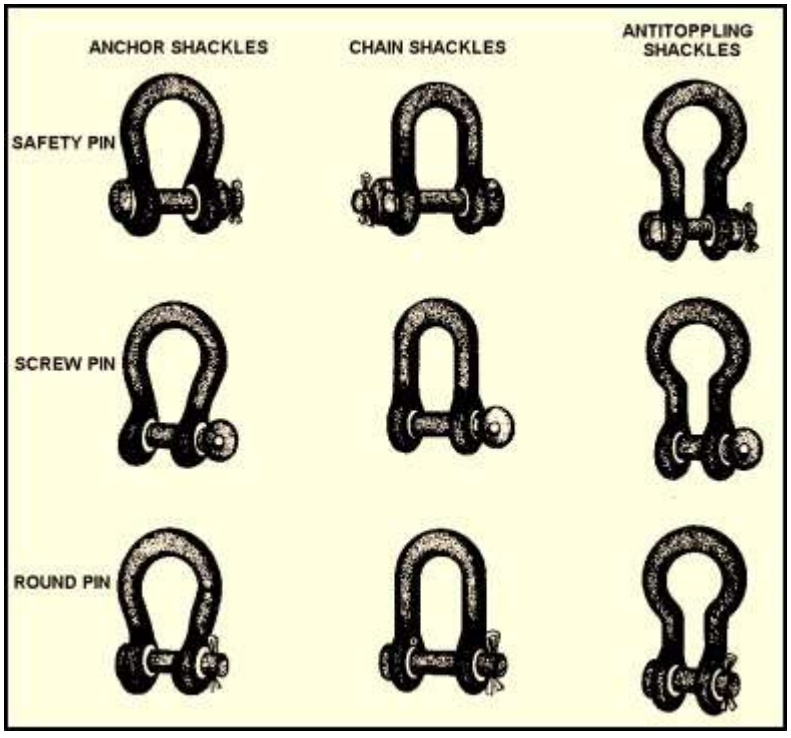
Shackles

Shackles are used as connectors of one wire to another, a sling to a load, a hook to a block or a hook to a wire rope eye. Their nominal size is given by the diameter of the shackle body.

The two principal designs are D and Bow shackles
Bow shackles are used when more than one attachment is to be made to the body.

Other types of shackles are usually named in relation to the pin type, including the anti-toppling/forelock shackle that is used for standing rigging, or where vibration is present. The pin is unthreaded, but it has a flat split pin as a keeper.

When using shackles check:

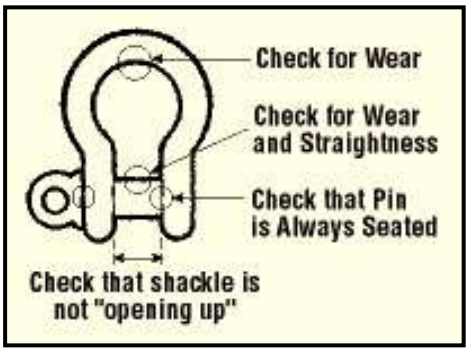


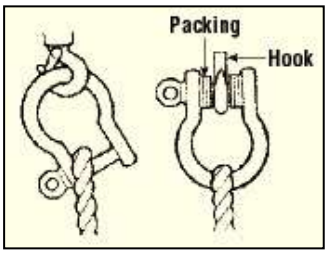
- Make sure pins are straight.
- Make sure that screw pins are screwed in all the way.
- Make sure that nuts on safety pins are snug against the eye of the shackle and cotter pins are inserted before the shackle is used.
- Make sure widths between the eyes are not greater than they were originally. Excessive widths indicate that the shackle had been strained and should not be used.
- Make sure, when shackles are placed under strain, the bearing surface of the sling or fitting being used covers the entire bearing surface of the shackle pin. If the size of the sling or the size of design of the fitting makes this impossible, then another size shackle should be used.

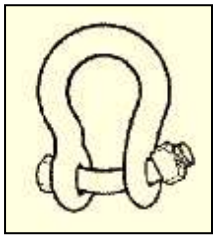
Inspection of Shackles

All pins must be straight and all screw pins must be completely seated. Cotter pins must be used with all round pin shackles.

Replace shackles worn in the crown or the pin by more than 10% of the original diameter.





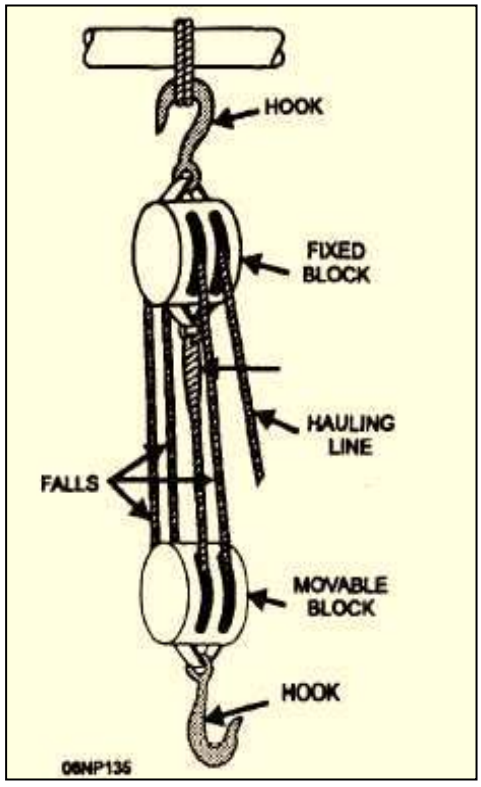


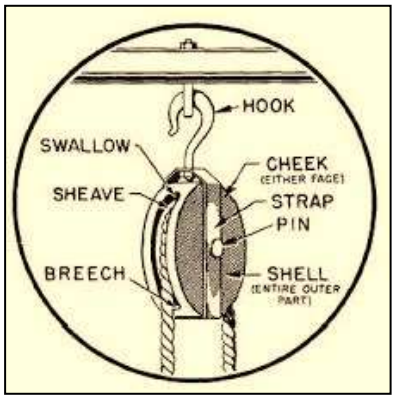
Do not replace the shackle pin with a bolt. A load will bend the bolt.

Do not allow a shackle to be pulled at an angle because the legs will open. Pack the pin with washers to centre the shackle.

Blocks

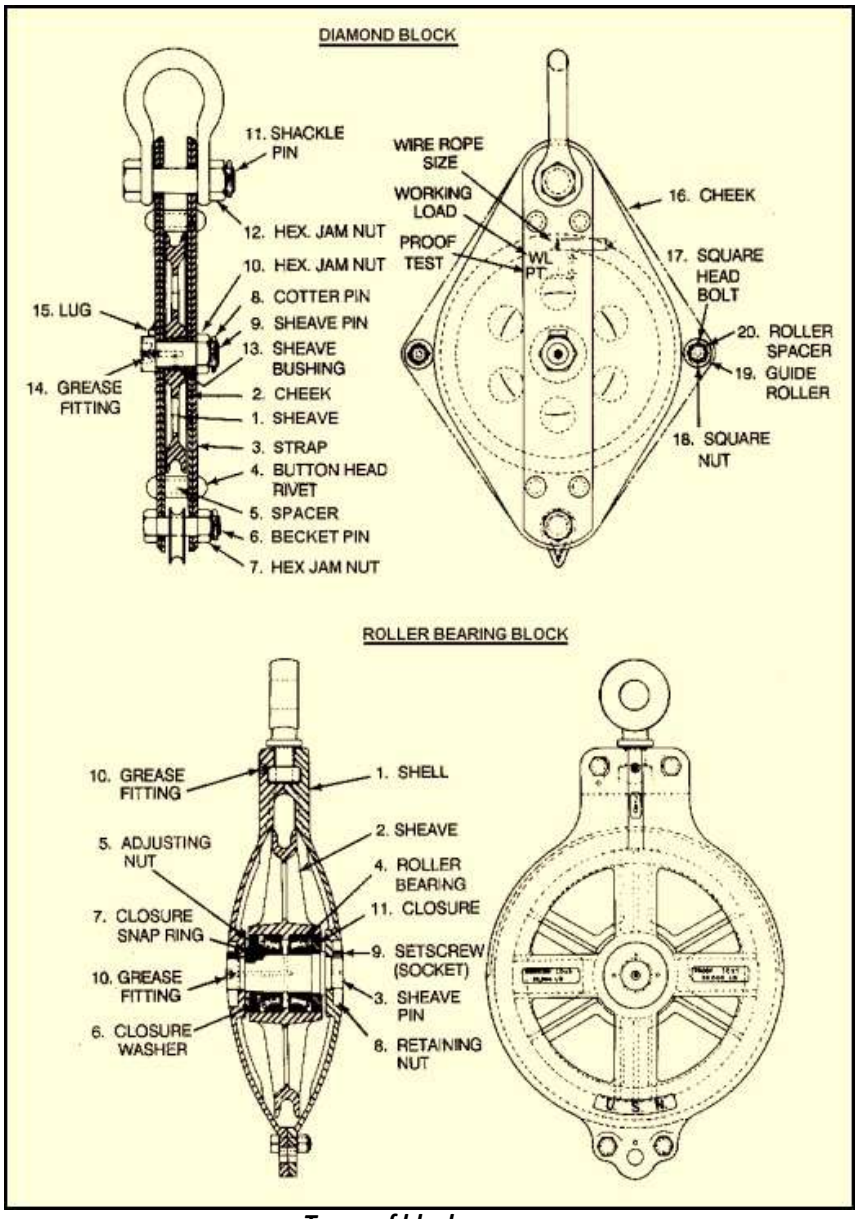
A block consists of one or more pulleys or sheaves fitted in a wood or metal frame. A block with a rope led over the sheave is convenient in applying power by changing the direction of the pull. Used in conjunction with rope and another block, it becomes a tackle and increases the power applied on the hauling part.





Detail of a block and tackle

Types of blocks and tackle



Types of blocks

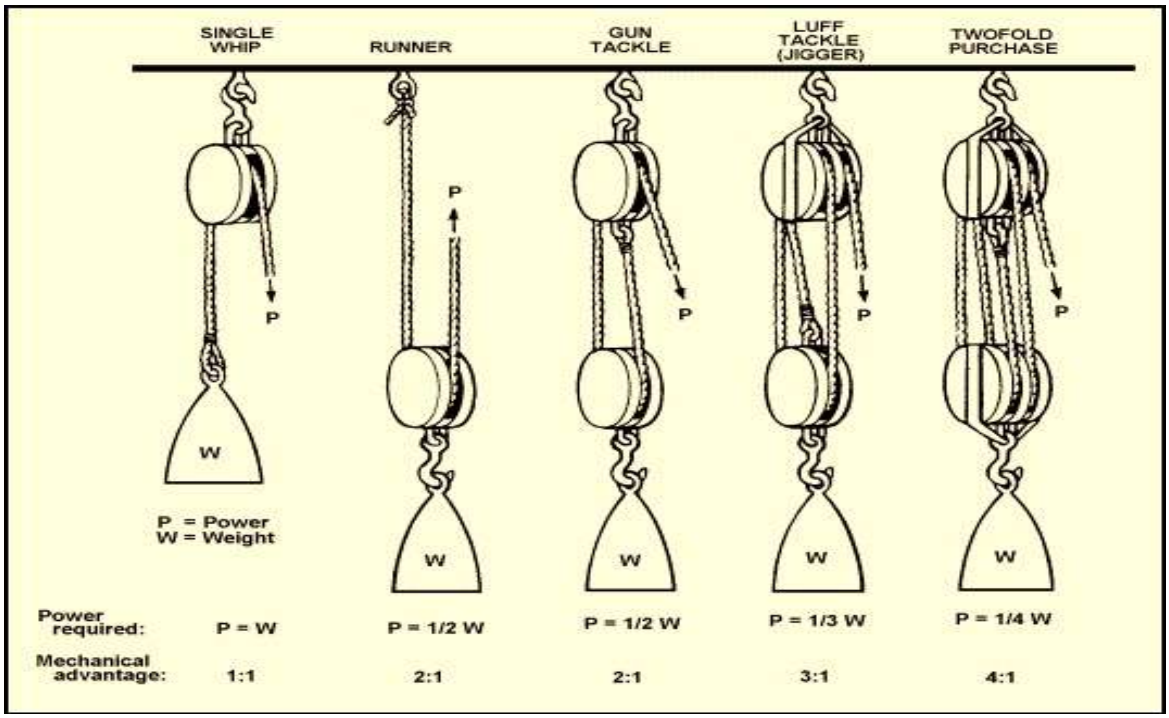
Block Size for Fibre Rope

The size of a block is found by measuring the length of the cheek of that block. The constant is 3 and the circumference of the line is the line size. The circumference of the line to be used will determine the size of the block needed. Blocks for fibre lines come in the following sizes: 4, 5, 6, 7, 8, 10, 12, and 14 inches.
Formula: LS X C = SB

Block Size for Wire Rope

It is impossible to give an absolute minimum size for wire rope sheaves because of the factors involved. However, experience has shown that the diameter of a sheave should be at least 20 times the diameter of the wire rope. The stiffer the wire rope, the larger the sheave diameter required.

