



NYK Maritime College



NYK SHIPMANAGEMENT

# **NMCR-17**

## **Safe Mooring Operation Training (Basic Course)**



NYK SHIPMANAGEMENT PTE LTD  
Training Center, No. 25 Pandan Crescent #04-10 Tic Tech Center, Singapore – 128477

1<sup>st</sup> Edition (Jun. 2013)



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## Introduction

Ships enter and leave ports regularly. Tying up a ship when alongside a berth or another vessel is potentially a very hazardous operation unless simple and effective safety procedures are followed. Mooring accidents are always on the list of personal injury accidents, often resulting in severe injuries or even fatalities.

Always anticipate well ahead and expect the unexpected. Maritime Incidents are seldom the result of single event, they are almost invariably the result of the culmination of an error chain. Situational awareness is extremely important to recognize that an error chain is developing and to take action to break the error chain.

This training is a basic guideline that should be taken into account by **Junior Officers and Ratings** while performing mooring and anchoring operations.



This course has been developed in response to the prevailing incidents and accidents onboard ships related to mooring and anchoring operations. To minimize the risks, Officers and Crew on board vessels must have good knowledge and understanding about safe mooring operations and equipment limitations.

## Objective

This training course will equip crew who are directly involved in mooring operations with the practical know-how and a prepared state of mind when engaging themselves in actual mooring on board.

Those who successfully complete this course should be able to:

- Be aware of the risk involved.
- Relate and learn from the mooring accidents and incidents.
- Understand the basic principles of safe mooring operations.
- Be familiar with types of ropes and wires used in mooring operations.
- Understand the basic principles of safe anchoring.
- Have basic comprehension about the mooring equipment.
- Be able to understand and use proper communication – hand and whistle signals.
- Be familiar with testing, inspection and maintenance of the mooring hawsers and mooring equipment.
- Handle mooring line & equipment properly with considering prevent injuries and incidents.

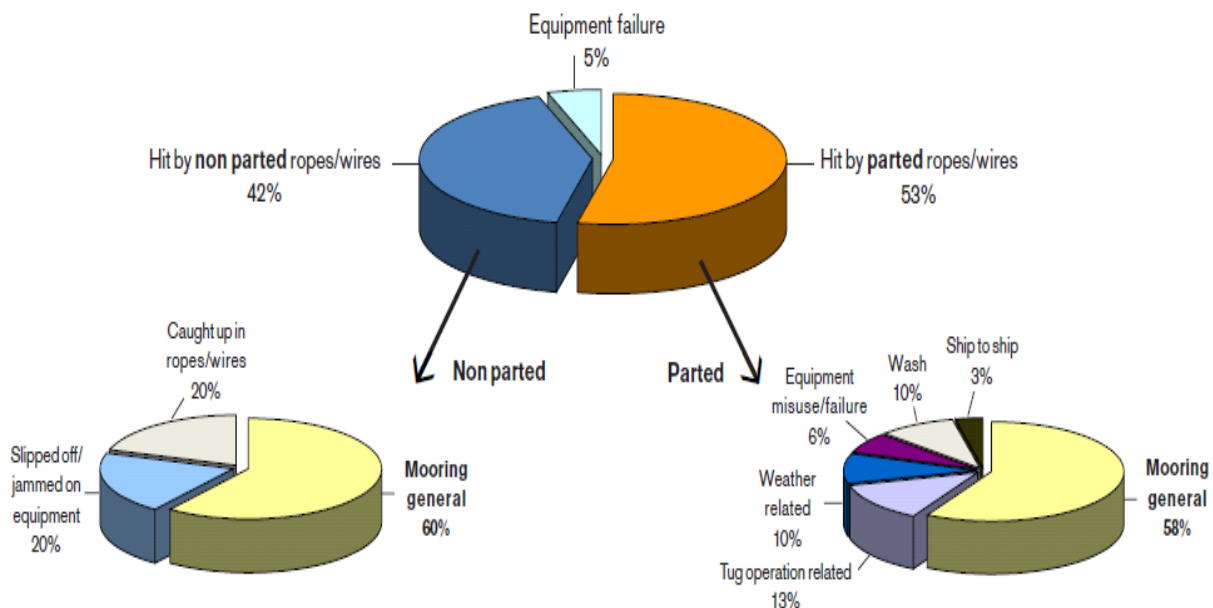
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## 1. Understanding Mooring Incidents

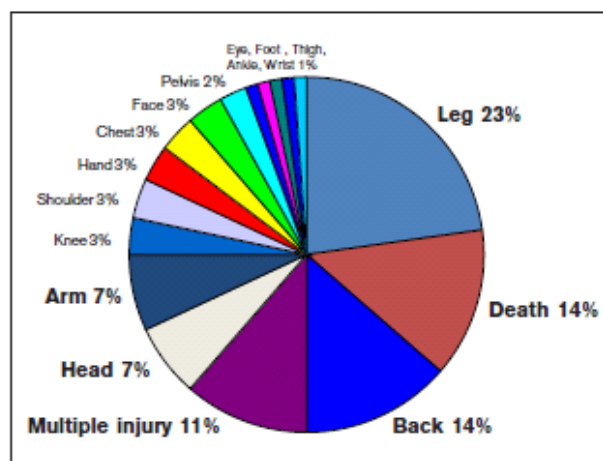
### 1.1 Statistics of Mooring Incidents (UK P&I Club LP News, Jan. 2009)

Many of these accidents have occurred during the handling of ropes/wires, where ropes/wires have parted (53%) or where ropes/wires have jumped/slipped off drum ends/bitts (42%) with 5% caused by actual equipment failure (see pie chart below centre).



Parted ropes/wires normally occur during general mooring, tug and ship to ship operations with equipment failure, misuse, wash damage and weather also playing a role. Injuries from non parted ropes/wires normally occur due to crew being caught up in ropes/wires and ropes wires slipping off and becoming jammed on drum ends during normal mooring operations (see pie charts).



Types of incidents resulting in personal injury



Injuries from Mooring Incidents

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## 1.2 Mooring Incidents in NYK Fleet



### (1) Fatality during adjusting / tending to mooring lines while at the berth (Casualty Report 2013 001)

#### Description of Incident : 24th May. 2013

A bulk carrier was alongside the berth at the port of Hong Kong and discharge of cargo was in progress. While a crew member was operating the winch in order to adjust the forward breast line, which led to the mooring winch via a pedestal roller, the mooring rope parted and hit the crew member on the right side of his face. He was transported to a hospital immediately but unfortunately he was declared dead upon arrival at the hospital.

The berth where the ship was moored is always subjected to strong currents and at the time of the accident, the strength of the currents had further increased due to the prevailing spring tide. On the following day, a head line parted at approximately the same time, however fortunately there was no accident.



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### **Cause(s) & Contributing Factors :**



One possibility is that the rope was under dynamic load/stress caused by the strong current, while it was being adjusted. It is suspected that one of the main causes is the poor condition of the mooring ropes.

### **Required Action :**

Unfortunately, similar accidents have occurred regularly in NYK fleet. Duty officers and crew members are strongly requested to give special attention to the below points so that a similar accident can be avoided.

- ① Be more vigilant during mooring operations not only when berthing/unberthing, but also when tending to / adjusting mooring lines during port stay.
- ② Officers on site should monitor the movements of the ship and condition of mooring ropes, and should properly maintain safe working conditions for the crew members.
- ③ Review the "Snap Back Zones" on board in order to identify potentially unsafe areas at the mooring stations and to prevent similar injuries.
- ④ When mooring ropes are under strain, crews should remain clear of the "Snap Back Zones."
- ⑤ Carry out periodical inspection of mooring ropes and maintain the record / history of the rope condition. Reverse or replace the mooring ropes according to the company's maintenance policy and plan.



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## (2) Finger Injury while making fast tug's line

**Description of Incident :** 24th Aug. 2012

While making fast the tug's line (heavy wire rope) at aft station, two crewmembers were holding and handling the tug's line to put the eye of the tug's line on to bitts.

One of the Crewmember's (AB-B) forefinger got caught between wire and the bitts as messenger rope which was used to pick up the tug's line slipped from the warping drum.

This resulted in to crushing of forefinger and uprooting of nail.

### **Cause(s) & Contributing Factors :**

- ① Unsafe mooring practice.
- ② Lack of safe mind.
- ③ Failure to analyze the risk factor and job hazard.
- ④ Chain stopper was not used as it was NOT available at mooring stations. (Tug's lines are never to be made fast without using chain stopper.)
- ⑤ No Proper PPE - AB was wearing cotton Gloves ( not leather gloves)

### **Required Action :**



- ① Place chain stoppers in mooring stations in case wires are to be handled.
- ② Brief crew members' regarding safe use of the same.
- ③ Emphasize proper PPE to be worn at all times.



Putting the eye of tug line on to the Bitts



Finger getting trapped between bitts and eye of tug's line due to sudden tightening of the line

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### (3) Stern Line Parted During Cargo Operations

#### Description of Incident : 1st Nov. 2012

Vessels stern mooring wire line parted during cargo discharge operations. Weather conditions were reported to be fine during the incident.

#### Cause(s) & Contributing Factors :



- ① Mooring wire had a splice.
- ② Damage to splice part of the wire including age deterioration due to the structure of hand splice,
- ③ Poor/lack maintenance and not proper mooring adjustment.

#### Required Action :

- ① Regular visual inspection of the mooring lines must be carried out in order to assess the condition of wires. Hand splice must be confirmed done properly.
- ② Proper maintenance of ship's mooring lines must be carried out as per schedule in order to ensure that the wires being used will provide the expected result.



Parted Stern Line

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#### **(4) BSN injured while securing the pilot ladder**

**Description of Incident :** 17th Dec. 2011

BSN was securing the pilot ladder by himself after picking up the pilot. While adjusting the ladder suddenly the rope jumped and caught his fingers of one hand.

He could not get the hand out of the rope and as he was far away from controller he could not stop the reel. He moved around with the reel and was finally pulled in by the rotating reel. This resulted in fracture of three ribs.

#### **Cause(s) & Contributing Factors :**

- ① Only One person allocated for the job needing adjustment on the running machinery.
- ② The Job was not included in the Daily Job order nor was discussed in Tool box meeting. Permit to work Overside was not being used for this job.

#### **Required Action :**



- ① Such Jobs will always be attended by Two persons together.
- ② This activity to be included in Daily Job order and discussed in daily tool box meeting. Required permit to be to work Overside <S-091005-02 CHK> must be used.
- ③ It would be re-iterated that Winch Operator would not leave the operating station without the Control lever being locked Neutral or Stop.
- ④ Warning signs for above to be posted/stenciled near such machinery.



Simulation

#### **(5) Accident during securing the tug lines (*Safety Bulletin 2009 002*)**

**Brief description of incident :** Dec. 2008

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While a bulker was berthing, two mooring ropes to be used as a tug line were sent from the ship's aft station to the tugboat. One mooring rope (starboard side) was first secured on the ship's bitt, and the other rope (port side) was temporarily secured through figure-eight turns on the bitt because of the need to adjust the rope length.

Few minutes later, the tug moved to the port side from the right aft to keep the slack ropes from entangling in the ship's propeller. Later, because of this operation, the tension of the ropes tightened, and the rope started to slowly run out. Two crew tried to stop the running rope by making more figure-eight turns on the bitt. At the same time, one crewman tried to stop the running rope by stepping on it near the fairleader without first receiving an order from an officer. However, the rope continued to run out and eventually caught the foot of the crewman who was stepping on the rope. His foot was caught between the rope and the fairleader. The injured crewman was sent to the nearest hospital for treatment, but unfortunately his right leg needed to be amputated under the knee.

### **Cause(s) & Contributing Factors :**

- ① Lack of communication with tug.
- ② Lack of safe mind that all moving gears and running ropes can lead to serious injuries.

### **Required Action :**

#### **\*General**



- ① Review the berthing operation of your vessel, including line-handling procedures, and check if there are any unsafe acts or conditions.
- ② Assign appropriate numbers of crews in consideration of workload, difficulty, and crew experience.
- ③ Tool box meetings should be held and involve all concerned crews.



Stepping on the rope

#### **\* During a berthing operation**

- ① Crew should not step on any running ropes, and keep clear of them.
- ② Officers on site should maintain good communication with the tugboat, line boat, and linesman on shore whenever crewmen handle a tug line or a mooring line.
- ③ Officers on site should properly supervise the safety work of crew.
- ④ Crew should take action only in compliance with clear orders from the director and should not take any independent action based on uncertain information or guesswork.

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## **(6) Fatality during Mooring Operation** *(Safety Bulletin 2008 012)*

### **Description of Incident : Aug. 2008**

While the PCC was going to alongside, a total of 5 crew, including 1 officer, were on the FWD mooring station. The vessel had two head lines running ashore from the center winch drums, and those two lines were being heaved up by one crewman on the center winch under the officer's direction. Two more lines from the portside winch drums were being slackened to send lines to the mooring boat under the direction of the BSN, with the winch being operated by a second crew (A). A third crewman was assisting the BSN in lowering the portside mooring line to the boat (see photo #01).

At that time, crew (A) might not have been able to get any information from the BSN, because the BSN was not visible and the sound levels in the winch area were very high due to hydraulic motors operating and the sound of mechanical ventilators located nearby. The BSN was signaling with his hand to slacken the ropes, but crew (A) could not have seen him easily because the large gypsy wheel was in the way, obscuring crewman A's vision (see photo #02).

Crew (A) climbed the winch structure where there was potential danger to get a better view of the BSN and the officer signaling on the fore side of the mooring deck. When climbing so, his foot would be perilously close to the running gear wheel (see photo #03). This situation suggests that crewman A might have slipped while operating the winch and gotten caught in the running gear wheel.

### **Cause(s) & Contributing Factors :**



- ① Conning position is not appropriate.
- ② Oral and visual communication is not sufficient.

### **Required Action :**

#### **\*General**

- ① Review the mooring operation of your vessel and check if there are any unsafe acts or conditions.
- ② To maintain safe conditions, hardware modifications shall be considered if necessary. The master should discuss the necessity of such modifications with the owner / manager before taking measures.
- ③ Clearly identify dangerous places and apply safety markings where necessary.
- ④ Appropriate numbers of crewmembers shall be assigned in consideration of workload, difficulty, and crew experience.



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- ⑤ Tool box meetings should be held and involve all concerned crewmembers.

**\* During a mooring operation**

- ① Officers on-site should properly supervise the safety work of crew.
- ② Conning positions should be considered. An on-scene director must take the proper place for managing crew and equipment.
- ③ Maintain good oral and visual communication with each other.
- ④ Crewmembers should take action only in compliance with clear orders from the director, and should not take any action based on uncertain information or guesswork.

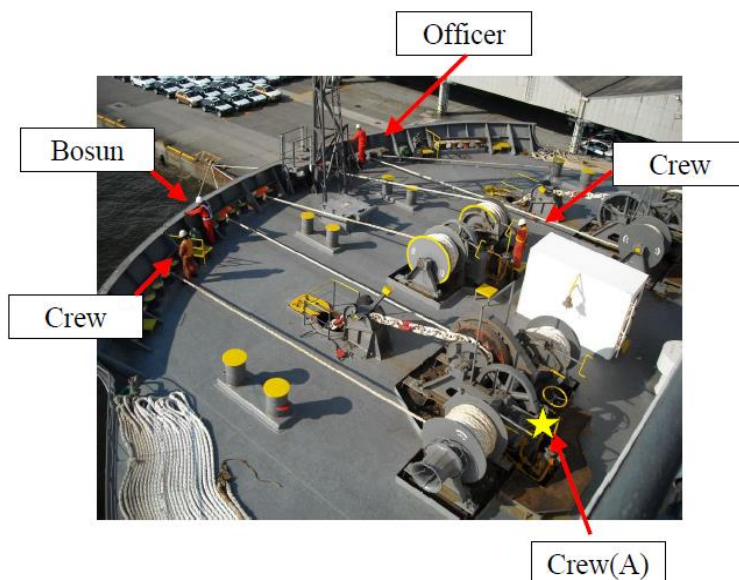




Photo #01 : Allocation



Photo #02 : View from winch control stand (Port Side)



Photo #03 : Image

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### 1.3 Risk Assessment of Mooring Stations

Vessel shall carry out a Risk Assessment of Mooring Operations, which shall include following:

#### (1) General Precautions

REMEMBER, you stand a greater risk of injuring yourself or your shipmate, during mooring and unmooring operations than at any other time. Following shall be taken account to ensure safety during such operation.

- a) Stand clear of all wires and ropes under heavy loads even when not directly involved in their handling.
- b) When paying out wires or ropes, watch that both your own and shipmate's feet are not in the coil or loop, BEWARE OF THE BIGHT!
- c) Always endeavor to remain in control of the line.
- d) Anticipate and prevent situations arising that may cause a line to run unchecked. If the line does take charge, do not attempt to stop it with your feet or hands as this can result in serious injury.
- e) Ensure that the "tail end" of the line is secured on board to prevent complete loss.
- f) Do not leave winches and windlasses running unattended.
- g) Do not stand on machinery itself to get a better view.
- h) Do not attempt to handle a wire or rope on a drum end, unless a second person is available to remove or feed the slack rope to you.
- i) Do not work too close to the drum when handling wires and ropes. The wire or rope could "jump" and trap your hand. Stand back and grasp the line about one meter from the drum or bitts.
- j) Always wear safety helmets with chin straps properly tightened during mooring operations.
- k) Very short lengths of line shall be avoided when possible; as such lines will take a greater proportion of the total load, when movement of the ship occurs.
- l) Two or more lines leading in the same direction shall, as far as possible, be of the same length.
- m) Two or more lines leading in the same direction shall always be of the same material. Never mix wire and soft moorings, if you can avoid it.
- n) Always stand well clear of a wire under load.
- o) Always wear gloves when handling ropes and wires.

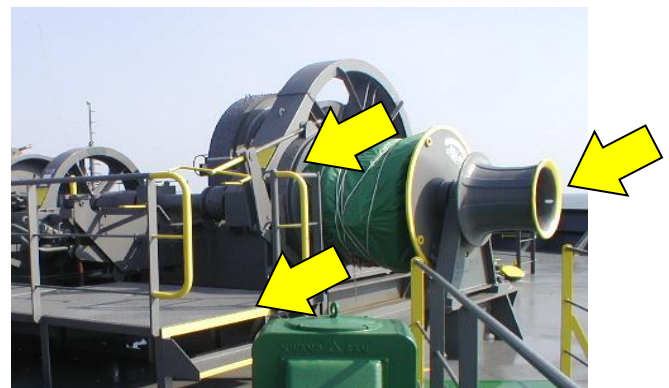
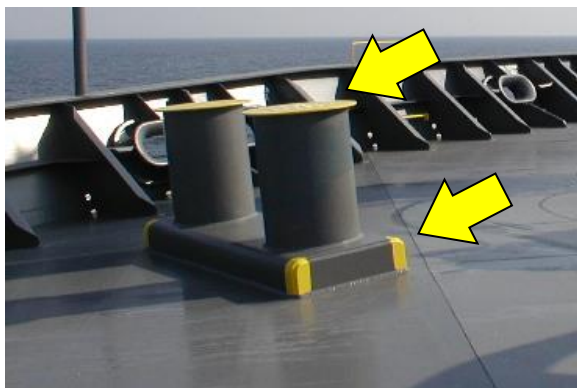
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- p) Upon completion of mooring the winch shall be left with the brake on and out of gear with stopper pin
- q) Do not leave the ropes on the warping drums but fast on bitts.
- r) Always use stopper ropes of material which is compatible to mooring ropes.(e.g. Manila Rope stopper should not be used with polypropylene ropes).
- s) Synthetic lines normally break suddenly and without warning.
- t) When making synthetic fiber ropes to bitts, do not use a "figure of eight" alone to turn them up. Use one or two round turns (but not more) around the leading post of the bitts before taking figure of eight for large size bitts. This method allows better control of the rope, is easy to use and is safer. Do not apply too many turns; generally 6 turns shall be taken with synthetic lines- if too many are applied then the line cannot be released in a controlled manner. Take at least 4-5 figure of eight turns of wires on bitts.
- u) When using winch stored ropes, do not run them through leads which are not on a direct line from the drum, as they are liable to chafe on the edge of the spool.
- v) Do not allow oil leaks from hydraulic winches to go unnoticed; it could lead to slips on deck.
- w) Spray shields/guards should be fitted to protect personnel and adjoining equipment/motors from the risk of leaks.



## (2) Hazard Highlighting

Highlighting hazards is particularly important for the safety of crew that are new to the vessel, cadets and other trainees, and visitors.

It is also important for the benefit of experienced crew who easily become complacent, tired, or too busy in their work to not notice a hazardous situation developing.





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### (3) Snap-Back and Safe Zones

Handling of mooring lines has a higher potential accident risk than most other shipboard activities. The most serious danger is snap-back, the sudden release of static energy stored in the synthetic line when it breaks.

When a line is loaded, it stretches. Energy is stored in the line proportion to the load and the stretch. When the line breaks, this energy is suddenly released. The ends of the line will snap-back, striking anything in their path with tremendous force.

Snap-back is common to all lines. Even long wire lines under tension can stretch enough to snap back with considerable energy. Synthetic lines are much more elastic, increasing the danger of snap-back.

Synthetic lines normally break suddenly and without warning. Unlike wires, they do not give audible signals of pending failure; nor do they exhibit a few visible broken elements before completely parting.

Line handlers shall stand well clear of the potential path of snap-back, which extends to the sides of and far beyond the ends of the tensioned line.

As a general rule, any point within about a 10 degree cone around the line from any point at which the line may break is in danger. A broken line will snap back beyond the point at which it is secured, possibly to a distance almost as far as its own length. If the line passes around a fairlead, then its snap-back path may not follow the original path of the line. When it breaks behind the fairlead, the end of the line will fly around and beyond the fairlead.

If an activity in a danger zone cannot be avoided, the exposure time can at least be reduced. When it is necessary to pass near a line under tension, do so as quickly as possible.



If it is a mooring line and the ship is moving about, time your passage for the period during which the line is under little or no tension.

If possible, do not stand or pass near the line while the line is being tensioned or while the ship is being moved along the pier.

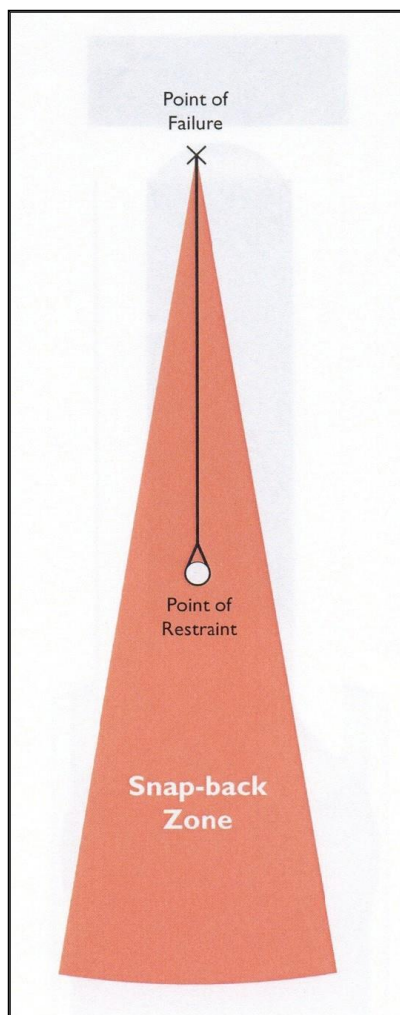
If you shall work near a line under tension, do so quickly and leave the danger zone as soon as possible. Plan your activity before you approach the line. Never have more people than necessary near the line.



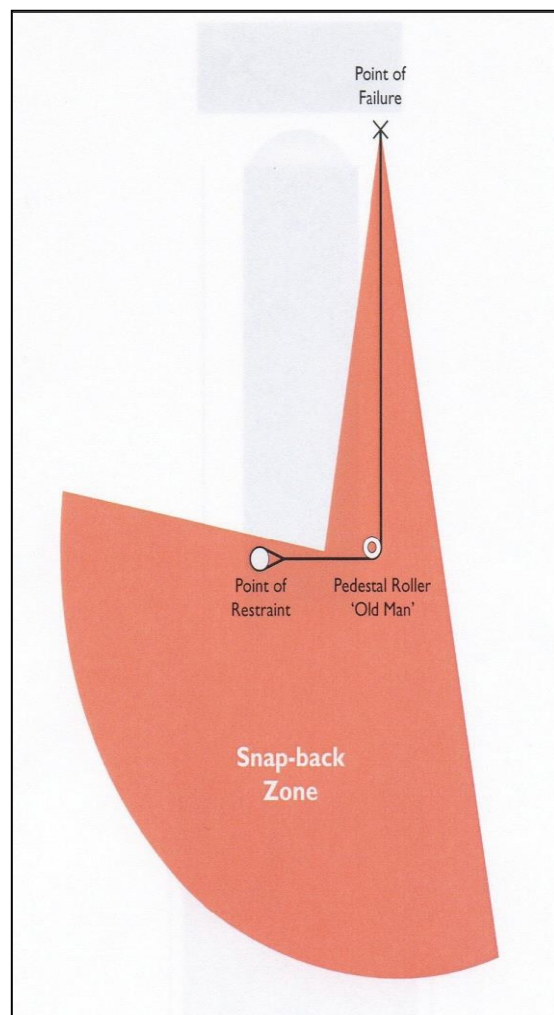
An Actual Mooring Deck Arrangement  
Illustrating Potential "Snap-Back" Zones

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If snap-back zones are painted on the deck then crew will be alerted to the danger when they notice they are standing in a highlighted zone. Painting these areas also helps supervising officers instruct crew to keep clear when lines are coming under tension.