Mechanical Advantage of Tackle
The mechanical advantage of a simple tackle is determined by counting the number of parts of the moving lines at the moveable block. The moveable block is the block that is attached to the weight to be moved.
Friction is not considered in the following example: If a load of 10 pounds requires 10 pounds to lift it, the mechanical advantage is 1. If a load of 40 pounds requires only 10 pounds of power to lift it, then the mechanical advantage is 4 to 1, or 4 units of weight lifted for each unit of power applied.

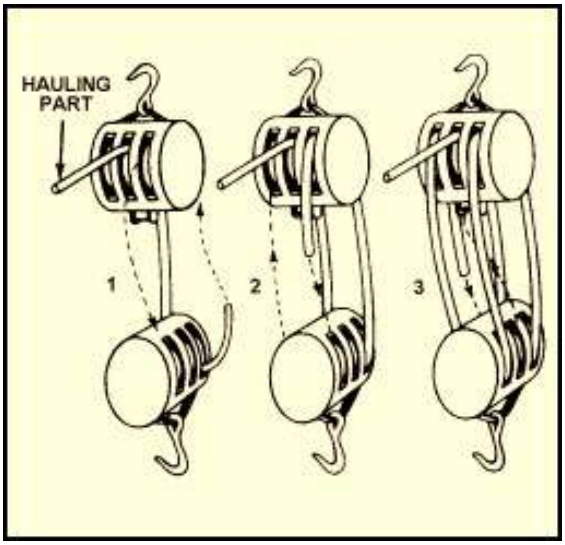


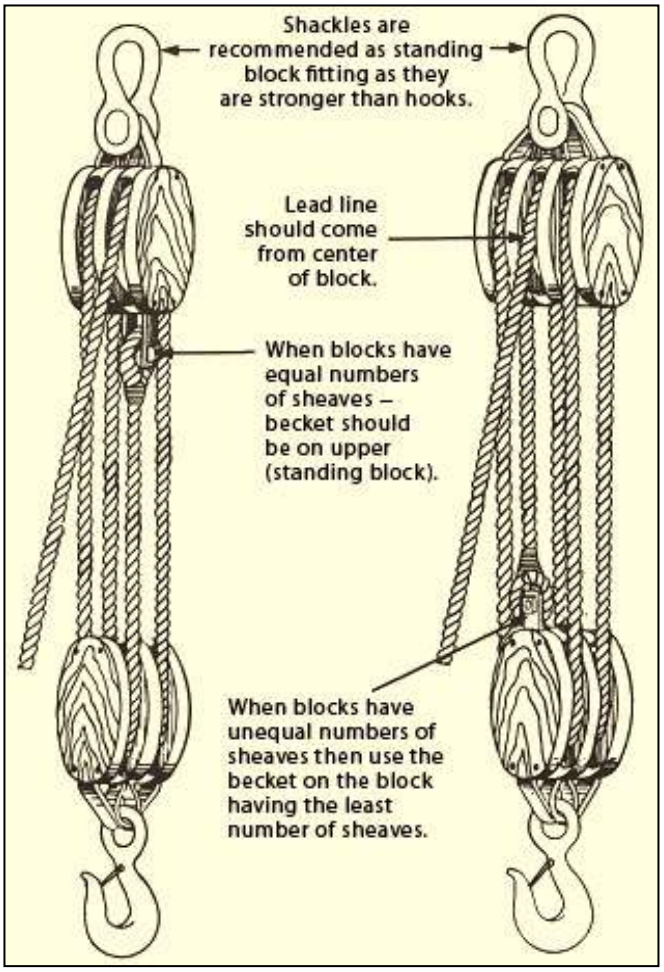
Mechanical advantage

Reeving Blocks and Tackles

The preferred method of reeving multiple sheave blocks is referred to as the "right angle" method. The advantage of using this right angle method of reeving is that it reduces the chances of the rope chafing or the block turning.

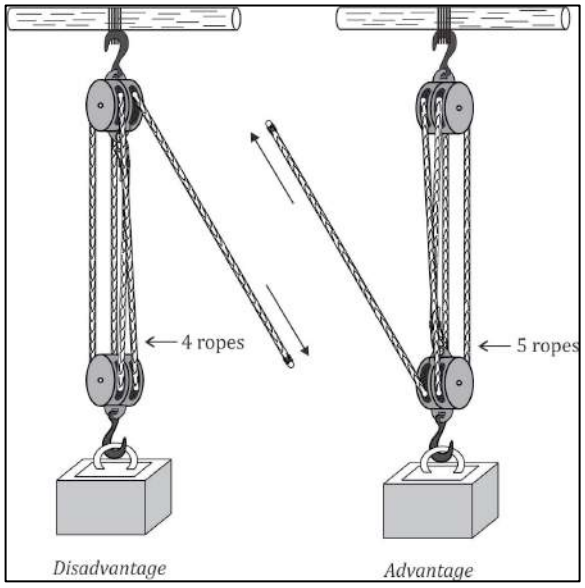
The two blocks are placed at right angles to one another before reeving commences.





Correct method for reeving a block

A tackle **rove to disadvantage** is where the pull on the rope is away from the direction in which the load is moved. The second case is known as **rove to advantage**, where the pull on the rope is towards the direction in which the load is moved.



Safe Working Loads and Breaking Strengths

The term Safe Working Load (SWL) is the weight (force) that an item of lifting equipment, lifting device or accessory can be safely used to lift, suspend or lower a mass without breaking. The SWL is usually marked on the equipment by the manufacturer.

SWL is usually 1/5 of the Minimum Breaking Strength (MBS) although other fractions may be used – it is the load level that is much less than that required to make the lifting equipment fail.

The Minimum Breaking Strength is the load tested to the point it breaks, the SWL being a small fraction of the breaking load for safety.

Manufacturers provide the safe working load for the products and where it is possible i.e. on shackles or derricks etc. they will be clearly marked on the item.

CHAPTER TWENTY-TWO

CAPACITIES, SAFE WORKING LOADS AND BREAKING STRENGTHS

The term Safe Working Load (SWL) is the weight (force) that an item of lifting equipment, lifting device or accessory can be safely used to lift, suspend or lower a mass without breaking. The SWL is usually marked on the equipment by the manufacturer.

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Synthetic/Natural Fibre Lines: Comparison

Size in (inches)	Manila		Three-strand Nylon		2-in-1 Braided Nylon	
	SWL (pounds)	BS (pounds)	SWL (pounds)	BS (pounds)	SWL (pounds)	BS (pounds)
1	200	1,000	500	2,500	600	3,000
1 ½	450	2,250	1,125	5,625	1,350	6,750
2	800	4,000	2,000	10,000	2,400	12,000
2 ½	1,250	6,250	3,125	15,625	3,750	18,750
3	1,800	9,000	4,500	22,500	5,400	27,000
3 ½	2,450	12,250	6,125	30,625	7,350	36,750
4	3,200	16,000	8,000	40,000	9,600	48,000
4 ½	4,050	20,250	10,125	50,625	12,150	60,750
5	5,000	25,000	12,500	62,500	15,000	75,000
5 ½	6,050	30,250	15,125	75,625	18,150	90,750
6	7,200	36,000	18,000	90,000	21,600	100,800
6 ½	8,450	42,250	21,125	105,625	25,350	126,750
7	9,800	49,000	24,500	122,500	29,400	147,000
7 ½	11,250	56,250	28,125	140,625	33,750	168,750
8	12,800	64,000	32,000	160,000	38,400	192,000
8 ½	14,450	72,250	36,125	180,625	43,350	216,750

Steel wire

6 x 19 6 x 36 GROUPS STEEL CORE - GRADE 1770 N/mm2							
ROPE DIA	SAFE WORKING LOAD					MIN BREAK LOAD	PROOF LOAD PER LEG @ 0 DEGREES
	SINGLE LEG	LEG ANGLE 0-90 DEGREES		LEG ANGLE 90-120 DEGREES			
		2 LEG	3 & 4 LEG	2 LEG	3 & 4 LEG		
mm	tonne	tonne	tonne	tonne	tonne	tonne	tonne
8	0.82	1.10	1.70	0.82	1.20	4.11	1.64
9	1.00	1.40	2.10	1.00	1.50	5.20	2.00
10	1.30	1.80	2.70	1.30	1.90	6.42	2.60
11	1.50	2.20	3.20	1.50	2.30	7.77	3.20
12	1.80	2.60	3.90	1.80	2.80	9.25	3.60
13	2.10	3.00	4.50	2.10	3.20	10.80	4.40
14	2.50	3.50	5.30	2.50	3.80	12.60	5.00
16	3.30	4.60	6.90	3.30	4.90	16.40	6.60
18	4.10	5.80	8.70	4.10	6.20	20.80	8.40
19	4.60	6.40	9.70	4.60	6.90	23.10	9.20
20	5.10	7.20	10.80	5.10	7.70	25.70	10.20
22	6.20	8.70	13.00	6.20	9.30	31.10	12.40
24	7.40	10.30	15.50	7.40	11.10	37.00	14.80
26	8.70	12.10	18.20	8.70	13.00	43.40	17.40
28	10.10	14.10	21.10	10.10	15.10	50.40	20.20
32	13.10	18.40	27.60	13.10	19.70	65.70	26.20
35	15.70	22.00	33.00	15.70	23.60	78.70	31.40
36	16.60	23.30	35.00	16.60	25.00	83.30	33.20
38	18.50	26.00	39.00	18.50	27.80	92.80	37.00
40	20.60	28.80	43.20	20.60	30.90	103.00	41.20
44	24.80	34.70	52.10	24.80	37.20	124.00	49.60
48	29.60	41.40	62.10	29.60	44.40	148.00	59.20
52	34.80	48.70	73.10	34.80	52.20	174.00	69.60
54	37.40	52.30	78.50	37.40	56.10	187.00	74.80
56	40.20	56.30	84.40	40.20	6.03	201.00	80.40
60	46.20	64.70	97.00	46.20	69.30	231.00	92.40
64	54.80	76.70	115.10	54.80	82.20	274.00	109.60
71	66.60	93.20	139.80	66.60	99.90	333.00	133.20
77	77.80	108.90	163.40	77.80	116.70	389.00	155.60

Sling Comparison

Rated Capacity in Tons (2,000 lbs.)									
Component Rope Diameter (in.)	Approximate Finished Sling Diameter (in.)	Vertical Capacity	Choker Capacity	Basket Hitch **				Standard Eye Dimension (in.)	
				Vertical	60°	45°	30°	Width	Length
* 1/8	3/8	1.2	1	2.4	2	1.6	1.2	3	6
* 3/16	9/16	2.4	2.1	4.8	4.2	3.4	2.4	4	8
* 1/4	3/4	4	3.5	8	6.9	5.7	4	5	10
* 5/16	1	5.6	4.9	11.2	9.7	8	5.6	6	12
3/8	1-1/8	8.7	7.6	17.4	15	12.3	8.7	7-1/2	15
7/16	1-5/16	11.7	10.3	23.4	20.3	16.5	11.7	9	18
1/2	1-1/2	15.3	13.4	30.6	26.5	21.6	15.3	10	20
9/16	1-3/4	19.3	16.9	38.6	33.4	27.3	19.3	12	24
5/8	1-7/8	23.7	20.7	47.4	41	33.5	23.7	12	24
3/4	2-1/4	33.8	29.5	67.5	58.5	47.7	33.8	15	30
7/8	2-5/8	45.7	40	91.4	79.2	64.6	45.7	17	34
1	3	59.4	52	118.7	102.8	83.9	59.4	20	40
1-1/8	3-3/8	75	65	149	129	105	75	22	44
1-1/4	3-3/4	92	80	184	159	130	92	25	50
1-3/8	4-1/8	110	96	220	190	156	110	27	54
1-1/2	4-1/2	131	115	262	227	185	131	30	60
1-3/4	5-1/4	176	154	351	304	248	176	35	70
2	6	227	199	455	394	321	227	40	80
2-1/4	6-3/4	284	248	567	491	401	284	45	90
2-1/2	7-1/2	347	303	693	600	490	347	50	100
2-3/4	8-1/4	414	363	828	717	585	414	55	110

Bollards come in many shapes, sizes, capacities and materials and throughout their life will suffer corrosion, fatigue and other effects.