**Figure 1 – A Simple Mooring System Illustrating the Potential “Snap-Back” Zone**

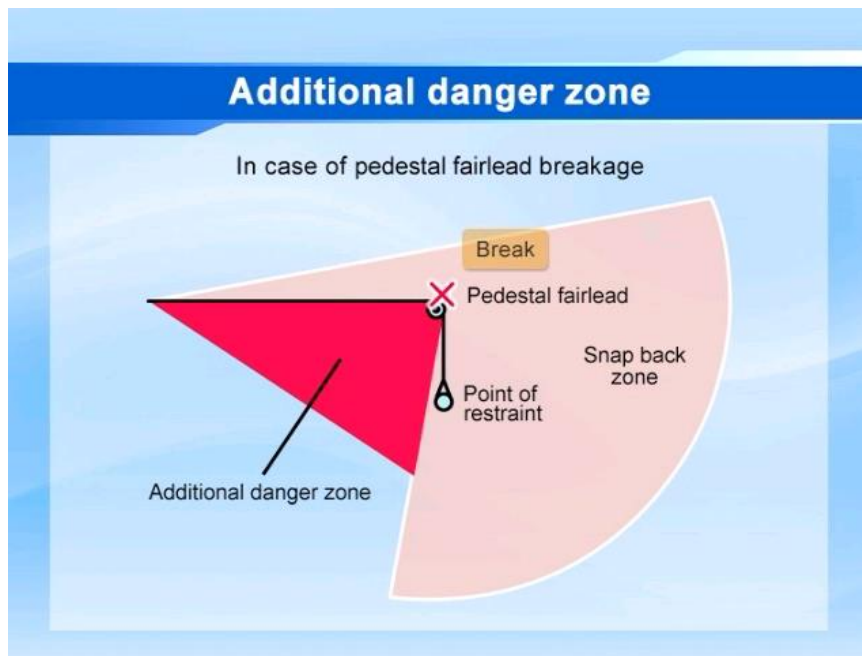


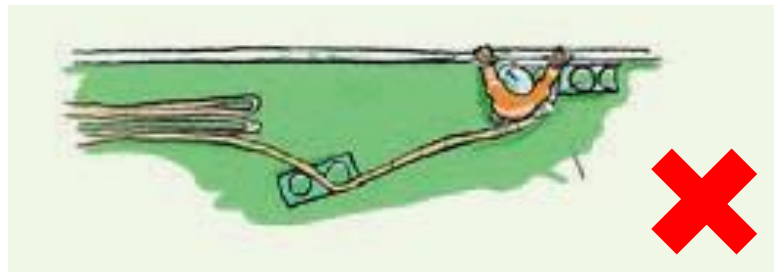
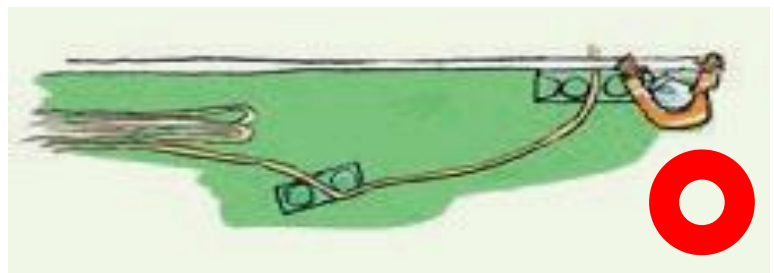
**Figure 2 – A Complex Mooring System Illustrating the Potential “Snap-Back” Zone**



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#### (4) Additional Danger Zone

Anyone working on deck should always keep in mind the mooring equipment could break anytime. Additional danger zone should be consider in case of pedestal fairlead breakage.



	<p>The working place to stand is inside the mooring line.</p>
	<p>The right place to stand is outside the mooring line.</p>

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## 1.4 Safety Precautions

### (1) Communication

Communication between the mooring team is key part of mooring procedures. VHF, walkie-talkie, hand signal, whistle and verbal communication are normally used. Be aware of any language barriers which can lead to miscommunication and an unintended action that may result in an accident. Always ensure that emergency signals and procedures are understood and well-practiced.

Importance of communication is "Answer Back" the message and not only acknowledged (not only by "Roger") for avoid misunderstanding.

### (2) Personal Protective Equipment

The mooring team should always be wearing the proper personal protective equipment (PPE). This should be verified by the team leader/person in charge. If the incorrect PPE is worn then person should not be allowed to take part in the mooring operation until correctly attired. Following PPE must wear at all times.

- Work Cloth (Not allow the baggy cloth)
- Helmet
- Eye Protector (Glass Type)
- Safety Shoes (Anti Static Type – Tanker/Gas)
- Leather Glove

The responsible officer of mooring operations shall wear following safety gear so that he can easily be distinguished from the other crew members during the mooring operation:



- Helmet (Red) and / or High Visibility Safety Vest , and
- Whistle

### (3) Minimum Manning

For safety of operations, following minimum personnel shall man each mooring stations:

- a) Mooring / Unmooring at berth, Pier, Buoy, STS, SBM: 3 crew and Deck Officer
- b) Making fast and letting go of Tug: 3 Crew and Deck Officer
- c) Anchoring and heaving up anchor: 2 Crew and Deck Officer
- d) Laying up and storing of ropes/wires on deck: 3 Crew





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## 1.5 Unsafe Act

Personnel involved in mooring operations should never:









- Stand in the bight or eye of a mooring line at any time.
- Walk over a slack mooring line between a bollard and a ship.
- Stand astride, stand on or walk over taut mooring lines.
- Wear rings hand jewelry.
- Sit on the bollard which was secured line.
- Stand behind a bollard when the ship is heaving alongside.
- Stand in a "DANGER ZONE", i.e. in the area into which a line under tension could recoil.
- Step the line which is likely to run.



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## 2. Basic Knowledge

### 2.1 Ship's Structure (Anchor, Mooring gear)

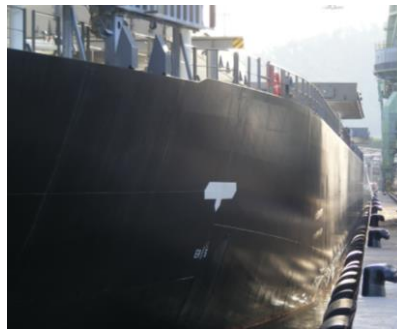
#### (1) Overview of Anchor and Mooring Gear

		
<b>Fairleader</b>	<b>Warping End</b>	<b>Universal Fairleader</b>
		
<b>Chain Stopper</b>	<b>Clutch</b>	<b>Double Bollard</b>
		
<b>Gypsy wheel</b>	<b>Closed (PAMANA) Chock</b>	<b>Bow Chain Stopper</b>
		
<b>Bitt</b>	<b>Pedestal Roller</b>	<b>MANDAL Shackle</b>

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**Cross Bitt**





**Tug Push Mark**

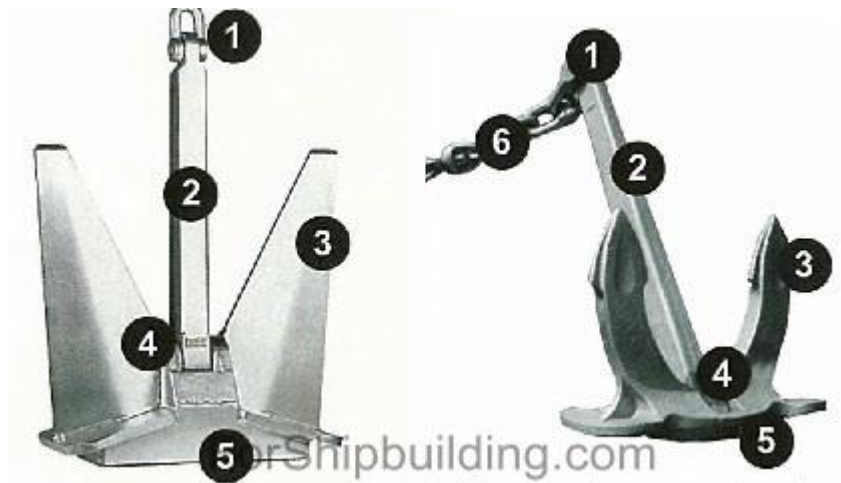


**Bitter End (BSN Store)**

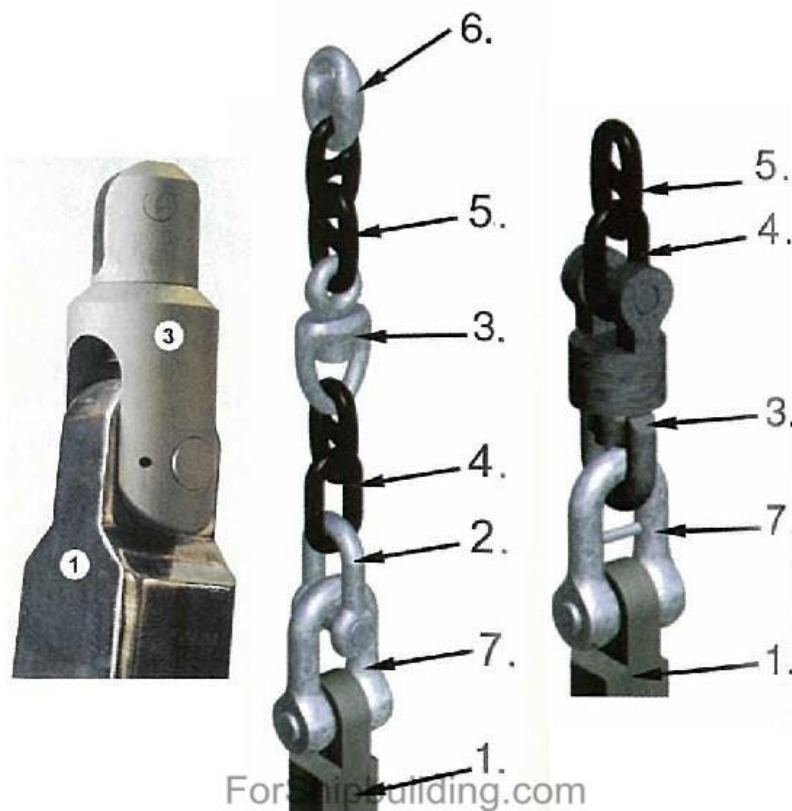


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## (2) Anchor Equipment





1. crown/ shackle
2. shank
3. flukes
4. crown pin
5. crown plate
6. anchor chain with swivel

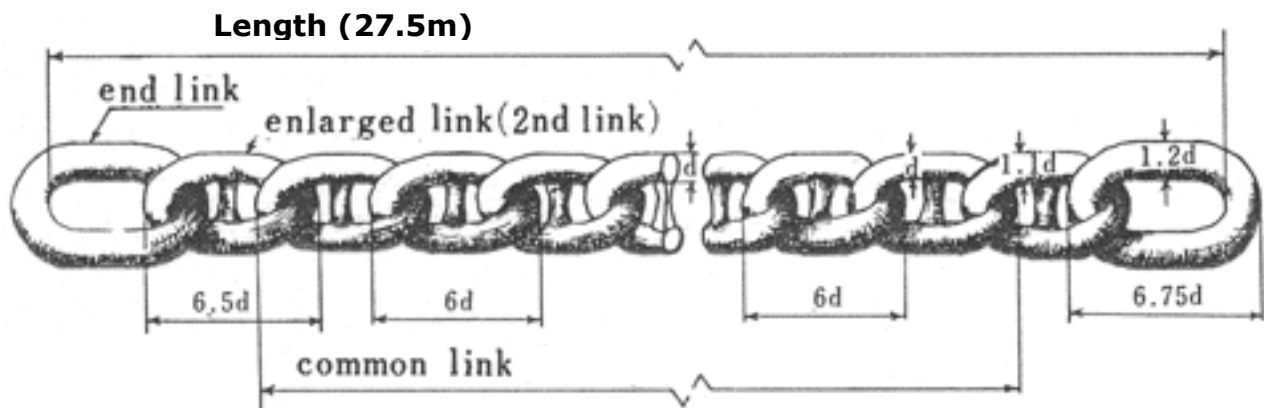


1. Anchor shank
2. Anchor/ link
3. Swivel
4. Open link
5. Enlarged link
6. Kenter shackle
7. Crown shackle

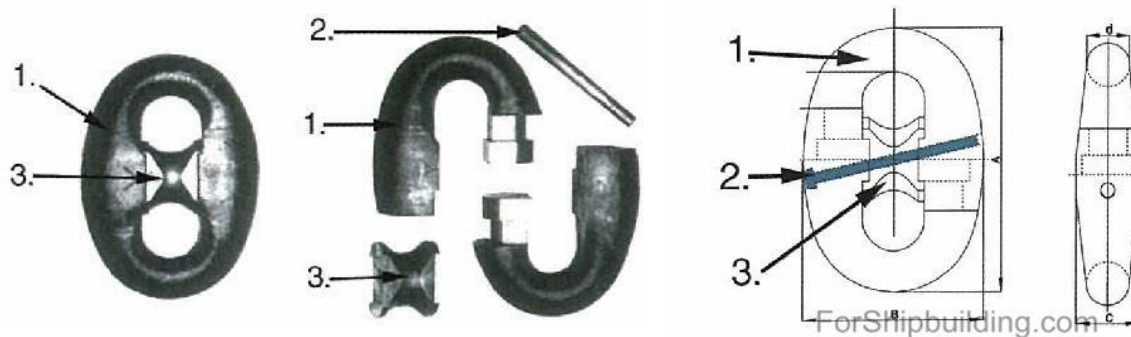


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### (3) Anchor Chain

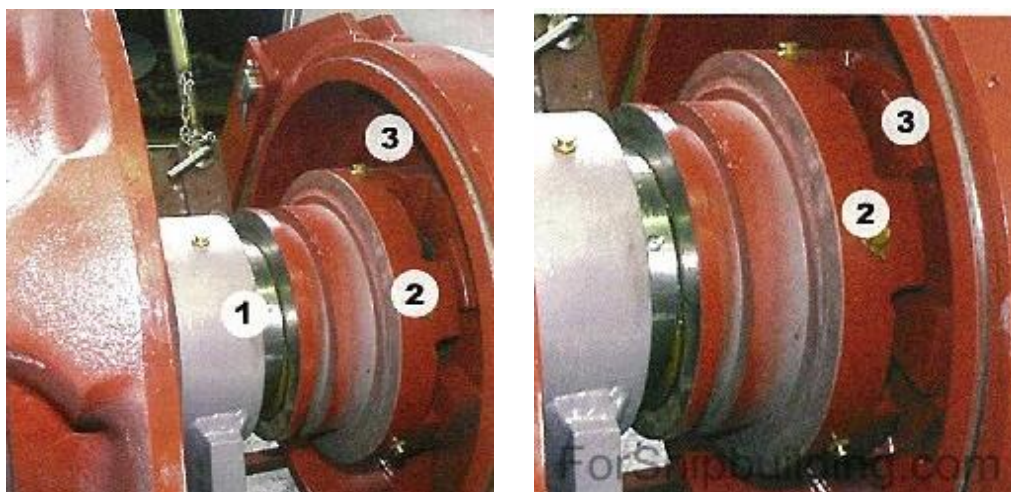


### (4) Kenter shackle





1. Half link    2. Locking pin    3. Stud

### (5) Claw clutch out and in

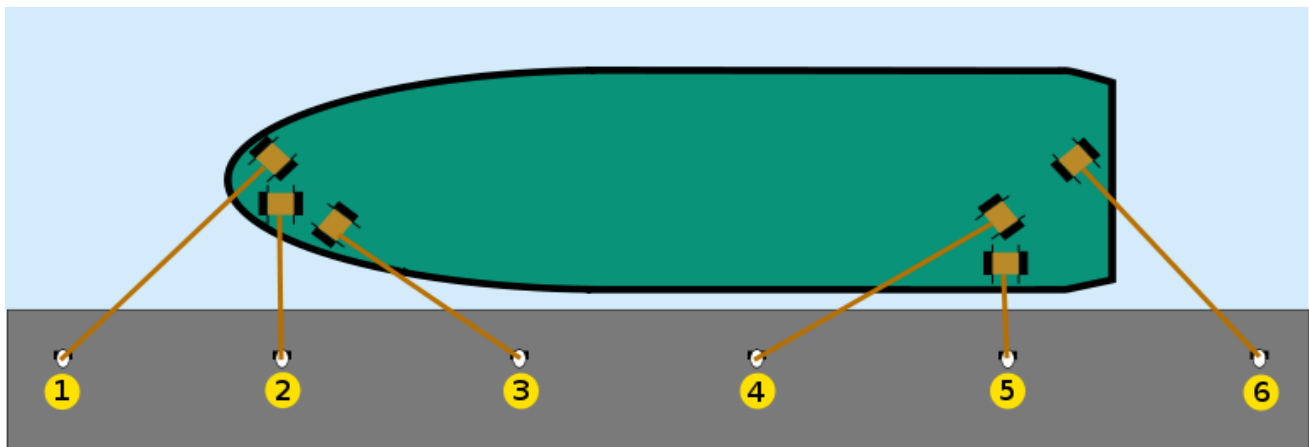


1. Bearing    2. Sliding claw    3. Fixed claw

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## 2.2 Mooring Arrangement



In order to understand the concept of mooring systems, each seafarer should first be familiar with the mooring lay-out and plans on board own ship. Each line on board has a corresponding term, function and effect on mooring. On the picture shown each mooring line from ship to shore is specifically labeled. Each line serves a specific purpose in keeping the ship alongside its berth, jetty, quay, etc.

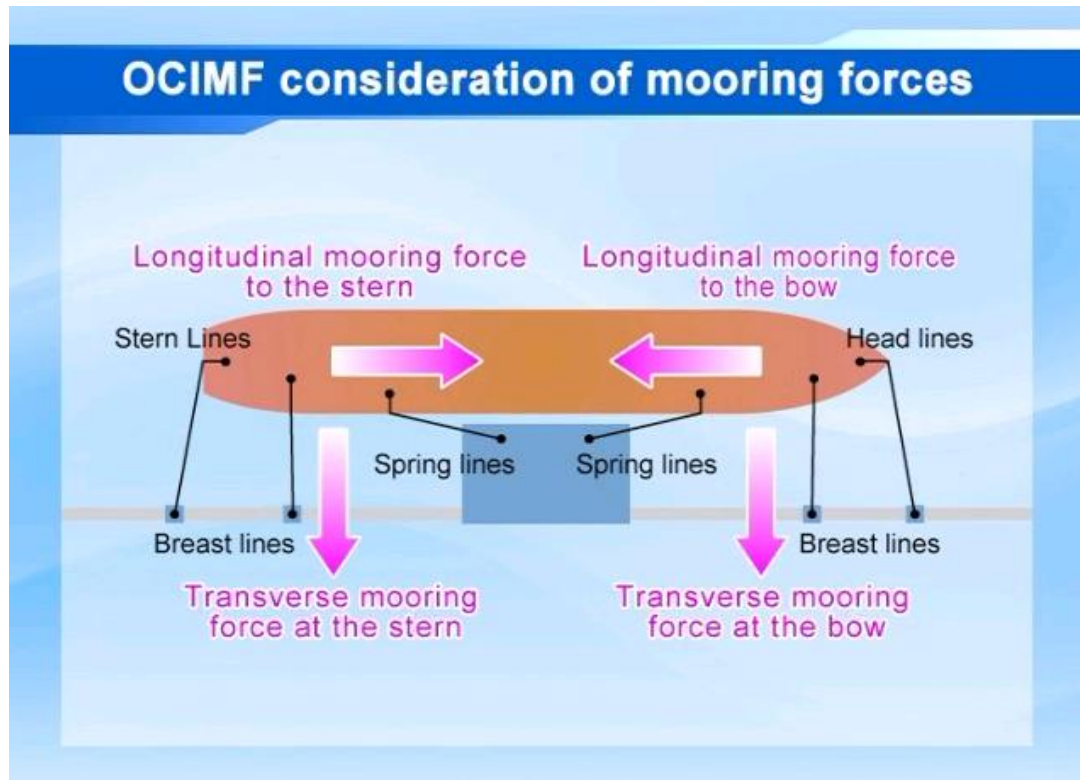


- ① Head line : Control the ship from moving astern and bow moving away from berth including any yawing.
- ② FWD Breast line : Keeps the ship's bow from moving away from berth.
- ③ FWD Spring line : Control the ship from moving ahead and bow moving away from berth.
- ④ AFT Spring line : Control the ship from moving astern and stern moving away from berth.
- ⑤ AFT Breast line : Keeps the ship's stern from moving away from berth.
- ⑥ Stern line : Control the ship from moving ahead and stern moving away from berth including any yawing.



For general applications, the mooring pattern must be able to cope with environmental forces from any direction.

This is done by splitting these forces into transversal and longitudinal components, and then calculating how to most effectively resist them.

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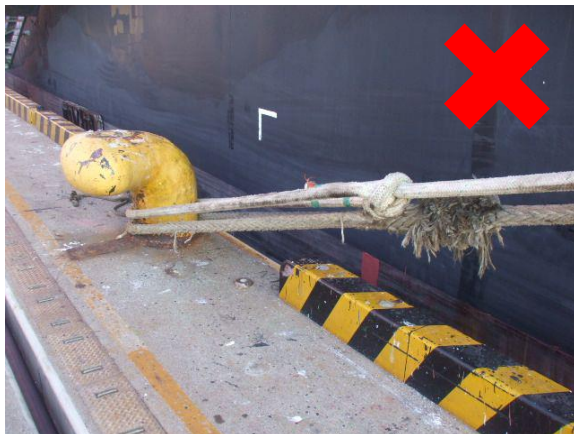
Some mooring patterns incorporate head and stern lines which are oriented between a longitudinal and transverse direction. The longitudinal component of such a line acts like a spring line and the transverse component like a breast line.

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## 2.3 Mooring Line

### (1) General Instructions



- All Mooring lines should be the same material, diameter and construction.
- The Hawser shall not be wound on the drum in a random manner.
- Synthetic lines are not very resistant to cuts and abrasion, and should not be exposed to conditions which might damage them. If they are used in fairleads previously used with wires, make certain the fairleads have not become grooved or roughened by the wires.
- Ensure that fairleads and warping drums are in good condition and free from excessive wear/abrasion and corrosion. Roller heads should be lubricated and freely moving to avoid friction damage to rope.
- When using winch stored ropes, do not run them through leads which are not on direct line from the drum, as they are liable to chafe on the edge of the spool.



### (2) Type of Ropes / Wires used in Mooring Operation

Synthetic fiber ropes are made of various materials, such as nylon, polyester and polypropylene. Compound fiber ropes are now mainly used for mooring. Each characteristic are follows.



**Nylon** Is a great fiber for applications which require stretch and energy absorption and easy to handle due to flexible and soft. Nylon ropes will lose between 10% to 15% of there strength when wet. Nylon handles the elements well and has good abrasion resistance. Nylon have High strength, stretch and stability in the synthetic fibers, and it Absorb high shock load and excellent for high energy absorption applications.

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- Polypropylene** Is an economical fiber that absorbs no water, floats and does not lose strength when wet. This fiber is susceptible to the elements, it has a low abrasion resistance due to its low melting point.
- Polyester** Is relatively strong rope which retains its strength whether wet or dry, and has almost same strength as Nylon but low stretch and heavy properties. Polyester ropes are easy to handle, they have good abrasion resistance and handle most weather conditions.
- Manila** Manila fiber ropes are economical and have a natural resistance to most weather elements. These fibers are subject to mildew and chemicals.
- Compound** This rope is composed of Polypropylene and polyester. It is superlative abrasion resistance. It is superior fatigue resistance and high strength with low stretch and low rebound. The breaking load does not decline in the wet condition. It is floats and soft, easy to handle.
- Aramid** Can include Spectra, Technora, and Kevlar. Aramid fiber ropes are extremely strong and have very little stretch. Aramid fiber ropes are highest abrasion resistant in the synthetic fibers.

Fiber Type	Strength (ratio)		Weight (ratio)	Elongation at Break	Specific Gravity	Melt Point	Float
	Dry	Wet/Dry					
Nylon	1.0	85%	1.00	30~35%	1.14	235°C	No
Polypropylene	0.55	100%	0.80	18~22%	0.91	165°C	Yes
Polyester	0.9~1.1	100%	1.20	15~20%	1.38	250°C	No
Manilla	0.3	104%	1.10	13~15%	1.45	135°C	No
Compound	0.95	100%	0.95	18~20%	1.02	200°C	Yes
Aramid	2.7	100%	1.26	4%	1.44	427°C	No





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### (3) Requirement of Mooring Lines









Following characteristic are required for mooring lines. 70% of NYK Fleet vessels which are using synthetic fibers are using compound (polypropylene and polyester) rope.