The forces exerted on a bollard are considerable, in excess of 2000kN, which can weaken the bollard and its fixings to the point that the bollard fails to withstand such forces. Should this happen, it can cause damage to dockside equipment and the quayside, as well as serious or fatal accidents.

Winches or windlasses should be constructed to give warning of undue strains by stalling at well below half the designed maximum safe working load of the weakest element in the system (e.g. bollard, fairlead, shackle, holding down bolt, etc.) and to afford further protection by walking-back at about half the design load (e.g. breaking strength of the mooring rope, tow line or hawser whichever is applicable). For Example: A winch or windlass capable of a 10 tonne pull should be fitted with a rope having a “breaking strain” of 20 tonnes or more.

Mooring winch capacity is determined at the ship design stage when factors such as the vessel’s size, number of mooring lines to be deployed, anticipated maximum wind area and anticipated effect of tidal conditions are considered, together with the mooring lines’ Mean Breaking Load (MBL). After selection of the MBL of the mooring lines the winch heaving load will be set to a lower value than the MBL to prevent the winch motor from applying excessive load.

Mooring Winch Brake Settings

After mooring it is standard practice to apply the winch brake and to take the winch motor out of gear, leaving friction between the brake lining and the winch drum to prevent rotation of the drum. Typically, mooring winch brakes are designed to hold up to 80% of the MBL with the capability of adjusting these to 60% of the MBL to allow for a margin of safety.

Anchors

Anchor size, type and capacity are included in the design but all vessels have to meet the Administration requirements

Chain

Chain Link Dimensions				Grade 2 Chain			Grade 3 Chain	# of		
inches	mm	Dim A	Dim B	Dim C 5 Links	Weight Per 90'	Proof Load	Break Load	Links per 90'	Proof Load	Break Load
5/8	16	3-3/4	2-1/4	13-3/4	365	23745	33220	33220	47465	432
3/4	19	4-1/2	2-5/8	16-1/2	480	34000	47600	47600	68000	357
13/16	20	4-7/8	2-7/8	17-7/8	570	39800	55700	55700	79500	329
7/8	22	5-1/4	3-1/8	19-1/4	660	46000	64400	64400	91800	305
15/16	24	5-5/8	3-5/16	20-5/8	760	52600	73700	73700	105000	285
1	25	6	3-9/16	22	860	59700	83600	83600	119500	267
1-1/16	27	6-3/8	3-3/4	23-3/8	970	67200	94100	94100	135000	251
1-1/8	29	6-3/4	4	24-3/4	1080	75000	105000	105000	150000	237
1-3/16	30	7-1/8	4-1/4	26-1/8	1220	83400	116500	116500	167000	225
1-1/4	32	7-1/2	4-1/2	27-1/2	1350	92200	129000	129000	184000	213
1-5/16	33	7-7/8	4-3/4	28-7/8	1490	101500	142000	142000	203000	203
1-3/8	34	8-1/4	4-15/16	30-1/4	1630	111000	155000	155000	222000	195
1-7/16	36	8-5/8	5-1/16	31-5/8	1780	120500	169000	169000	241000	187
1-1/2	38	9	5-3/8	33	1940	131000	183500	183500	262000	179
1-9/16	40	9-3/8	5-5/8	34-3/8	2090	142000	198500	198500	284000	171
1-5/8	42	9-3/4	5-7/8	35-3/4	2240	153000	214000	214000	306000	165
1-11/16	43	10-1/8	6-1/116	37-1/8	2410	166500	229000	229000	327000	159
1-3/4	44	10-1/2	6-5/16	38-1/2	2590	176000	247000	247000	352000	153
1-13/16	46	10-7/8	6-1/2	39-7/8	2790	188500	264000	264000	377000	147
1-7/8	48	11-1/4	6-3/4	41-1/4	2980	201000	281000	281000	402000	143

1-15/16	50	11-5/8	7	42-5/8	3180	214000	299000	299000	427000	139
2	51	12	7-3/16	44	3360	227000	318000	318000	454000	133
2-1/16	52	12-3/8	7-7/16	45-3/8	3570	241000	337000	337000	482000	129
2-1/8	54	12-3/4	7-5/8	46-3/4	3790	255000	357000	357000	510000	125
2-3/16	56	13-1/8	7-7/8	48-1/8	4020	269000	377000	377000	538000	123
2-1/4	58	13-1/2	8-1/8	49-1/2	4250	284000	396000	396000	570000	119
2-5/16	59	13-7/8	8-5/16	50-7/8	4490	299000	418000	418000	598000	117
2-3/8	60	14-1/4	8-9/16	52-1/4	4730	314000	440000	440000	628000	113
2-7/16	62	14-5/8	8-3/4	53-5/8	4960	330000	462000	462000	660000	111
2-1/2	64	15	9	55	5270	346000	484000	484000	692000	107
2-9/16	66	15-3/8	9-1/4	56-3/8	5540	363000	507000	507000	726000	105
2-5/8	67	15-3/4	9-7/16	57-3/4	5820	379000	530000	530000	758000	103
2-11/16	68	16-1/8	9-11/16	59-1/8	6110	396000	554000	554000	792000	99
2-3/4	70	16-1/2	9-7/8	60-1/2	6410	413000	578000	578000	826000	97
2-13/16	71	16-7/8	10-1/8	61-7/8	6710	431000	603000	603000	861000	95
2-7/8	73	17-1/4	10-3/8	63-1/4	7020	449000	628000	628000	897000	93
2-15/16	75	17-5/8	10-9/16	64-5/8	7330	467000	654000	654000	934000	91
3	76	18	10-13/16	66	7650	485000	679000	679000	970000	89
3-1/16	78	18-3/8	11	67-3/8	7980	504000	705000	705000	1008000	87
3-1/8	79	18-3/4	11-1/4	68-3/4	8320	523000	732000	732000	1046000	85
3-3/16	81	19-1/8	11-1/2	70-1/8	8660	542000	759000	759000	1084000	85
3-1/4	83	19-1/2	11-11/16	71-1/2	9010	562000	787000	787000	1124000	83
3-5/16	84	19-7/8	11-15/16	72-7/8	9360	582000	814000	814000	1163000	81
3-3/8	86	20-1/4	12-1/8	74-1/4	9730	602000	843000	843000	1204000	79
3-7/16	87	20-5/8	12-3/8	75-5/8	10100	622000	871000	871000	1244000	77
3-1/2	90	21	12-5/8	77	10500	643000	900000	900000	1285000	77
3-5/8	92	21-3/4	12-15/16	79-3/4	11300	685000	958000	958000	1369000	73
3-3/4	95	22-1/2	13-3/8	82-1/2	12000	728000	1019000	1019000	1455000	71
3-7/8	98	23-1/4	14	85-1/4	12900	772000	1080000	1080000	1543000	69
4	102	24	14-3/8	88	13700	816000	1143000	1143000	1632000	67

Bitts, Bollards, Chocks and Fairleads

The mooring and towing fittings are used for mooring ships to quays, piers, and buoys and meet the stresses resulting from the tide, wind load, and wave load safely.

They are made up of tools such as mooring winch, fittings such as chock, fairlead, guide roller, bollard and bitt, seat on which fittings are installed and reinforced parts of the ship.

They also cover rope used in mooring, a chain and a chain stopper used to fasten the chain to a ship. They are required to be installed with strength appropriate for the size of the ship and the reinforcement of ship's lower part must be designed strongly enough to endure load transmitted from mooring and towing fittings.

CHAPTER TWENTY-THREE
WIRE SPLICING, WIRE GRIPS, WIRE CONSTRUCTION AND CARE

Inspection of Wire Rope

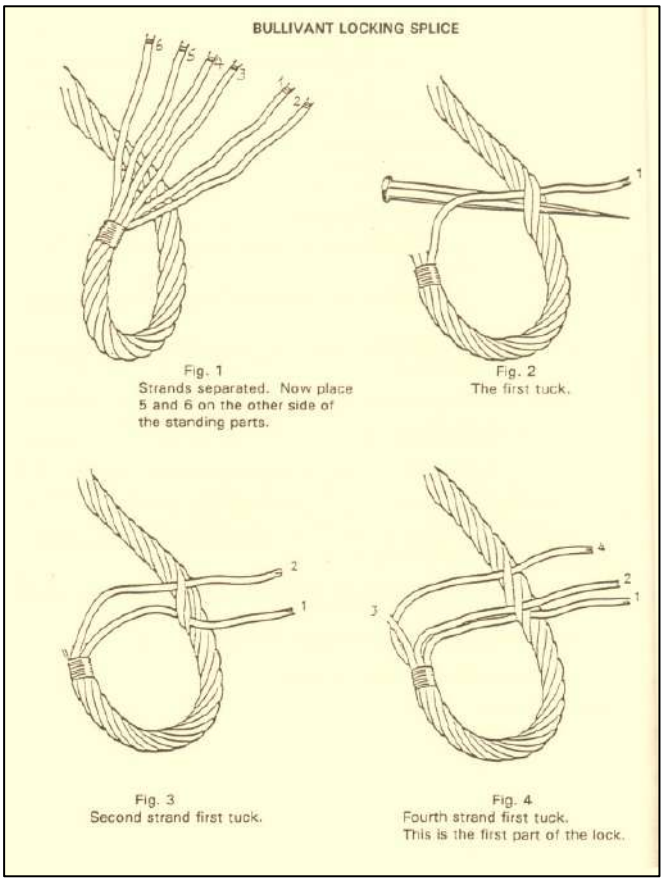
- Only trained personnel should carry out an inspection of wire ropes.
- Inspect wire ropes before usage every working day.
- Keep records of inspections.
-

heck for abrasions, corrosion, pitting, and lubrication inside rope. Insert a wooden fid beneath two strands and rotate to lift strands and open rope.

Eye Splice in Wire Rope

The MCA only recognises the "Bullivant" eye splice. There are some other types which may only be used in specialised situations but they can be dangerous if wrongly used.

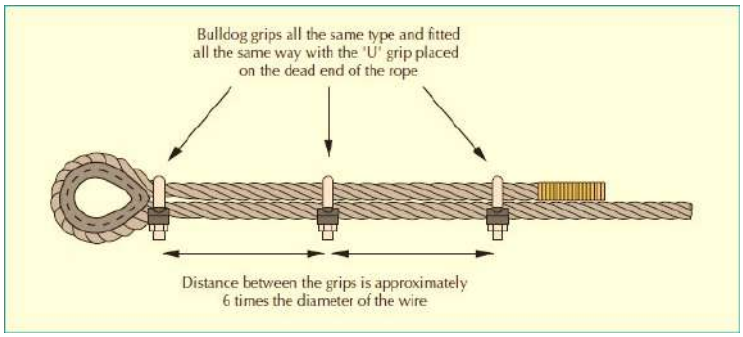
1. Put a strong whipping about 10 diameters from the end and un-lay the strands back to the whipping.

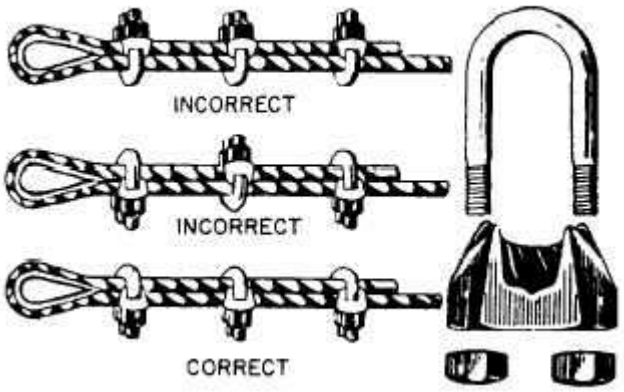


2. Whip the ends of the strands of the preformed wires, adhesive insulating tape will be sufficient.
3. The eye should now be formed to the size required. Stop off the two pieces of wire leaving 3 adjacent strands on one side of the standing part and three on the other.
4. When using the spike to open up the wire, be careful not to damage the wire or heart. When the spike has been inserted under the strand to be lifted push it well in to leave sufficient room to pass the tuck. Be careful not to kink this strand or it will not lie flat.
5. Nos. 1, 2 and 4 - Tuck with the lay.
6. Nos. 3, 6 and 5 Tuck against the lay.
7. Strands tuck in this order:
   No. 1 tucks under two strands.
   No. 2 enters the rope at the same place as No. 1 but tucks under only one strand.
   No. 3 tucks under the same strand as No. 4, against the lay, causing a lock.
   No. 6 tucks under the next two strands against the lay, tuck heart with this strand.
   No. 5 enters the rope at the same place as No.6 but under one strand.
8. Hammer the tucks to tighten the shape.
9. Every strand now tucks against the lay, over one and under one working from 1 to 6. Complete second tuck,
10. Hammer out and then remove cores from strands.
11. Complete third tuck,
12. Hammer out and then extract 1/3 the wires from each strand.
13. Bend these wires down out of the way.
14. Complete fourth tuck,
15. Hammer out and then extract a further 1/3 the wires from each strand.
16. Bend these wires down out of the way.
17. Complete fifth tuck, by tucking over one and under two.
18. Hammer out complete splice from crown to tail.
19. Break off all excess wire.

Correct Fitting of Wire Grips (e.g. 'Bulldog' grips).

An alternative and easier way of creating an eye in wire rope is to use wire grips.





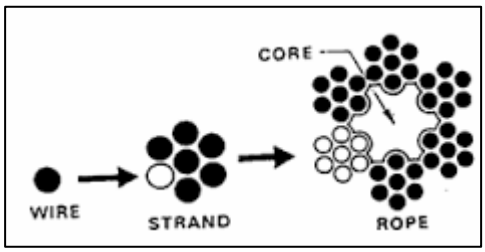
Wire grips allow a quick and easy way to make a temporary wire rope eye splice.

They are NEVER to be used for joining two lengths of wire rope

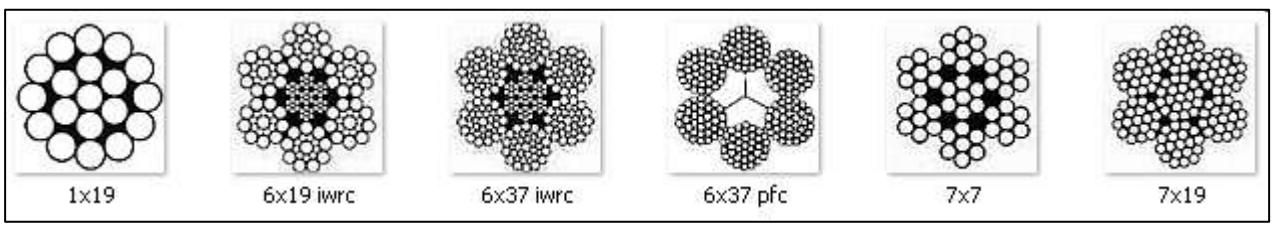
For correct and safe use the grips must be attached properly with the “U” part over the tail or unstressed side. Nuts should be checked for tightness.

Wire Rope Construction

A **strand** is two or more wires wound concentrically in a helix. They are usually wound around a centre wire. Strand is normally referred to as 1 by the total number of wires in the given strand. Such as 1 x 7 (one group of seven wires) or 1 x 19 (one group of nineteen wires).

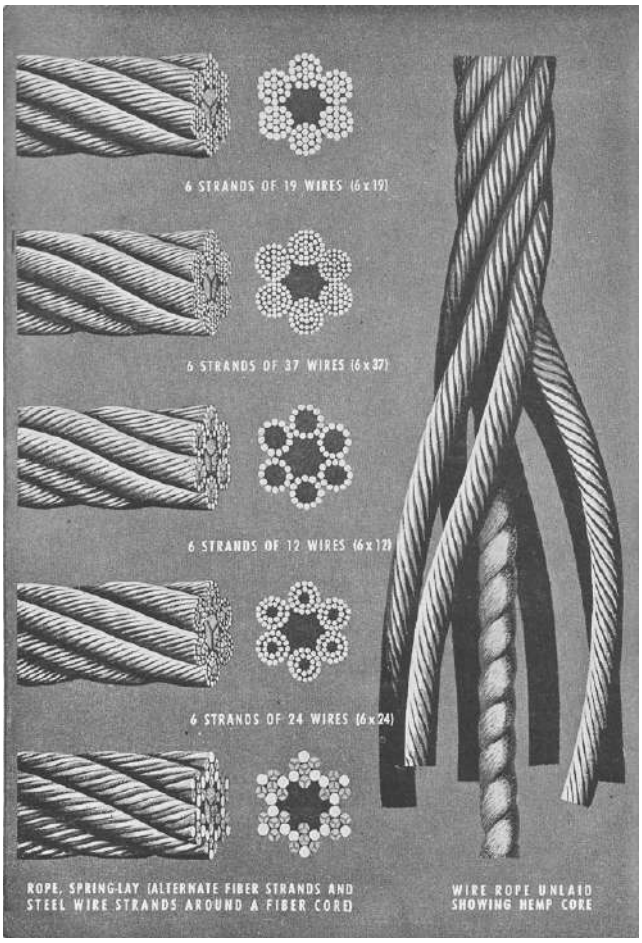


Strand



Flexible construction of wire rope ie 7 x 7 (seven groups of 1 x 7 strand) and 7 x 19 (seven groups of 1 x 19 strand) respectively.

The **core** can also be of a composition other than metal. This core can be one of three types. The first is a fibre core, made up of synthetic material. Fibre cores are the most flexible and elastic, but have the downside of getting crushed easily. The second type, wire strand core, is made up of one additional strand of wire, and is typically used for suspension. The third type is independent wire rope core (IWRC), which is the most durable in all types of environments

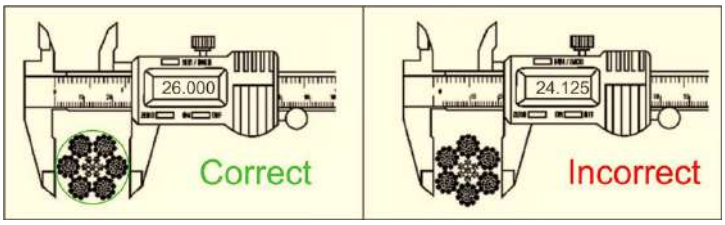


Construction is the way of describing the number of wires contained in the rope and their relationships to each other. 1 x 19 describes one group of nineteen wires; 7 x 19 describes seven groups of nineteen wires (or seven groups of 1 x 19); 6 x 37 IWRC describes six groups of thirty-seven wires wound around a core that might actually be 7 x 7 construction itself. Thus the term Independent Wire Rope Core, since the core of 7 x 7 is actually a piece of wire rope.
Stranded ropes are an assembly of several strands laid helically in one or more layers around a core. Most types of stranded ropes only have one strand layer over the core.

The lay direction of the strands in the rope can be right (symbol Z) or left (symbol S) and the lay direction of the wires can be right (symbol z) or left (symbol s). This kind of rope is called regular/ordinary lay rope if the lay direction of the wires in the outer strands is in the opposite direction to the lay of the outer strands themselves.

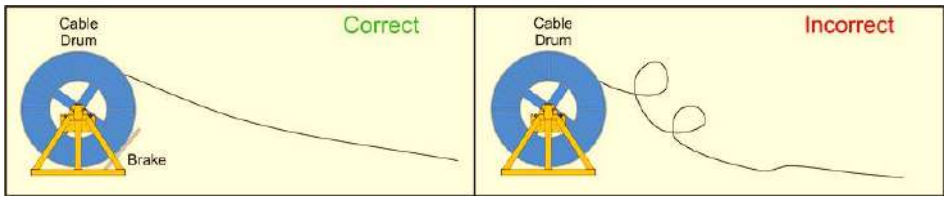
Measuring the Diameter of Wire Rope

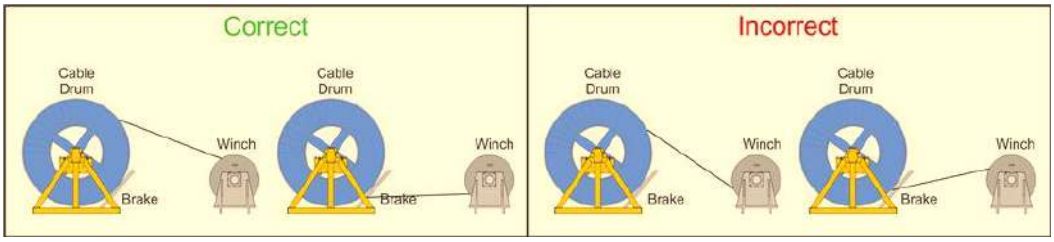
Wire rope is described by its diameter which is determined by measuring the circle that just touches the extreme outer limits of the strands of rope, as shown in the diagram below.



Unreeling/ Uncoiling Wire Rope

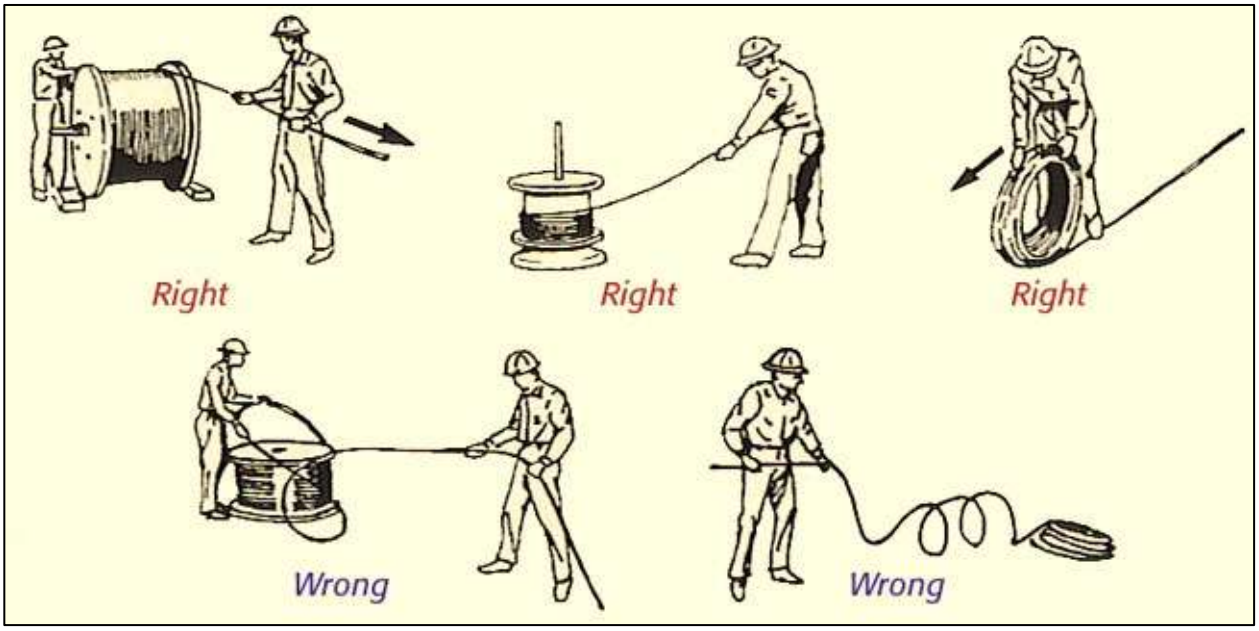
To unreel wire rope from a heavy wire rope drum, place a shaft through the centre and jack up the reel far enough to allow it to revolve easily.