- High strength
- Low stretch at break
- High abrasion resistance
- High weather resistance
- High flexibility and low weight for handling

Material	Model & Size	% of use in NYK Fleet	Ship Type	Price (US\$)
Nylon	Double Braided, 56~80mm	25%	Bulk	3,300~6,000
Polypropylene	8 Strand, 65~75mm	5%	Bulk	1,900~2,500
	Double Braided, 65~75mm		Bulk	4,400~4,600
CE Compound	8 Strand, 65~75mm	70%	Bulk, CNTR CEN CARGO	2,300~3,000
	12 Strand, 65~75mm		CNTR	2,500~3,400
	Double Braided, 65~70mm		PCC	4,000~4,800

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#### (4) Types and Characteristics of Rope Structures

	Three-stranded	Eight-stranded (cross)	12-stranded	Double-braided (doubler)
Cross section				
Profile				
Structure	Rope of three strands twisted together	Rope combining a total of eight strands, comprising four parallel strands each twisted clockwise or counter-clockwise.	Rope combining a total of 12 strands, comprising six parallel paired strands each twisted clockwise or counter-clockwise.	Rope formed by making an inner layer core rope combining loosely twisted strands and further combining many outer layer strands.
Strength	○	○	⊙	⊙
Extensibility	High	High	Medium	Low
Wear resistance	○	○	⊙	⊙
Flexibility	△	○	⊙	⊙
Coiling	⊙	○	○	○
Kink	△	⊙	⊙	⊙
Weatherability	○	○	○	○
Workability	⊙	○	○	△
Mass	Small	Small	Medium	Large

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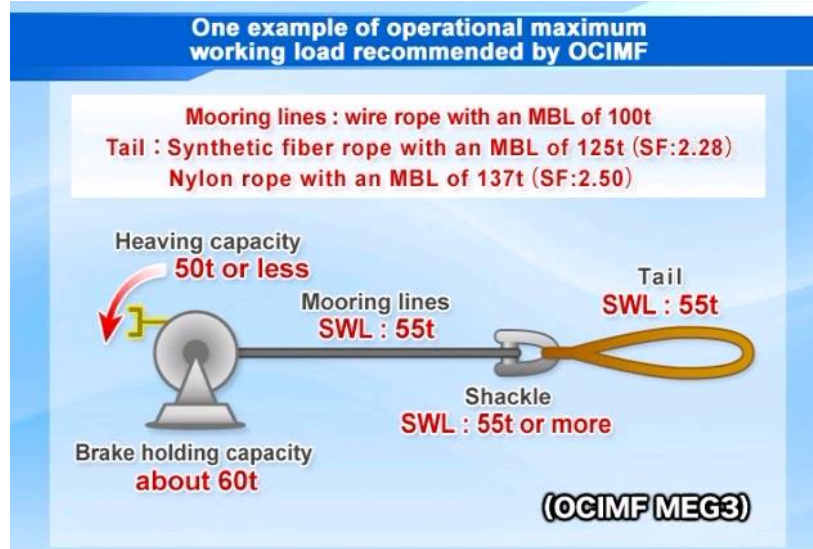
## 2.4 Design Load, Safety Factor and Strength

In order to define the strength of a fitting or piece of equipment, the following factors must be known or assumed:



- MBL : Minimum Breaking Load
- SWL : Safety Working Load. The SWL is the maximum load that should normally be applied in service conditions.
- SF : Safety Factor. the safety factor may be defined as the ratio of breaking load to SWL.
- Tail Rope MBL  $\geq$  Mooring Line MBL x 1.25
- Nylon Tail MBL  $\geq$  Mooring Line MBL x 1.37
- Brake Holding Power  $\div$  Mooring Line MBL x 60%
- Length of Tail Rope = 11m
- MBL of Tail Rope  $>$  MBL of Mooring Wire x 125%

Safety factors of mooring lines		
Calculating formula of safety factor : $SF = MBL / SWL$		
( SF:Safety Factor MBL:Minimum Breaking Load SWL:Safe Working Load )		
	Material	Safety factor (SF)
Mooring lines	Steel	1.82
	Polyamid	2.22
	Other synthetic materials	2.00

(OCIMF MEG3)



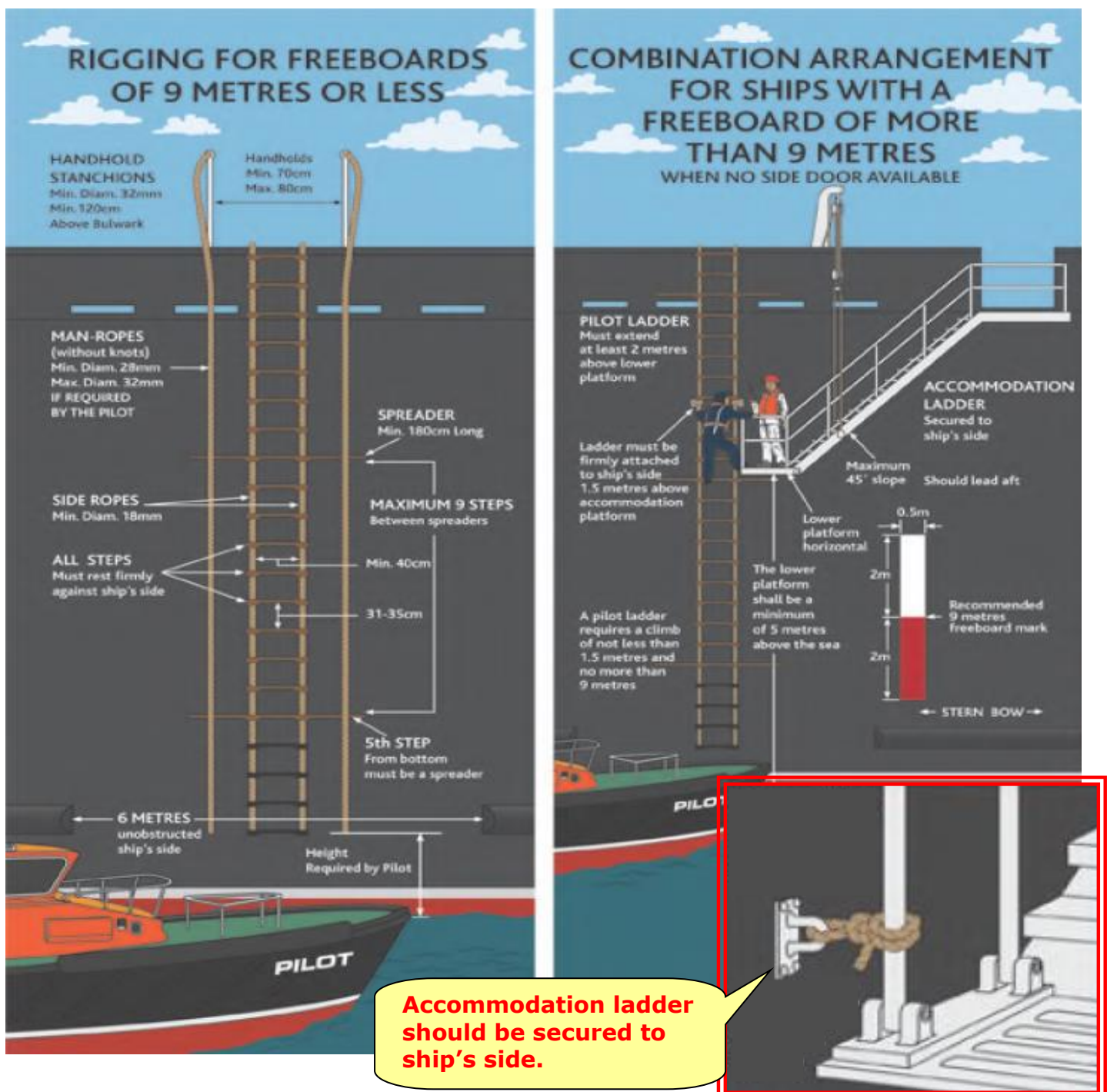




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## 2.5 Pilot Ladder

### (1) Incident during Pilot Transfer

While the pilot was a few steps down on the gangway which was being used in combination with the pilot ladder, the officer in attendance started lowering the gangway abruptly. He probably did not understand the method of rigging of the combination ladder and tried to lower the gangway to the water level. Consequently, the gangway tilted to the outboard side because the bottom end was secured to the pilot ladder and the pilot almost lost his balance and could have fallen into the water.



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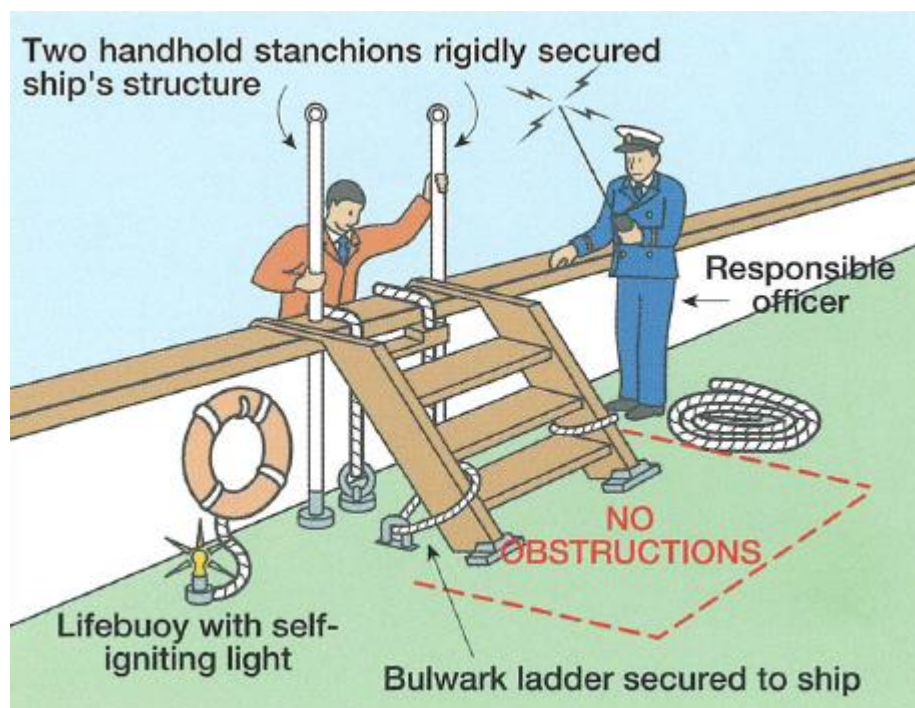
## (2) Rigging of Pilot Ladder



The preparation of the pilot ladder shall always be carried out by at least two workers.

A pilot ladder combined with accommodation ladder is usually the safer method of embarking or disembarking a pilot on ships with a freeboard of more than 9 meters.

The Officer ordered by the Master shall inspect the following and check that the pilot ladder has been suitably rigged.

- The height of the pilot ladder from the surface of the water (the height specified by the pilot if requested);
- At night, the lighting of the pilot ladder and the vicinity of the boarding entrance;
- Checking of lifebuoy and self-igniting light in vicinity of boarding place;
- Pilot ladder is secured to ship's side;
- Stanchions at boarding entrance are fitted;
- Bulwark ladder is secured to ship;
- Accommodation ladder is rigged (state of stanchions, safety ropes and hoisting wire);
- Readying of heaving line;
- Safety of passageway for pilot (clean up slippery water and oil stains);



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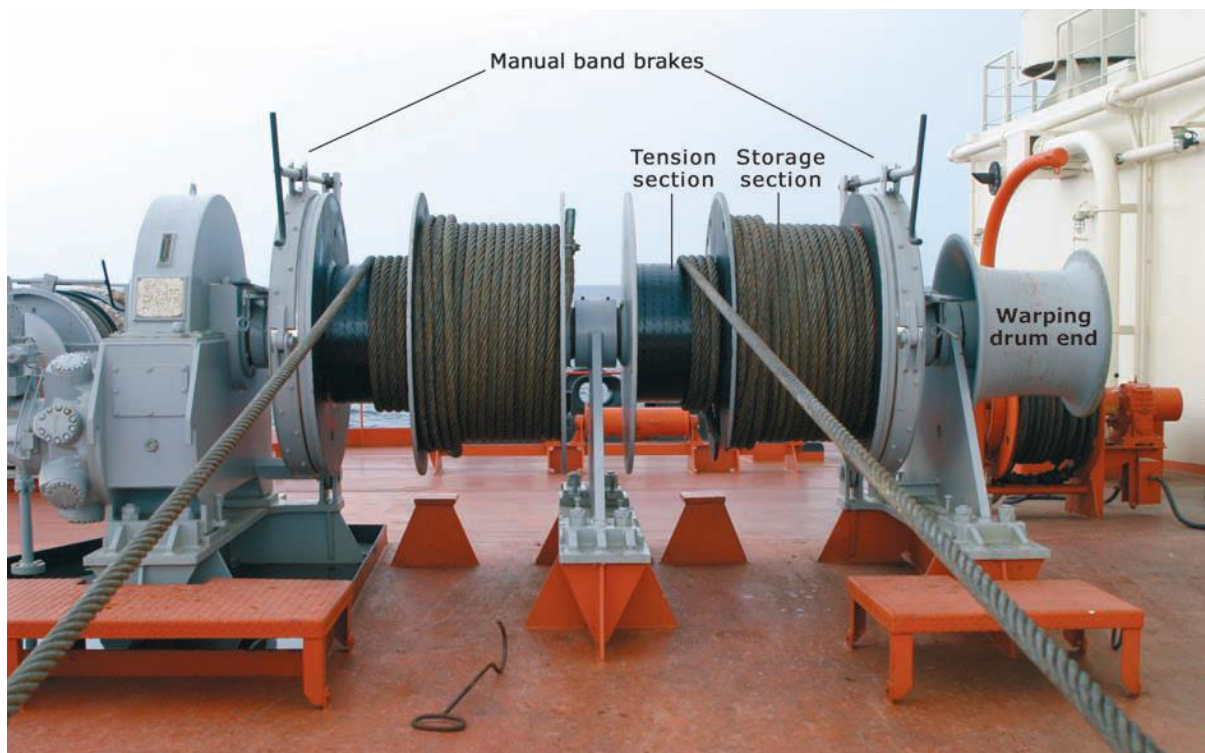
## 2.6 Split Drum

There are two main types of winch drum, Undivided Drum and Split Drum.