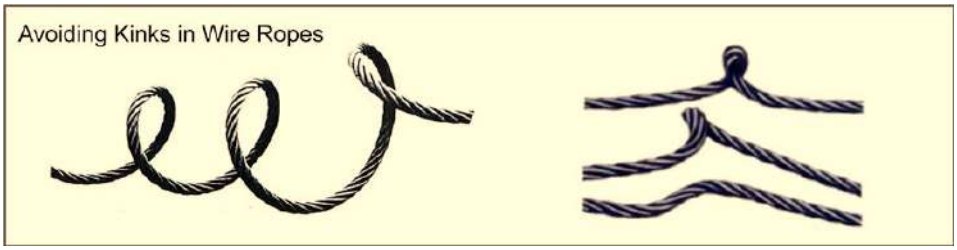




This is a two person operation, the first person takes the end of the rope and walks away from the reel, taking the wire rope off the top of the reel.

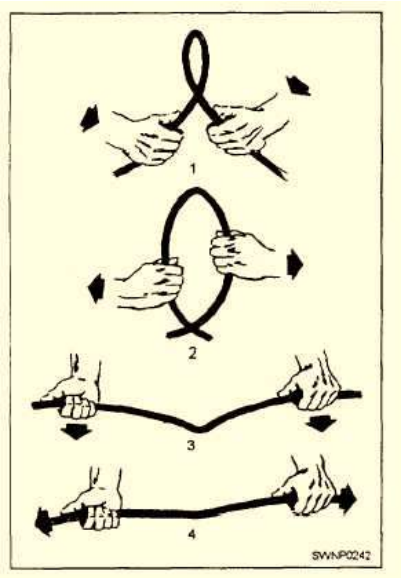
The second person needs to control the speed of the turning cable drum by holding a wood block against the flange as a brake. Care must be taken to stop slack rope developing on the reel, which can cause kinks in the wire rope and to avoid throwing off turns or spirals in which kinks could occur.

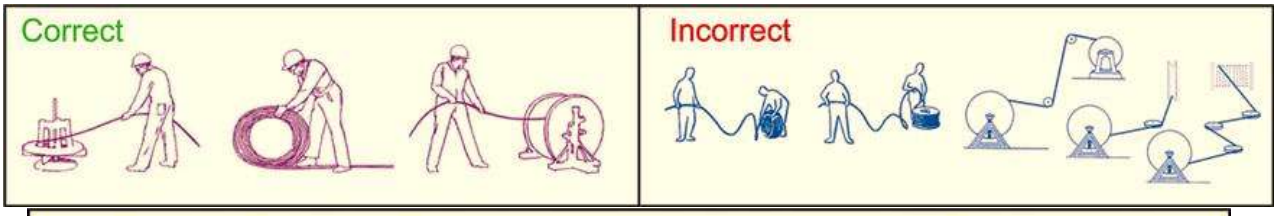


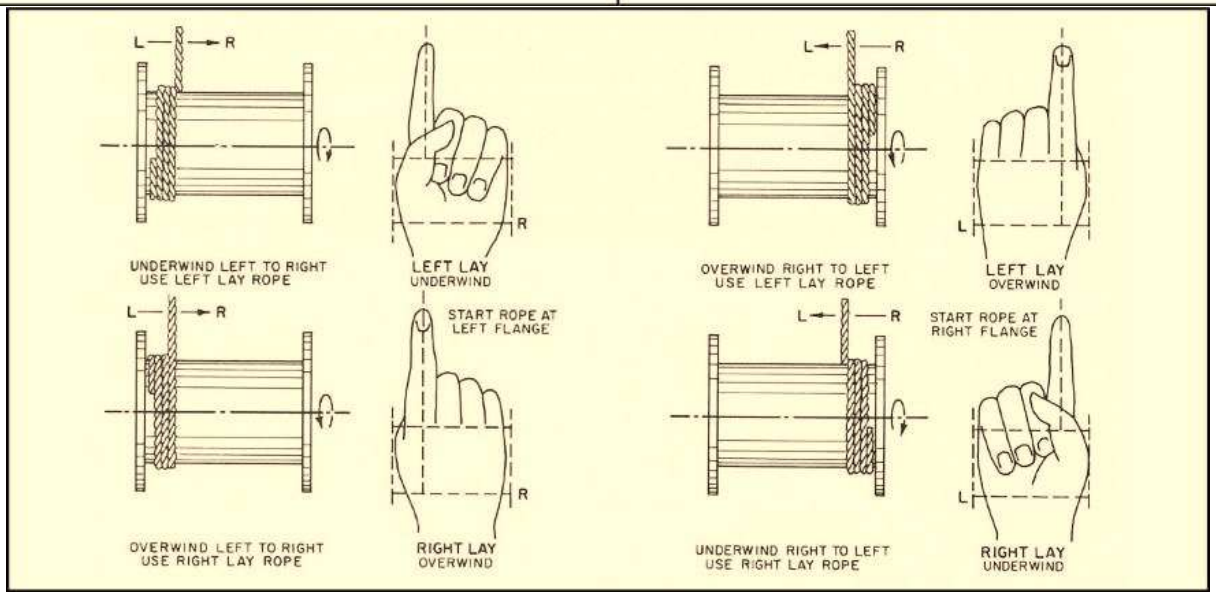


Wire rope should never be handled in a way that it twists or un-lays. Never uncoil wire rope by pulling coils off a coil that is laid flat on the ground. Doing this will create spirals and likely kinking of the rope. Torsions are put into the rope by every loop that is pulled off, and the rope becomes twisted and unmanageable.

Kinks are places where the rope has been unintentionally bent to a permanent set. They can also be caused by bending a rope around a sheave having too severe a radius. Wires in the strands at the kink are permanently damaged and weakened







A simple method of determining how a wire rope should be started on a drum is shown above. The observer stands behind the drum, with the rope coming towards him. Using the right hand for right-lay wire rope, and the left hand for left lay wire rope, the clenched fist denotes the drum, the extended index finger the oncoming rope.

Maintenance and Inspection

Wire ropes for ships are used in harsh marine environment. For safety and to ensure optimum performance application of good practice for inspection and maintenance must be strictly adhered too.

Maritime personnel working on ships, need to exercise a great deal of care and restraint to identify any kind of damage before using the wire ropes. Using a damaged wire rope can result in disastrous consequences causing harm to ship's crew and property.
Better performance of wire ropes is assured when maintenance and inspection of these wire ropes is carried out at regular interval of time by the right person.

Maintenance

The maintenance of wire rope is determined by its working environment that includes weather conditions and the type of rope. A well-lubricated wire rope has a longer useful life and will be less prone to corrosion. The personnel in charge of wire rope maintenance must maintain a stringent lubrication regime to ensure that the wire rope is appropriately lubricated; with extra emphasis on areas that will pass through and around sheaves and also those that go under water. Pressure lubrication is best suited for marine wire ropes, but using a brush and allowing it to penetrate is also acceptable.

Wire rope lubricants have two principal functions:

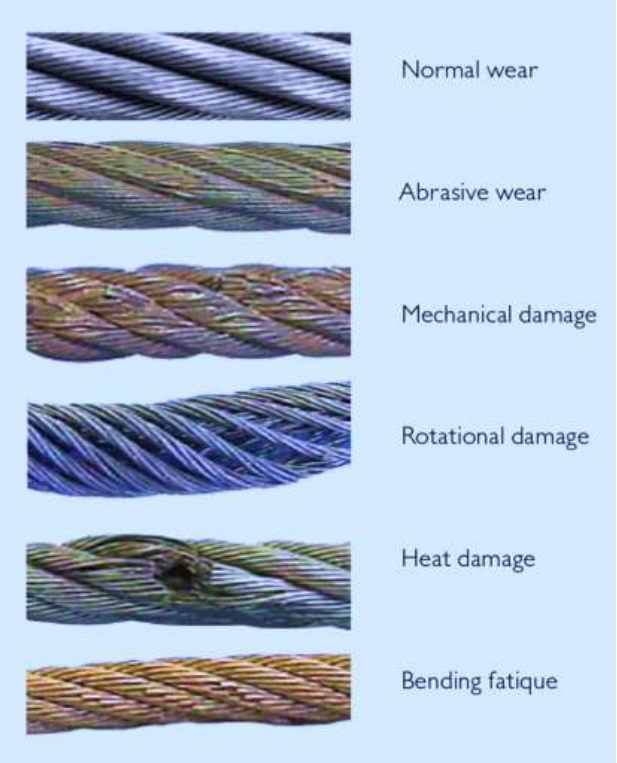
1. To reduce friction as the individual wires move over each other.
2. To provide corrosion protection in the core and inside wires and on the exterior surfaces.

There are two types of wire rope lubricants, penetrating and coating. Penetrating lubricants contain a petroleum solvent that carries the lubricant into the core of the wire rope then evaporates, leaving behind a heavy lubricating film to protect and lubricate each strand. Coating lubricants penetrate slightly, sealing the outside of the cable from moisture and reducing wear and fretting corrosion from contact with external bodies.

Inspection

Wire rope inspection involves thoroughly checking for damage both before and after use and also during routine checks.

Regular planned inspections are designed to detect any and every deterioration and/or deformation resulting from wire rope usage. If any damage is found, it must be reported to the designated authority who can then take stock of the situation. If the damage cannot be safely rectified then the wire rope must be replaced.



Factors to consider when inspection:

- Application of the wire rope
- Operational conditions
- Manufacturers recommendations and statutory requirements
- Analysis of usage history
- Analysis of wire rope history of the previous wire rope used for the same application

Inspections will be focussed on discovering damage that may be an immediate hazard:

- Rope distortion such as kinking, crushing, un-stranding, bird-caging, main strand displacement, or core protrusion
- Corrosion
- Broken or cut strands

Replace when individual broken/protruding wires or fish hooks (broken wires bent back into a hook) are:

1. **6** wires are found broken in any **rope lay length** (counting all of the strands).
2. **3** wires are found broken in any **strand lay length** (an individual strand).
3. **1** wire is found broken within **1 rope lay length** of **any** end fitting.

Also if there is significant Flattening, Corrosion and/or worn spots.

Store wire in a clean acid free environment having been cleaned and lubricated.

Chains and Cables

There are a number of different types of chain in use on ships:

Stud Link Chain Cable is strong chain and has a stud across its middle which gives the extra rigidity. It is made to ISO 1704 standard. Stud link chain is normally used as anchor cable chain or chafe chain in offshore moorings. It is sometimes used as a mooring chain.

Open Link Chain Cable (Studless Chain) has lower strength and is more suitable for mooring chain in docks, ports, marinas and inland waterways.

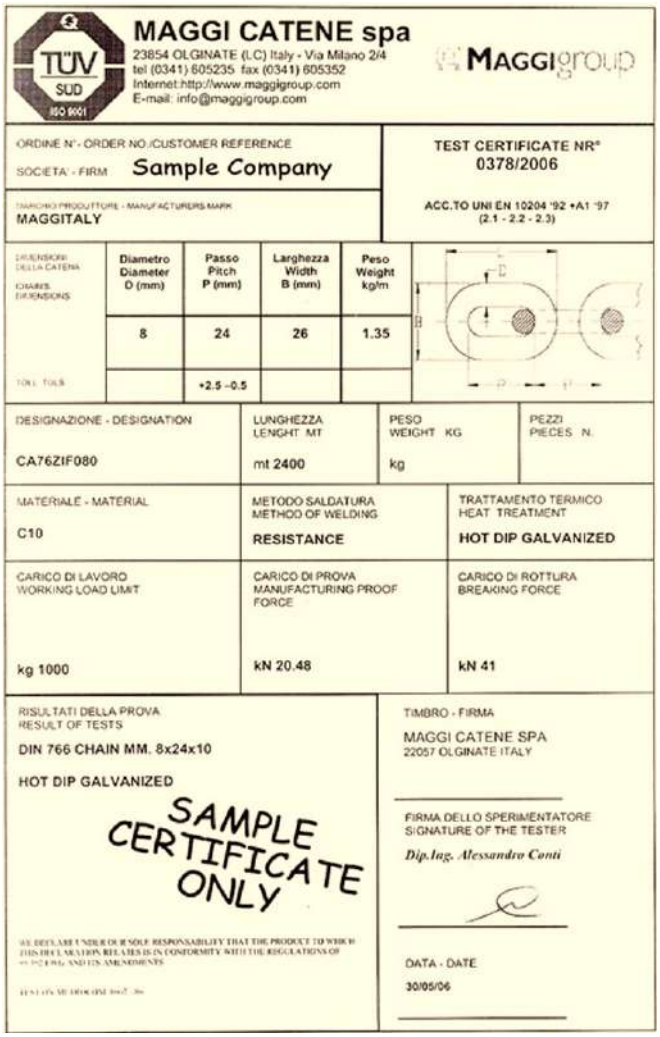
Long Link Chain Cable is an open link type cable for general use and is normally used when components are needed to be joined or inserted in the links in the chain. Often used for lifting chain and mooring chain.