Although there are advantages and disadvantages in both systems, the split drum has one main **advantage**: when properly deployed, the mooring line is always run off the first layer of the tension drum, thereby maintaining a constant and effective brake holding capacity and heaving force.

The drum consists of a tension section and a separate storage section divided by a notched flange. Properly deployed, the winch operates with one layer of line only on the tension section maintaining a constant and effective holding power.



The main **disadvantage** of split drums is the increased operational difficulty when making a line fast. Care must be taken when transferring the line from storage to tension section.



Operation of a split drum with more than one layer will decrease the brake holding capacity and thereby the effectiveness of the mooring system.

The condition of wire lines deteriorates when they are squashed by overlying tight turns. A 'split drum' winch avoids such damage by separating the tension section of the barrel, which should only have a single layer of turns on it, from the storage section that holds the rest of the line in several layers.



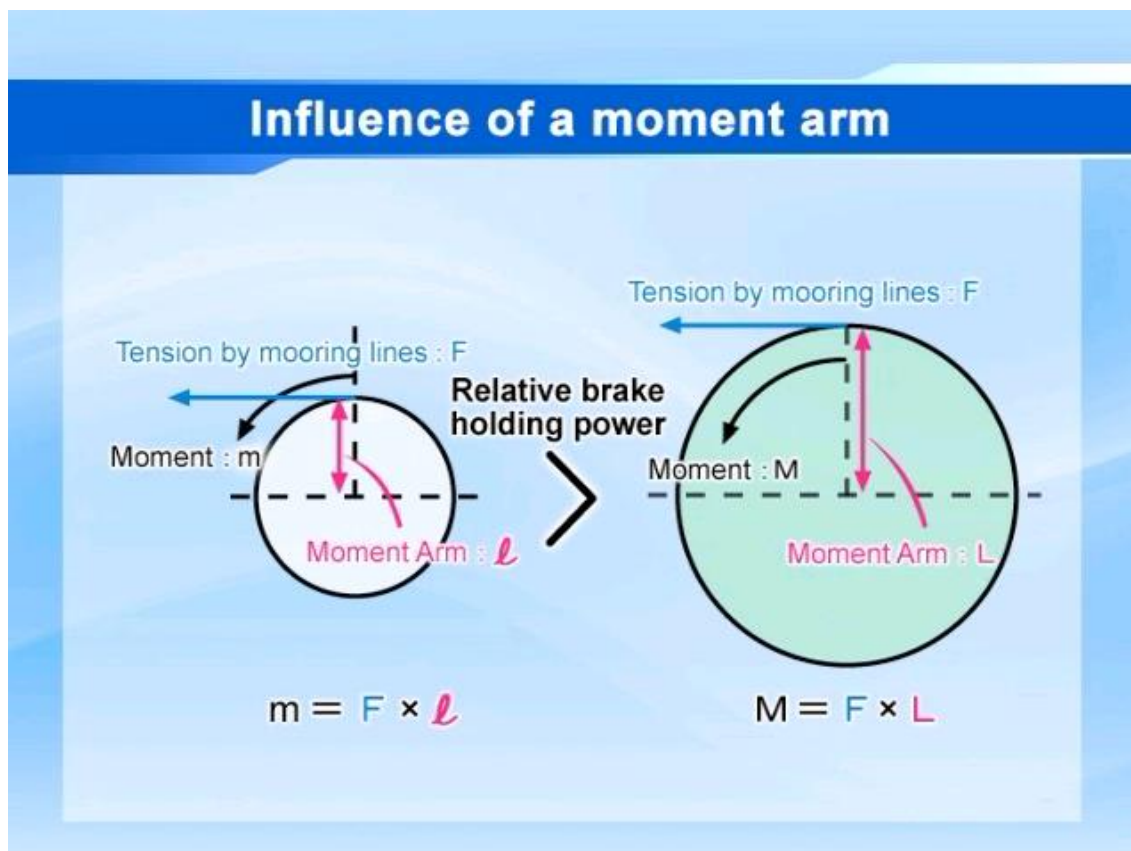
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## 2.7 Brake Holding Capacity

The rated brake holding capacity for these winches is always be quoted for only a single layer on the tension drum. Operation with additional layers on the drum would decrease the brake holding capacity.

Theoretical reduction in holding capacity for more than one layer assuming a rated holding capacity of 55 tons.

No. of Layer	Theoretical holding capacity % Rated Holding Capacity	
1st Layer	55 tones	100%
2nd Layer	48 tones	89%
3rd Layer	44 tones	82%
4th Layer	40 tones	75%
5th Layer	37 tones	69%



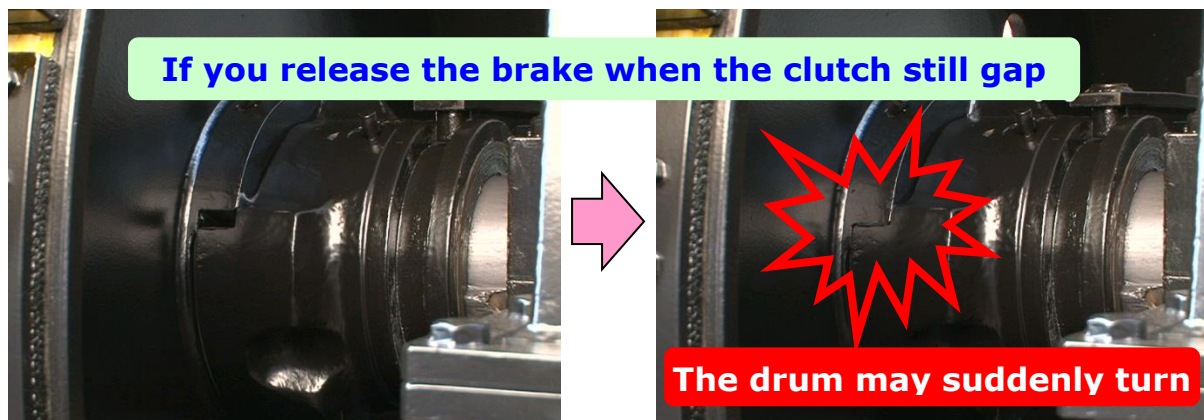
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### 3. Basic Practical Exercise of Mooring Operation

Before carrying out any practical exercise, make sure that all personnel involved have been properly briefed and have the appropriate Personal Protective Equipment (PPE).

#### 3.1 Mooring Winch Operation

During operation of mooring winch under tension, Incorrect operation will cause the damage of claw of gear clutch due to some clearance between claw of the mooring rope drum and claw of the clutch cylinder, the tensile tension of the mooring rope caused the claw on the mooring drum to move and impact the claw of the clutch cylinder. This impact resulted in material failure and breaking of the claw.





Following procedure should be done for prevent damage.

- ① After engaging the clutch with stopper pin, the hydraulic motor is operated with heave so as the mating face of the clutch makes smooth contact with the mating face of the pinion.
- ② Loosening of the mooring winch brake is to be done slowly to avoid jerks and thus minimize the impact.
- ③ Check the condition of the claws on the winches for any worn out edges and abnormal clearance, for possible repairs.
- ④ The mooring lines shall be kept on brake and the clutch disengaged after use. Do not forget put back stopper pin.

In addition, during moored the berth, the mooring lines to be tended regularly and maintained at near equal tension to prevent the build up of excessive load on any particular line.

This leads to minimum shock tensional load when the brake is released.

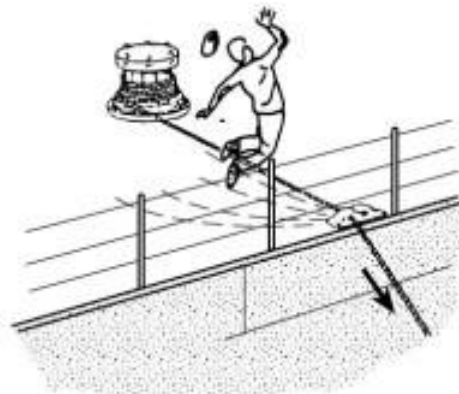
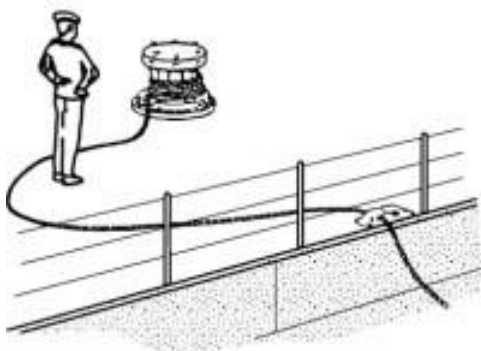
After made fast, mooring drums should always be left disconnected from the winch drive whenever the mooring line is tensioned and the band brake is fully applied.



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### 3.2 Handling of Mooring Rope

Mooring/Unmooring work is one of most dangerous jobs and sometimes fatal accidents happen to a seaman and/or a ship during work. We should keep it in mind that:



- Do not stand or stay where a rope might bound back or rebound in case of a rope whipping or breaking off suddenly.
- At least 2 men are to be assigned to work together when using mooring winch and a rope.
- Signaling between a person in charge and workers is most important when preparing mooring ropes before entering or leaving a port.
- When slackening a mooring rope walk it back on a winch rather than releasing manually.
- Maintain a proper distance from the warping end of mooring winch to avoid loose clothing being caught.
- When preparing hawsers on deck beware that if too much is laid out, it can snake away and becomes uncontrollable due to its weight.
- When securing a mooring rope on a winch drum, it shall be wound politely from one side toward the other side, not being jammed each other.
- A synthetic fiber hawser elongates and reduces in diameter under load. It is most dangerous when stranding and recoiling. You should be aware and stand well clear.
- Any protrusions or flaws on the fairleader or panama chock may damage synthetic fibers. Rust should be removed, also grooving from wire ropes are also damaged.
- Chemical agents paints and thinners will cause damage to Synthetic fiber hawsers. They should be stowed well clear of these substances.



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### 3.3 Handling of Mooring Wire

- Steel wires should be stopped with chain stoppers, which should run in the direction opposite to that of the steel wire in question.  
Do not use rope stopper for mooring wire due to not enough SWL and slip by grease of mooring surface.
- Make sure the steel wire is stored/heaved in/run out properly, without any kinks.
- Kinked steel wires should be inspected prior to use. If their strength has been affected, they should not be used in the operation and should be condemned.
- Steel cables must never be belayed on top of ropes.
- Only special shackles (e.g., MANDAL SHACKLE) should be used to connect steel wires to ropes.
- Beware of burrs, and use leather gloves when handling steel wires.

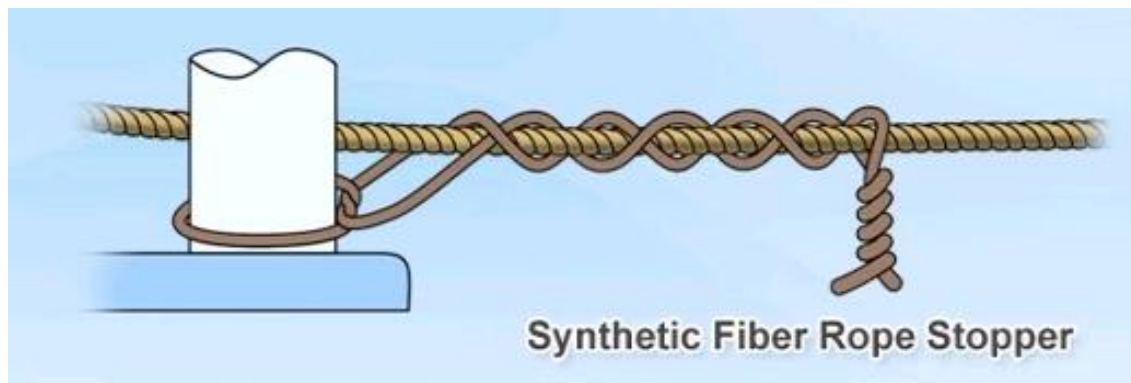
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### 3.4 How to use Rope/Chain Stopper

#### (1) Rope Stopper

Do not use rope stopper for mooring wire due to not enough SWL and slip by grease of mooring surface.