Short Linked Chain Cable is the most flexible chain and consequently the chain less prone to damage from stress and fractures. Because of this it is the most commonly used as lifting chain when supplied in high grade and hardened alloy chain. As a mooring chain it makes excellent strong flexible light chain.

All chains and cables used for cranes, davits, mooring, cargo lifting and stowage must have test certificates and rigorous inspection and replacement regime

Hooks shackles, links, swivels etc. have a stamped indication it has been tested

Test certificates include information such as Product, dimensions, Safe Working Load, SWL, test load etc., see sample



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ACC.TO UNI EN 10204 '92 +A1 '97
(2.1 - 2.2 - 2.3)

DIMENSIONI DELLA CATENA / CHAIN DIMENSIONS	Diametro Diameter D (mm)	Passo Pitch P (mm)	Larghezza Width B (mm)	Peso Weight kg/m
	8	24	26	1.35
TOLL. TOLS		+2.5 -0.5		

DESIGNAZIONE - DESIGNATION	LUNGHEZZA LENGHT MT	PESO WEIGHT KG	PEZZI PIECES N.
CA76ZIF080	mt 2400	kg	

MATERIALE - MATERIAL	METODO SALDATURA METHOD OF WELDING	TRATTAMENTO TERMICO HEAT TREATMENT
C10	RESISTANCE	HOT DIP GALVANIZED

CARICO DI LAVORO WORKING LOAD LIMIT	CARICO DI PROVA MANUFACTURING PROOF FORCE	CARICO DI ROTTURA BREAKING FORCE
kg 1000	kN 20.48	kN 41

RISULTATI DELLA PROVA
RESULT OF TESTS
DIN 766 CHAIN MM. 8x24x10
HOT DIP GALVANIZED

SAMPLE CERTIFICATE ONLY

WE DECLARE UNDER OUR SOLE RESPONSABILITY THAT THE PRODUCT TO WHICH THIS DECLARATION RELATES IS IN CONFORMITY WITH THE REGULATIONS OF ... AND ITS AMENDMENTS

TIMBRO - FIRMA
MAGGI CATENE SPA
22057 OLGINATE ITALY

FIRMA DELLO SPERIMENTATORE
SIGNATURE OF THE TESTER
Dip.Ing. Alessandro Conti

DATA - DATE
30/05/06

CHAPTER TWENTY-FOUR
SAFE HANDLING, STOWAGE AND SECURING OF CARGO

Planning is necessary to ensure that the valuable goods and cargo loaded on a ship reach their destination without causing damage or harm to the ship or its staff. Hence a cargo plan is necessary to ensure the same.

Cargo Planning

Even an average sized ship can carry thousands of tons of cargo, and this cargo cannot be simply haphazardly loaded on board the vessel but needs to be stowed in an orderly fashion. This is necessary due to several reasons such as the following:

Ship Stability

Unplanned stowage of cargo could lead to the ship capsizing on being unstable in the rough seas.

With solid cargo such as containers it is important to store heavy objects towards the bottom while the lighter ones on top.

In case of liquid cargoes it should be ensured that the cargo is compartmentalized in such a manner so as to reduce or minimize the free-surface effect of the cargo which could lead to instability during the voyage.

Structural Safety

Apart from stability, another factor to be kept in mind for safety reasons is to remain within the prescribed working loads for the ship structural parts such as the decks and so forth. Care should be taken not to exceed the load density of the decks.

Safety Codes

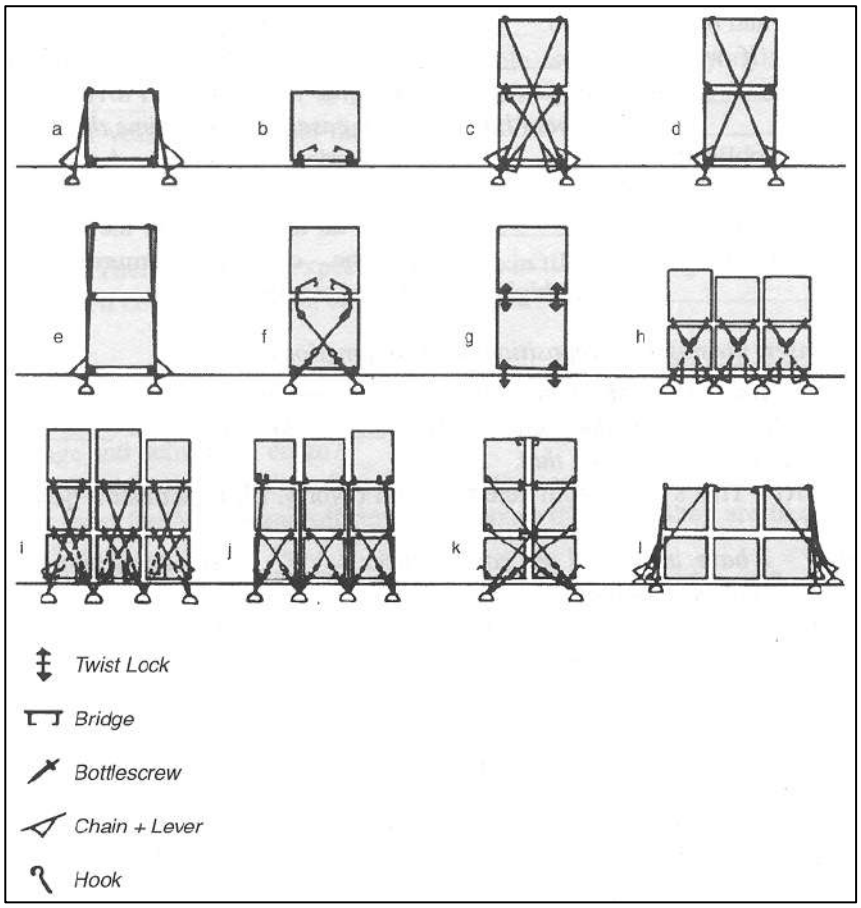
There are safety codes applicable for all types of cargoes, especially dangerous cargoes such as chemicals and gases.
These codes must be adhered to under all conditions so as to ensure safety of the crew who handles such cargoes.

Economy

The main purpose of the ship is to maximize profit for the owners and operators; it can be achieved by carrying or transporting the maximum amount of cargo in a single voyage. Hence a proper cargo plan ensures that the available cargo space is utilized with the maximum possible efficiency. Overloading is thoroughly policed by all maritime states to stop potential accidents.

Intermixing

If more than one type of cargo is being carried, it is possible that some or all of these cargoes may not be compatible with each other and could produce some dangerous chemical reactions.



Stowage Plans

A ship's cargo plan shows the distribution as well as the disposition of all parcels of cargo aboard the vessel. The plan is formulated usually from the workbooks of the 'deck officers', a fair copy being produced before departure from the final port of loading. This allows copies of the plan to be made before the vessel sails. The copies are forwarded to agents at ports of discharge to allow the booking and reservation of labour, as appropriate.

It is important to plan in advance, both at the shore terminal and offshore to aid effective cargo securing. The objective of pre-planning is the safe and practical restraint of cargo carried on the deck of offshore support vessels so that personnel, ship and cargo may be reasonably protected at all stages of carriage, and during cargo operations offshore.

The cargo plan should include relevant details of cargoes:

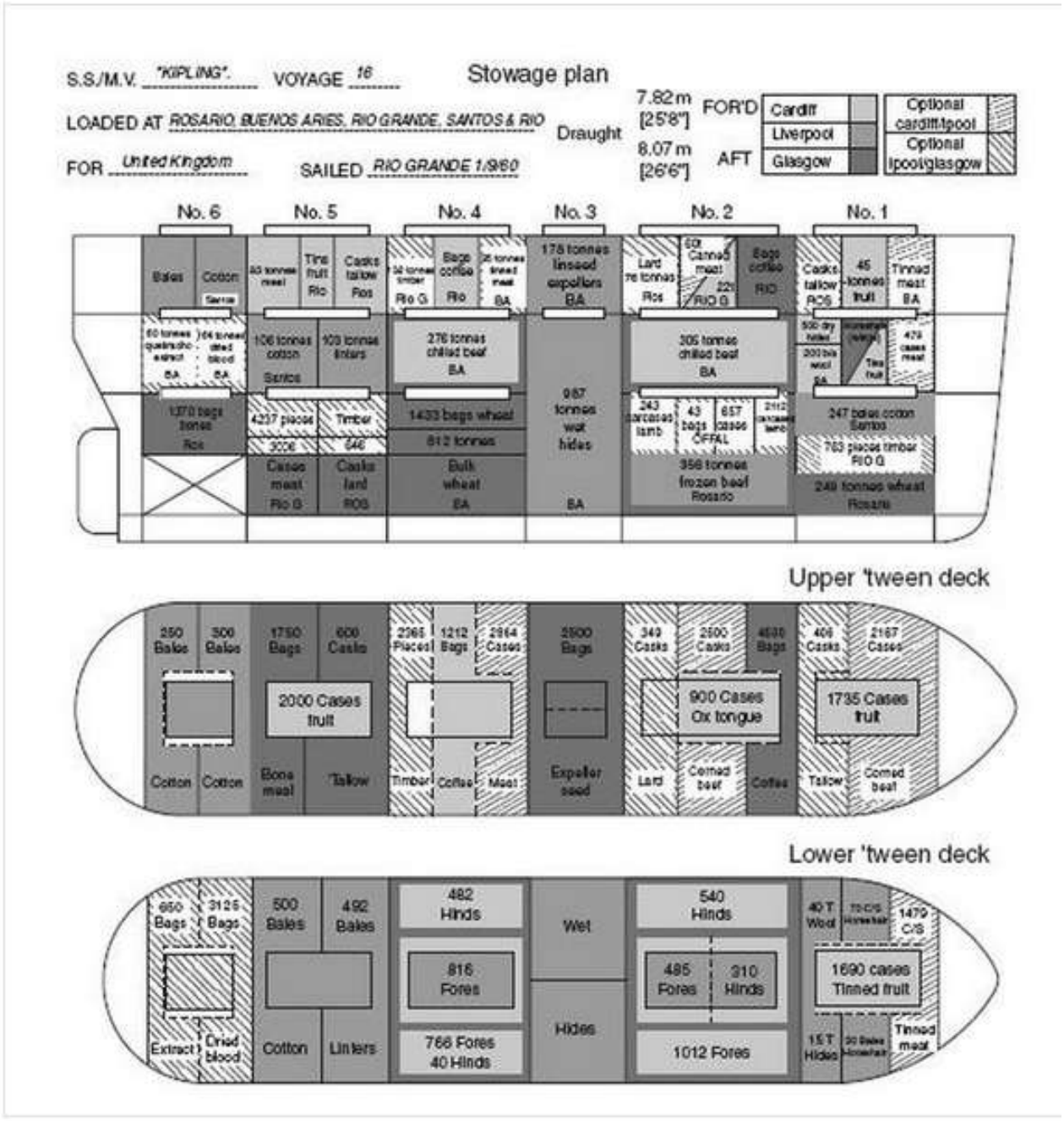
Total quantity, description of package, bales, pallets etc., tonnage, port of discharge, identification marks and special features if and when separated.

The port of discharge is normally 'highlighted' in one specific colour, reducing the likelihood of a parcel of cargo being over-carried to the next port. Cargoes which may have an optional port of discharge are often double-coloured to the requirements of both ports. The plan provides at a glance the distribution of the cargo and shows possible access to it in the event of fire or the cargo shifting. Its most common function is to limit over-carriage and the possibility of short delivery at the port of discharge. It also allows cargo operations, stevedores, rigging equipment, lifting gear and so on to be organised without costly delays to the ship.

All cargo should be stowed having due regard to the order of discharge. When planning the position of cargo and the order of loading and unloading, the effects that these operations will have upon access and the safety of personnel should be considered. The following points should be taken into account:

- Cargo information, including gross mass of the cargo or cargo units and any special properties detailed on board or in the shipping documents, should be recorded and used in planning.
- Wherever practicable, where more than one port is involved for loading or unloading, cargo should be loaded in layers rather than in tiers so as to avoid the development of high vertical walls of cargo.
- Care should be taken not to over-stow lighter cargoes with heavier cargoes which may lead to a collapse of the stow.
- Wherever practicable, cargo should be stowed so as to leave safe clearance behind the rungs of hold ladders and to allow safe access as may be necessary at sea.
- The need to walk across or climb onto deck cargo, where this may involve an approach to an unprotected edge with risk of falling, should be minimised.
- Care should be taken to avoid large gaps next to cargo where it is stacked against corrugated bulkheads.

Deck cargo should be stowed in accordance with the statutory regulations, and kept clear of hatch coamings to allow safe access. Access to safety equipment, firefighting equipment (particularly fire hydrants) and sounding pipes should also be kept free. Any obstructions in the access way such as lashings or securing points should be painted white to make them more easily visible. Where this is impracticable and cargo is stowed against ship's rails or hatch coamings to such a height that the rails or coamings do not give effective protection to personnel from falling overboard or into the open hold, temporary fencing should be provided.


S.S./M.V. "KIPLING". VOYAGE 16
Stowage plan
LOADED AT ROSARIO, BUENOS ARIES, RIO GRANDE, SANTOS & RIO
FOR United Kingdom
SAILED RIO GRANDE 1/9/60
Draught
7.82 m [25'8"] FOR'D
8.07 m [26'6"] AFT
Cardiff
Liverpool
Glasgow
Optional cardiff/lpool
Optional lpool/glasgow
No. 6
No. 5
No. 4
No. 3
No. 2
No. 1
Bales Cotton
Tins fruit Rio
Casks tallow Rios
Bags coffee Rio
178 tonnes linseed expellers BA
Bags coffee RIO
Casks tallow ROS
45 tonnes fruit
Tinned meat BA
106 tonnes cotton Santos
103 tonnes linters
276 tonnes chilled beef BA
305 tonnes chilled beef BA
987 tonnes wet hides
1370 bags tonnes Rios
4217 pieces
Timber
1433 bags wheat
812 tonnes
343 carcases lamb
43 bags
657 cases OFFAL
247 bales cotton Santos
783 pieces timber RIO G
Cases meat Rio G
Casks lard ROS
Bulk wheat BA
356 tonnes frozen beef Rosario
249 tonnes wheat Rosario
Upper 'tween deck
250 Bales
500 Bales
1750 Bags
600 Casks
2000 Cases fruit
2365 Pieces
1212 Bags
2964 Cases
3500 Bags
340 Casks
2500 Casks
4630 Bags
900 Cases Ox tongue
406 Casks
2167 Cases
1735 Cases fruit
Cotton
Cotton
Bone meal
Tallow
Timber
Coffee
Meat
Expeller seed
Lard
Corned beef
Coffee
Tallow
Corned beef
Lower 'tween deck
650 Bags
3125 Bags
500 Bales
492 Bales
482 Hinds
816 Fores
766 Fores 40 Hinds
Wet
Hides
540 Hinds
495 Fores
310 Hinds
1012 Fores
40 T Wool
1479 C/S
1690 cases Tinned fruit
15 T Hides
Tinned meat
Extract
Dried blood
Cotton
Linters

Dry Cargo

All cargoes should be stowed and secured in a manner that will avoid exposing the ship and persons on board to unnecessary risk. The safe stowage and securing of cargo depends upon proper planning, execution and supervision by properly qualified and experienced personnel.

Loading, stowage and securing of cargo other than bulk cargo is to be carried out in accordance with the ship's approved cargo-securing manual. Further guidance is contained in the IMO Code of Practice for Cargo Stowage and Securing (IMO Resolution A.714(17)). Cargo securing should be completed before the ship proceeds to sea.

All cargo should be stowed having due regard to the order of discharge at a port or number of ports. When planning the position of cargo and the order of loading and unloading, the effects that these operations will have upon access and the safety of personnel should be considered.

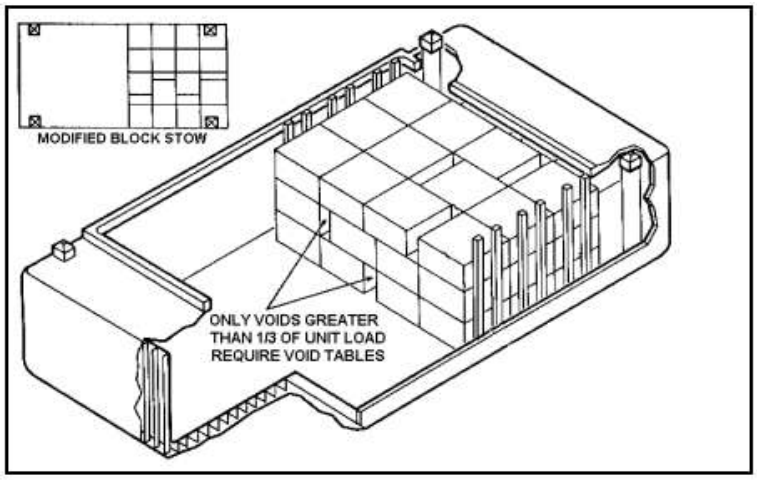
- Use a stowage plan to ensure cargo weight is distributed as evenly as possible and total weight is within the maximum payload limit
- The stowage plan should include an arrangement that allows the centre of gravity of the stowed cargo to be at, or below, the half-height point of the container. That is, heavy cargo should be stowed at the bottom of the container for better stability
- When securing cargo, the centre of gravity should also be at or close to the half-length position of the container for safer container handling
- When necessary, dunnage such as wood planks, plastic foam and paper boards should be used to protect against mechanical damage or, when stacking, to create a level surface
- When transporting moisture-sensitive cargo, use desiccants to protect cargo from damp. Roof dunnage and floor dunnage can also be used to dissipate moisture and avoid accumulation of damp or sweat or the cargo can be wrapped with a plastic sheet or tarpaulin
- Bottom and intermediate dunnage must be arranged in a way that allows easy cargo handling with forklift trucks and other equipment without causing damage

Cargo Securing Arrangements for Dry Cargo

Lashing is a general term that is used for all the securing arrangements onboard: It includes ropes, wires, webbings, bandings, strapping or chains, bottle screws and other patent tensioning devices mostly used on container ships

Tomming

Construction of a support of square section softwood framework, which chocks off the cargo against ship's structure or other cargo.



Filling

Use of air bags, empty pallets, old tyres, etc. to fill the voids and broken stowage between items of cargo and between cargo and ship's structures.

Anti-skid

Flat-boards are used to increase frictional capabilities of the cargoes

Binding

Even out a stow with dunnage to make several units into one block. Also stowing bags or cartons in different directions in each layer forms a self-locking slab which is a tight stow for shifting cargoes.

Structural Modifications

Very heavy and uncomfortably shaped cargo may be secured by welding the unit directly to the ship's structure or by fabricating a steel framework or other support or chock which is permanently attached to the ship's structure

Basics of Safe Slinging

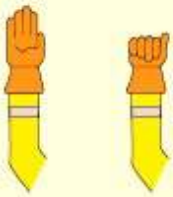
1) When loads are lifted on a sling the general idea is to get the load to be as secured in the air as it was on ground.
2) The loads must be satisfactorily secured by the slings:

    - Loads are completely contained by the slings (e.g. Bags in nets).
    - Use fixed lifting pendants or lugs if available.
    - Ropes or wire slings must be completely wrapped around the loads – no loads should be left resting in loose bights of the line.
    - When using specialized components, they must be properly attached to the cargo, and the manufacturer's instructions should be followed.

3) The slings must be sufficiently attached to the lifting appliances.
4) The loads must be slung so that they will not collapse or change form when they are lifted.
5) The load must not damage the sling, possibly causing the slings to part. Use stuffing or padding at susceptible points or sharp edges.
6) Ensure that the loads are not to be damaged by the sling.
7) All lifting parts should have their pivoting points as near to the vertical as possible for a clean lift by the crane.

Signals for the Operation of Equipment

Operators and crew should know these signals.

Meaning	*Description*	*Illustration*
	A. General hand signals	
START Attention Start of Command	both arms are extended horizontally with the palms facing forward.	
TAKING THE STRAIN or INCHING THE LOAD	the right arm points upwards with the palm facing forwards. The fingers clenched and then unclenched.	 *
STOP Interruption End of movement	the right arm points upwards with the palm facing forwards.	
END of the operation (operations cease)	both hands are clasped at chest height.	
	OR	
	both arms extended at 45° downwards and lower arms crossed back and forth sharply across torso.	 *

B. Vertical movements

RAISE	the right arm points upwards with the palm facing forward and slowly makes a circle.		
LOWER	the right arm points downwards with the palm facing inwards and slowly makes a circle.		
DERRICKING THE JIB	signal with one hand. Other hand on head	 Jib up	*
		 Jib down	*
TELESCOPING THE JIB	signal with one hand. Other hand on head	 Extend jib	*
		 Retract jib	*
VERTICAL DISTANCE	the hands indicate the relevant distance.		

C. Horizontal movements

MOVE FORWARDS (Travel to me)	both arms are bent with the palms facing upwards and the forearms make slow movements towards the body	
MOVE BACKWARDS (Travel from me)	both arms are bent with the palms facing downwards and the forearms make slow movements away from the body.	
RIGHT to the signalman's (in the direction indicated)	the right arm is extended more or less horizontally with the palm facing downwards and slowly makes small movements to the right.	
LEFT to the signalman's (in the direction indicated)	the left arm is extended more or less horizontally with the palm facing downwards and slowly makes small movements to the left.	
HORIZONTAL DISTANCE	the hands indicate the relevant distance.	
SLEWING (In direction indicated)	both arms close to side extending one arm 90º from elbow.	 *  *

D. Danger

DANGER EMERGENCY STOP	both arms point upwards with the palms facing forwards.	

E. Other

SECURE Secure the Load	both arms are crossed closely to the chest with hands clenched.	 *
TWISTLOCKS Twistlocks on/off	the left arm points upwards. Rotate wrist of left hand clockwise signalling twist on, and anticlockwise for signalling twist off.	 *

F. Operating instructions

QUICK	all movements faster.
SLOW	all movements slower.

CHAPTER TWENTY THREE

CAPACITIES, SAFE WORKING LOADS AND BREAKING STRENGTHS

The term Safe Working Load (SWL) is the weight (force) that an item of lifting equipment, lifting device or accessory can be safely used to lift, suspend or lower a mass without breaking. The SWL is usually marked on the equipment by the manufacturer.

SWL is usually 1/5 of the Minimum Breaking Strength (MBS) although other fractions may be used – it is the load level that is much less than that required to make the lifting equipment fail.

The Minimum Breaking Strength is the load tested to the point it breaks, the SWL being a small fraction of the breaking load for safety.

Manufacturers provide the safe working load for the products and where it is possible i.e. on shackles or derricks etc. they will be clearly marked on the item.