The stopper is formed of two tails of equal length secured to the base of the bitts. The tails should be half hitched under the mooring rope to be stoppered off and then crisscross on the opposite sides of the mooring rope. It is important to note that in the first cross of the stopper the tail nearest the rope is with the lay. When the second cross is put in the reverse side of the mooring rope, is not the tail of the rope. The crisscrossing of tails is continued about 5 times, then the tails are twisted together to tension up the stopper about the mooring line.



In case of single tail, the double half hitch as in the photo instead of the single hitch can be used. The tail of the stopper is then turned up in the lay of the rope, and held while the weight is transferred.





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## (2) Chain Stopper



Using chain stopper for fiber rope might cause crushing and pinching damage to yarns and strands when tension comes on the chain stopper. A Chain Stopper shall never be used on a hawser rope.

Chain stoppers come in different sizes and grades; all chain stoppers should be supplied with certification detailing construction and SWL (Safe Working Load).

Apply double lower winding to inside then wind the chain to outside with against lay of wire.

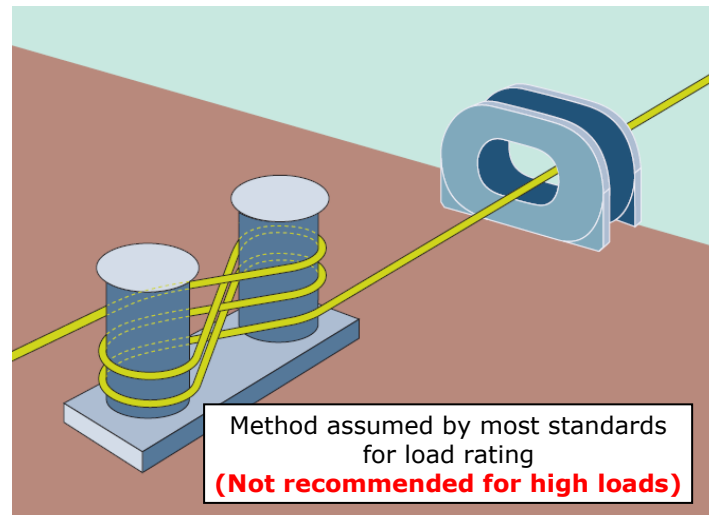
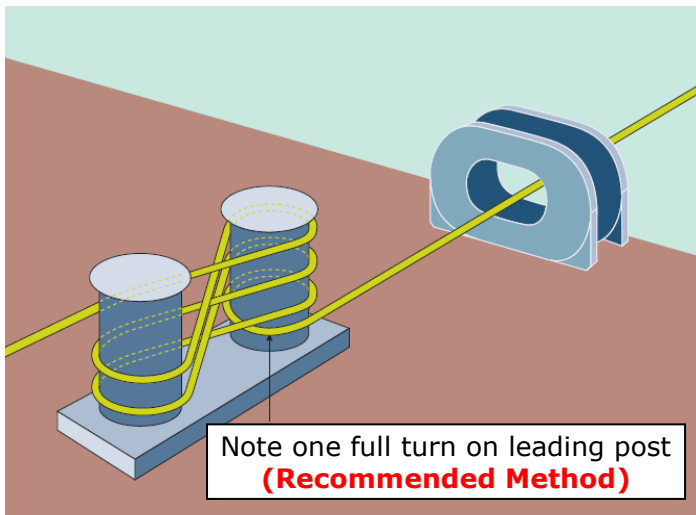
It is most dangerous when tension of the mooring rope and wire is transferred to the stopper. Walk back slowly and carefully until the stopper holds the tension firmly. Signaling is most impotent.



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### 3.5 Holding of Mooring Line



When securing a synthetic fiber hawser to a bollard, initial turn should be around the fore piece of the bollards and then belay in the shape of figure 8 with at least 6 turns. This method allow for easy adjustment to hawser length and prevents slipping under sudden weight.



Methods of Belaying a Rope on Bollard



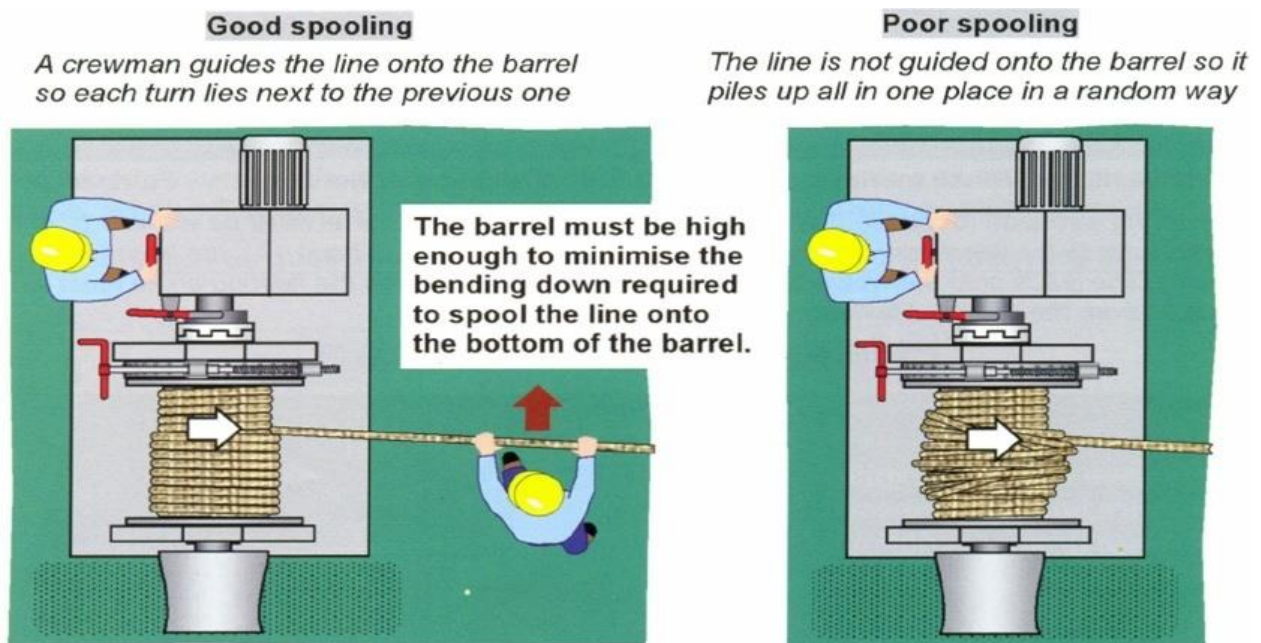
Mooring lines should never be secured to the warping ends, as are not designed for holding the load of the mooring ropes.

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### 3.6 Spooling of rope on winch

Poor spooling may lead to the following problems:

- Rope may not all fit onto the barrel and the pile up of turns can collapse.
- Rope can slip down between the gaps between underlying previously poorly spooled turns and become trapped.





The photo on the left of bellow shows part of a hawser that has been wound irregularly around a reel and biting into another part underneath when the ship is moored.

If a part of a hawser bites into another part when the ship is moored, the surface of the hawser will be damaged by friction. In winding a hawser round a reel, the following precautions should be taken.

- Wind the hawser in an orderly way under appropriate tension.
- Wind the hawser round the reel in a twist-free state.
- As the fiber of the hawser is not resistant to friction from outside, do not drag it on the deck.

The photo on the right of bellow shows a case in which hawser biting is prevented in a port where the hull oscillates greatly. If a moored hull oscillates a lot, especially longitudinally, even if the hawser is wound neatly around the reel, the tension to restrain the hull will become strong enough to let a part of the hawser bite into another part underneath.



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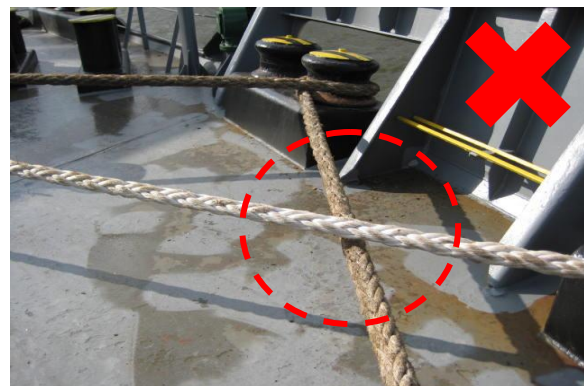
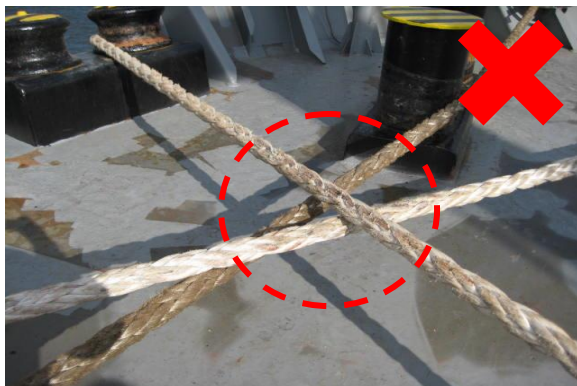
In such a case, one measure to prevent biting is to place a used hawser as shown in the photo on the left.





### 3.7 Rope Protection

Synthetic fiber ropes should avoid from abrasion resistance as match as possible. Applying Chafe gear is recommended for abrasion resistance.

- Once it has been determined that chafe gear will be used then it must be stressed that it be positioned **at each mooring.**
- Chafe gear that is badly worn or shredded should be replaced immediately as it is the only defense the line has from damage in the chocks.
- Any damage incurred in the chocks should be repaired immediately.





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### 3.8 Unmooring

- Unmooring should not commence until the ship or shore gangway has been properly secured, or brow landed.
- No mooring line should be slackened or released except on the specific instruction of the Master or Pilot. Likewise, slackened lines should not be released until advised by the Master/Pilot as such lines may still be required for warping purposes.
- A mooring line should never be let go under tension. Once a line has been released from a bollard or hook, it should be walked clear of any obstruction, unless it has been released using a triggered slip hook. All personnel in the vicinity should stand well clear.
- When releasing a mooring line, care should be taken to hold it by the side of the eye, and to avoid hands getting between the line and the hook or bollard.
- When releasing a dipped rope, sufficient slack should be pulled through the eye of any other ropes, so that the eye of the line to be released may be pulled over the top of the hook or bollard. This will facilitate clearing any subsequent jam as and when the line is put under tension.
- Where a mooring is badly jammed, it may be necessary to slacken briefly other lines on the same bollard, whilst taking care not to release them.
- When releasing mooring lines at the stern, including after breast lines and back-springs, they should be controlled and if possible kept clear of the water to reduce the risk of fouling propeller(s). Berths can sometimes provide messenger lines to assist the process.



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## 4. Communication and Signals



### 4.1 Definitions of Order

<u>Let Go</u>	At this order <u>remove the turns and slack down the hawser. When the eye of the hawser is removed from the shore bollard, heave it in, but if it is the last hawser to a buoy, do not remove the turns suddenly, as the hawser will have a lot of strain on it; slack away gradually at first until the hawser stops slackening itself.</u>
<u>Make Fast</u>	At this order, <u>make fast the hawser on the bitt. If the hawser is on the drum and it has to be transferred to the bitts, pass a stopper on the hawser and when ready, slack a little hawser from the drum or walk the winch back a little so as to shift the strain gently onto the stopper. When the stopper has taken the strain, quickly remove the hawser from the drum and make it fast on the bitt, taking in all the slack.</u>
<u>Single Up</u>	It means that <u>all lines should be cast off except those as advised by the master.</u> When the ship is to leave berth, stations are called and the crew take in all extra hawsers, so that when the order "let go" is given, there are only one or two ropes to contend with. generally this order is qualified by stating what lines are to be kept, e.g., "single up to a line and backspring, or single up to a slip wire".
<u>Slack</u>	<u>Pay out the hawser.</u>
<u>Take In Slack</u>	<u>Do not make tight, line should be kept moderate.</u>
<u>Hold On</u>	It means that the <u>hawser should not be slackened any more and should be stopped wherever it is.</u> Carry out this order by taking one more turn on the bitt or drum. Of course do not break the hawser and always avoid overload.

### 4.2 Standard Communication Phrases

Verbal communication must be precise, simple and unambiguous, to avoid confusion and error. Use standard terminology, clear, short and concise. Importance of communication is "Answer Back" the message and not only acknowledged (not only by "Roger") for avoid misunderstanding.

Radio communication should avoid un-necessary use and do not communicate by uncommon language or private matters in radio communication.



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## **(1) General**

- Is/are the propeller(s) clear?  
Yes, the propeller(s) is clear.  
No, the propeller(s) is not clear.
- Keep the propeller(s) clear.
- Are fenders on the berth?  
Yes, fenders are on the berth.  
No, fenders are not on the berth.
- Have fenders ready fore and aft.