Synthetic/Natural Fibre Lines: Comparison

Size in (inches)	Manila		Three-strand Nylon		2-in-1 Braided Nylon	
	SWL (pounds)	BS (pounds)	SWL (pounds)	BS (pounds)	SWL (pounds)	BS (pounds)
1	200	1,000	500	2,500	600	3,000
1 ½	450	2,250	1,125	5,625	1,350	6,750
2	800	4,000	2,000	10,000	2,400	12,000
2 ½	1,250	6,250	3,125	15,625	3,750	18,750
3	1,800	9,000	4,500	22,500	5,400	27,000
3 ½	2,450	12,250	6,125	30,625	7,350	36,750
4	3,200	16,000	8,000	40,000	9,600	48,000
4 ½	4,050	20,250	10,125	50,625	12,150	60,750
5	5,000	25,000	12,500	62,500	15,000	75,000
5 ½	6,050	30,250	15,125	75,625	18,150	90,750
6	7,200	36,000	18,000	90,000	21,600	100,800
6 ½	8,450	42,250	21,125	105,625	25,350	126,750
7	9,800	49,000	24,500	122,500	29,400	147,000
7 ½	11,250	56,250	28,125	140,625	33,750	168,750
8	12,800	64,000	32,000	160,000	38,400	192,000
8 ½	14,450	72,250	36,125	180,625	43,350	216,750

Sling Comparison

Rated Capacity in Tons (2,000 lbs.)									
Component Rope Diameter (in.)	Approximate Finished Sling Diameter (in.)	Vertical Capacity	Choker Capacity	Basket Hitch **				Standard Eye Dimension (in.)	
				Vertical	60°	45°	30°	Width	Length
* 1/8	3/8	1.2	1	2.4	2	1.6	1.2	3	6
* 3/16	9/16	2.4	2.1	4.8	4.2	3.4	2.4	4	8
* 1/4	3/4	4	3.5	8	6.9	5.7	4	5	10
* 5/16	1	5.6	4.9	11.2	9.7	8	5.6	6	12
3/8	1-1/8	8.7	7.6	17.4	15	12.3	8.7	7-1/2	15
7/16	1-5/16	11.7	10.3	23.4	20.3	16.5	11.7	9	18
1/2	1-1/2	15.3	13.4	30.6	26.5	21.6	15.3	10	20
9/16	1-3/4	19.3	16.9	38.6	33.4	27.3	19.3	12	24
5/8	1-7/8	23.7	20.7	47.4	41	33.5	23.7	12	24
3/4	2-1/4	33.8	29.5	67.5	58.5	47.7	33.8	15	30
7/8	2-5/8	45.7	40	91.4	79.2	64.6	45.7	17	34
1	3	59.4	52	118.7	102.8	83.9	59.4	20	40
1-1/8	3-3/8	75	65	149	129	105	75	22	44
1-1/4	3-3/4	92	80	184	159	130	92	25	50
1-3/8	4-1/8	110	96	220	190	156	110	27	54
1-1/2	4-1/2	131	115	262	227	185	131	30	60
1-3/4	5-1/4	176	154	351	304	248	176	35	70
2	6	227	199	455	394	321	227	40	80
2-1/4	6-3/4	284	248	567	491	401	284	45	90
2-1/2	7-1/2	347	303	693	600	490	347	50	100
2-3/4	8-1/4	414	363	828	717	585	414	55	110

Steel Wire

6 x 19 6 x 36 GROUPS STEEL CORE - GRADE 1770 N/mm2							
ROPE DIA	SAFE WORKING LOAD					MIN BREAK LOAD	PROOF LOAD PER LEG @ 0 DEGREES
	SINGLE LEG	LEG ANGLE 0-90 DEGREES		LEG ANGLE 90-120 DEGREES			
		2 LEG	3 & 4 LEG	2 LEG	3 & 4 LEG		
mm	tonne	tonne	tonne	tonne	tonne	tonne	tonne
8	0.82	1.10	1.70	0.82	1.20	4.11	1.64
9	1.00	1.40	2.10	1.00	1.50	5.20	2.00
10	1.30	1.80	2.70	1.30	1.90	6.42	2.60
11	1.50	2.20	3.20	1.50	2.30	7.77	3.20
12	1.80	2.60	3.90	1.80	2.80	9.25	3.60
13	2.10	3.00	4.50	2.10	3.20	10.80	4.40
14	2.50	3.50	5.30	2.50	3.80	12.60	5.00
16	3.30	4.60	6.90	3.30	4.90	16.40	6.60
18	4.10	5.80	8.70	4.10	6.20	20.80	8.40
19	4.60	6.40	9.70	4.60	6.90	23.10	9.20
20	5.10	7.20	10.80	5.10	7.70	25.70	10.20
22	6.20	8.70	13.00	6.20	9.30	31.10	12.40
24	7.40	10.30	15.50	7.40	11.10	37.00	14.80
26	8.70	12.10	18.20	8.70	13.00	43.40	17.40
28	10.10	14.10	21.10	10.10	15.10	50.40	20.20
32	13.10	18.40	27.60	13.10	19.70	65.70	26.20
35	15.70	22.00	33.00	15.70	23.60	78.70	31.40
36	16.60	23.30	35.00	16.60	25.00	83.30	33.20
38	18.50	26.00	39.00	18.50	27.80	92.80	37.00
40	20.60	28.80	43.20	20.60	30.90	103.00	41.20
44	24.80	34.70	52.10	24.80	37.20	124.00	49.60
48	29.60	41.40	62.10	29.60	44.40	148.00	59.20
52	34.80	48.70	73.10	34.80	52.20	174.00	69.60
54	37.40	52.30	78.50	37.40	56.10	187.00	74.80
56	40.20	56.30	84.40	40.20	6.03	201.00	80.40
60	46.20	64.70	97.00	46.20	69.30	231.00	92.40
64	54.80	76.70	115.10	54.80	82.20	274.00	109.60
71	66.60	93.20	139.80	66.60	99.90	333.00	133.20
77	77.80	108.90	163.40	77.80	116.70	389.00	155.60

Bollards come in many shapes, sizes, capacities and materials and throughout their life will suffer corrosion, fatigue and other effects.

The forces exerted on a bollard are considerable, in excess of 2000kN, which can weaken the bollard and its fixings to the point that the bollard fails to withstand such forces. Should this happen, it can cause damage to dockside equipment and the quayside, as well as serious or fatal accidents.

Winches or windlasses should be constructed to give warning of undue strains by stalling at well below half the designed maximum safe working load of the weakest element in the system (e.g. bollard, fairlead, shackle, holding down bolt, etc.) and to afford further protection by walking-back at about half the design load (e.g. breaking strength of the mooring rope, tow line or hawser whichever is applicable). For Example: A winch or windlass capable of a 10 tonne pull should be fitted with a rope having a "breaking strain" of 20 tonnes or more.

Mooring winch capacity is determined at the ship design stage when factors such as the vessel's size, number of mooring lines to be deployed, anticipated maximum wind area and anticipated effect of tidal conditions are considered, together with the mooring lines' Mean Breaking Load (MBL). After selection of the MBL of the mooring lines the winch heaving load will be set to a lower value than the MBL to prevent the winch motor from applying excessive load.

Mooring Winch Brake Settings

After mooring it is standard practice to apply the winch brake and to take the winch motor out of gear, leaving friction between the brake lining and the winch drum to prevent rotation of the drum. Typically, mooring winch brakes are designed to hold up to 80% of the MBL with the capability of adjusting these to 60% of the MBL to allow for a margin of safety.

Anchors

Anchor size, type and capacity are included in the design but all vessels have to meet the Administration requirements

Chain

Chain Link Dimensions					Grade 2 Chain		Grade 3 Chain			
inches	mm	Dim A	Dim B	Dim C 5 Links	Weight Per 90'	Proof Load	Break Load	# of Links per 90'	Proof Load	Break Load
5/8	16	3-3/4	2-1/4	13-3/4	365	23745	33220	33220	47465	432
3/4	19	4-1/2	2-5/8	16-1/2	480	34000	47600	47600	68000	357
13/16	20	4-7/8	2-7/8	17-7/8	570	39800	55700	55700	79500	329
7/8	22	5-1/4	3-1/8	19-1/4	660	46000	64400	64400	91800	305
15/16	24	5-5/8	3-5/16	20-5/8	760	52600	73700	73700	105000	285
1	25	6	3-9/16	22	860	59700	83600	83600	119500	267
1-1/16	27	6-3/8	3-3/4	23-3/8	970	67200	94100	94100	135000	251
1-1/8	29	6-3/4	4	24-3/4	1080	75000	105000	105000	150000	237
1-3/16	30	7-1/8	4-1/4	26-1/8	1220	83400	116500	116500	167000	225
1-1/4	32	7-1/2	4-1/2	27-1/2	1350	92200	129000	129000	184000	213
1-5/16	33	7-7/8	4-3/4	28-7/8	1490	101500	142000	142000	203000	203
1-3/8	34	8-1/4	4-15/16	30-1/4	1630	111000	155000	155000	222000	195
1-7/16	36	8-5/8	5-1/16	31-5/8	1780	120500	169000	169000	241000	187
1-1/2	38	9	5-3/8	33	1940	131000	183500	183500	262000	179
1-9/16	40	9-3/8	5-5/8	34-3/8	2090	142000	198500	198500	284000	171
1-5/8	42	9-3/4	5-7/8	35-3/4	2240	153000	214000	214000	306000	165
1-11/16	43	10-1/8	6-1/116	37-1/8	2410	166500	229000	229000	327000	159
1-3/4	44	10-1/2	6-5/16	38-1/2	2590	176000	247000	247000	352000	153
1-13/16	46	10-7/8	6-1/2	39-7/8	2790	188500	264000	264000	377000	147
1-7/8	48	11-1/4	6-3/4	41-1/4	2980	201000	281000	281000	402000	143
1-15/16	50	11-5/8	7	42-5/8	3180	214000	299000	299000	427000	139
2	51	12	7-3/16	44	3360	227000	318000	318000	454000	133
2-1/16	52	12-3/8	7-7/16	45-3/8	3570	241000	337000	337000	482000	129
2-1/8	54	12-3/4	7-5/8	46-3/4	3790	255000	357000	357000	510000	125
2-3/16	56	13-1/8	7-7/8	48-1/8	4020	269000	377000	377000	538000	123
2-1/4	58	13-1/2	8-1/8	49-1/2	4250	284000	396000	396000	570000	119
2-5/16	59	13-7/8	8-5/16	50-7/8	4490	299000	418000	418000	598000	117
2-3/8	60	14-1/4	8-9/16	52-1/4	4730	314000	440000	440000	628000	113
2-7/16	62	14-5/8	8-3/4	53-5/8	4960	330000	462000	462000	660000	111
2-1/2	64	15	9	55	5270	346000	484000	484000	692000	107
2-9/16	66	15-3/8	9-1/4	56-3/8	5540	363000	507000	507000	726000	105
2-5/8	67	15-3/4	9-7/16	57-3/4	5820	379000	530000	530000	758000	103

2-11/16	68	16-1/8	9-11/16	59-1/8	6110	396000	554000	554000	792000	99
2-3/4	70	16-1/2	9-7/8	60-1/2	6410	413000	578000	578000	826000	97
2-13/16	71	16-7/8	10-1/8	61-7/8	6710	431000	603000	603000	861000	95
2-7/8	73	17-1/4	10-3/8	63-1/4	7020	449000	628000	628000	897000	93
2-15/16	75	17-5/8	10-9/16	64-5/8	7330	467000	654000	654000	934000	91
3	76	18	10-13/16	66	7650	485000	679000	679000	970000	89
3-1/16	78	18-3/8	11	67-3/8	7980	504000	705000	705000	1008000	87
3-1/8	79	18-3/4	11-1/4	68-3/4	8320	523000	732000	732000	1046000	85
3-3/16	81	19-1/8	11-1/2	70-1/8	8660	542000	759000	759000	1084000	85
3-1/4	83	19-1/2	11-11/16	71-1/2	9010	562000	787000	787000	1124000	83
3-5/16	84	19-7/8	11-15/16	72-7/8	9360	582000	814000	814000	1163000	81
3-3/8	86	20-1/4	12-1/8	74-1/4	9730	602000	843000	843000	1204000	79
3-7/16	87	20-5/8	12-3/8	75-5/8	10100	622000	871000	871000	1244000	77
3-1/2	90	21	12-5/8	77	10500	643000	900000	900000	1285000	77
3-5/8	92	21-3/4	12-15/16	79-3/4	11300	685000	958000	958000	1369000	73
3-3/4	95	22-1/2	13-3/8	82-1/2	12000	728000	1019000	1019000	1455000	71
3-7/8	98	23-1/4	14	85-1/4	12900	772000	1080000	1080000	1543000	69
4	102	24	14-3/8	88	13700	816000	1143000	1143000	1632000	67

Bitts, Bollards, Chocks and Fairleads

The mooring and towing fittings are used for mooring ships to quays, piers, and buoys and meet the stresses resulting from the tide, wind load, and wave load safely.

They are made up of tools such as mooring winch, fittings such as chock, fairlead, guide roller, bollard and bitt, seat on which fittings are installed and reinforced parts of the ship.

They also cover rope used in mooring, a chain and a chain stopper used to fasten the chain to a ship. They are required to be installed with strength appropriate for the size of the ship and the reinforcement of ship's lower part must be designed strongly enough to endure load transmitted from mooring and towing fittings.