## **(2) Berthing**



- We will berth port side / starboard side alongside.
- We will moor  
~ to buoy(s) (ahead and astern).  
~ alongside.  
~ to dolphins.
- Send out  
~ the head / stern / breast lines.  
~ the ... spring(s) forward / aft.
- Do you have tension winches?  
Yes, we have tension winches (forward and aft).  
No, we do not have tension winches.
- Have the heaving lines ready forward and aft.
- Send the heaving / head / stern / breast line(s) ashore.
- The linesmen will use shackles / lashings for securing the mooring.
- Use  
~ the centre lead / panama lead .  
~ the bow lead.  
~ the port quarter / starboard quarter lead.
- Heave on the ... line(s) / ... spring(s).
- Pick up the slack on the ... line(s) / ... spring(s).
- Heave away.

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- Stop heaving.
- Slack away / check the ... line(s) / ... spring(s).
- Hold on the ... line(s) / ... spring(s).
- Heave in easy.
- Heave alongside.
- Keep the ... line(s) / ... spring(s) tight.
- Report the forward / aft distance to ... .
- The forward / aft distance to ... .. is metres.
- We have to move ... metres ahead / astern.
- We are in position.
- Make fast fore and aft.
- Finished with manoeuvring stations.

### **(3) Unberthing**




- Stand by engine(s).
- Are you ready to get underway?  
Yes, we are ready (to get underway).  
No, we are not ready (yet) ( to get underway).
- We will be ready to get underway in ... minutes.
- Stand by for letting go.
- Single up the ... lines and ... springs fore and aft.
- Slack away / hold on / heave on the
  - ~ head / stern line.
  - ~ breast line.
  - ~ fore / aft spring.
- Let go
  - ~ the head / stern line.
  - ~ the breast line.
  - ~ the fore / aft spring
- Let go the towing line(s).
- Stand by bow anchor(s).
- Finished with manoeuvring stations.



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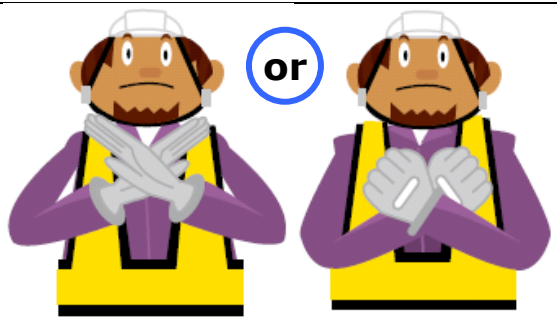
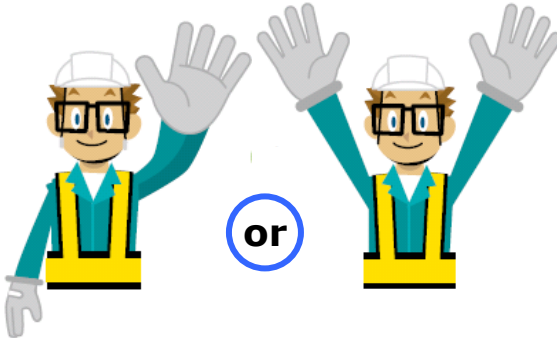
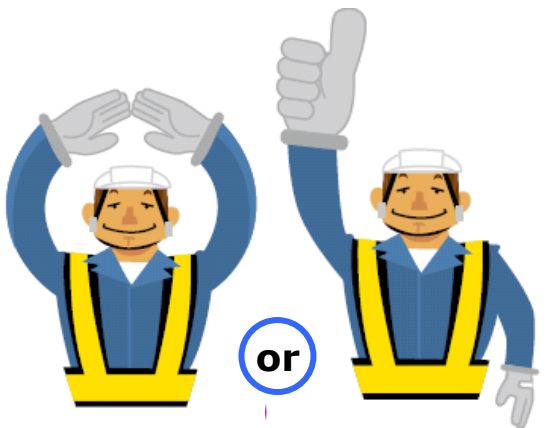

### 4.3 NYK Standard Hand & Whistle Signals (Mooring Operation)

Hand signals specified in this standard shall be used when engaged in mooring operation. Whistle signals are provided for guidance as use of whistle signals is recommendation only. If whistle signaling is in use on board, it shall be in accordance with this standard.



All persons involved in the operation should use the same signaling standards.

Meaning	NYK Standard	Remark
<b>Heave in Raise</b>  <b>Whistle:</b> ••(2 Short)		One arm points upward by index finger with the palm facing forward, and makes a circle.
<b>Slack</b>  <b>Whistle:</b> •••(3 Short)		One arm points downward with the open palm facing inward, and moves it up and down.
<b>Hold on Stop</b>  <b>Whistle:</b> —(1 Long)		One fist is raised with the palm facing inward or forward.

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<b>Make Fast Secure Stop</b> <b>Whistle:</b> — (1 Long)		Both arms are crossed closely to the chest with open palms. or Both arms are crossed closely to the chest with hands clenched.
<b>Attention Wait</b> <b>Whistle:</b> • (1 short)		One hand is raised and show the palm. or Both arms point upward with the palms facing forward.
<b>Okay I Agree</b>  No whistle signal		Both arms are raised over the head with the palms facing inward, and make a ring with both hands. or One hand is raised and show the thumbs up.
<b>Finished</b>  <b>Whistle:</b> . — . — .		Both arms are raised with the palms facing forward, and wave arms up and down on either side.
<b>Cancel Danger Emergency</b>	<b>Whistle only:</b> . . . . . (at least five short & rapid blasts)	



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## 5. Damage

Any defects or damage to a berth or its infrastructure found before or occurring during the berthing operation should be reported as soon as possible to the Master.

### 5.1 Watching Stationed Fore and Aft

Tugs are often used when vessel are moored. Ensure that good communication vessels is established and tested.



The person in charge of the mooring party shall ensure that the mooring crew is kept well clear of the tugs lines when under load. When the tug is made fast or let go the person in charge shall ensure that operation is carried out in a controlled manner keeping in close contact with the bridge and the tug.

In addition to an ordinary lookout, the Deck Officers stationed fore and aft shall pay attention to movements of tugboats and report to the Master immediately when he infers the ship is in dangerous condition.

Regrettably, accidents related to the hull damage have been reported on several occasions. Because the tugs push at improper position strongly due to lack of communication between Pilot, Master and duty officer on the station. Following shall be taken account to ensure safety.

- Supplementary tug marks are to be posted on upper deck; so that the Master can also monitor that the tugs are pushing the vessel at right positions.
- Master to advise pilot, soon after boarding, to inform the tugs to push the vessel at the dedicated tug position, marked on hull.
- Duty officers on fwd & aft station to confirm that tugs are pushing at the right places on her Hull and advice Master during stations.



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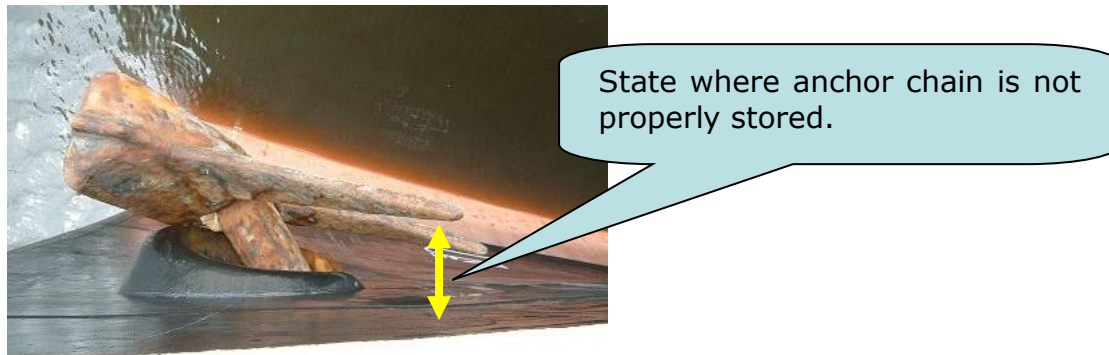
## 6. Anchoring Incidents in NYK Fleet

### (1) Lost Anchor and Chain due to Improper Securing

(Ref : Safety Bulletin GEN 2010 011)

#### Description of Incident :



While the ship was west of the Philippine island of Luzon en route to Korea to discharge cargo from Indonesia, the ship encountered rough seas that splashed on the bow. During the morning rounds, the bosun noticed an abnormal port anchor, and found that the bitter end had bent in the bosun's store. The captain stopped the ship's engine, and the crew tried to heave up the anchor using the windlass and mooring winches but could not heave up. The captain then received permission from the ship-management company to cut and cast off the anchor and chains.



#### [OBSERVATION]

The following causes were noted:



- The anchor and chain could not be stowed in a proper position because the anchor chain had been stretched. The chain was secured by lashing wire in a position that had slack about two-thirds the length of a chain link, and the chain stopper was set. The anchor was stowed correctly, however, so that it did not touch the hull.
- The above improper storing of the anchor had been observed from the previous dry dock, but nothing had been done.
- The chain stopper pin was not set at a proper position, so the stopper pin could not prevent the chain stopper from bouncing.
- Proper tension to the anchor lashing was not applied. The lashing wire had not secured the anchor tightly.
- The manual brake of the windlass was not applied tightly enough.
- There was a lack of awareness about the risks to a slack anchor chain during rough seas.

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## [COMMENT]

To prevent a similar accident, please ensure the following:

- Conduct proper maintenance of the brake lining of the windlass to maintain appropriate holding power.
- Periodically check the storing condition of the anchor and the chain stopper.
- While the ship is at dock, the setting position of the chain stopper and any gaps with the chain link should be checked and adjusted if necessary. The condition of the chain stopper itself should be checked, and if any dents, bends, or other damage are observed, these should be repaired.
- Apply the windlass brake and the anchor-lashing tightly.
- Confirm an appropriate setting of the chain stopper, the windlass brake, and the anchor lashing again when rough seas are expected.

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## (2) Lost Anchor and Chain during Anchoring

### Description of Incident :

While the vessel was anchoring with 9 S.S. in the water, it started to drag anchor and the master ordered to stand by engine and FWD station. The master ordered the C/O to veer out additional anchor chain. While veering out anchor chains, a strange noise was suddenly heard from the chain locker. The entire anchor chain then veered out and dropped into the sea, even with a tightened brake.



Damaged handrail





Damaged bitter end

### [COMMENT]

The accident occurred after the vessel delayed taking action in rough weather. Dragging anchor can cause a serious marine accident. Even if a vessel drags anchor, a serious accident can be avoided by taking appropriate action, such as heaving up the anchor and dropping it with engine assistance or drifting out to sea after heaving up the anchor.

To avoid dragging anchor and take appropriate action, you are requested to gather weather information and well understand each vessel's critical wind velocity for dragging anchor.

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## 7. Guideline for Safe Anchoring (Anchor Watch)

### 7.1 Anchor Watch

Maintain anchor watch as per company's procedures in SMS manual.

Master should instruct OOW criteria of anchoring condition and when to call Master, by written instructions.

Critical wind velocity for dragging anchor shall be calculated as per SMS ZZ-S-P-07.20.02 1.1.6 and result of the calculation shall be readily available on the bridge so that the OOW is able to refer to it at any time.

OOW shall keep a close watch for sudden changes in weather, signs of dragging anchor, signs of cable fouling and dangerous behavior of other ships in the vicinity. Master should immediately be informed when anything unusual is observed.

Type of ship		Critical wind velocity [m/sec]	Calculation conditions			
			Frontal area of windage [m²]	Anchor	Anchor chain	Others
				Type Weight	Dia. Weight	
Container (3800TEU)	Ballast	17	1108	AC-14	87mm	
	Full load	18	979	9.27 t	0.166 t/m	
Container (6300TEU)	Ballast	16	1620	AC-14	97mm	
	Full load	17	1490	12.08 t	0.206 t/m	
Bulk Carrier (200,000DWT)	Ballast	18	1207	AC-14	97mm	
	Full load	23	761	11.60 t	0.206 t/m	
PCC (6000RT)	Ballast	12	1060	AC-14	81mm	T=5×R
	Full load	13	980	8.43 t	0.144 t/m	
VLCC	Ballast	17	1875	AC-14	114mm	
	Full load	22	1125	16.13 t	0.285 t/m	
LNG Carrier (Moss type)	Ballast	15	1762	JIS	114mm	
	Full load	15	1684	21.50 t	0.285 t/m	



Fig. 1 : Critical wind velocity for dragging anchor for typical types of ships

In consideration of the above, if wind velocity is expected to reach the velocity shown in bellow table, the vessel should take action to avoid dragging, such as standing by its main engine and bow thruster, adjusting the ship's draft, enhancing the anchor watch, and escaping to a safe offing.

Vessel Type	Warning Wind Velocity Boding Dragging
PCC	Ave. 10 m/s
VLCC, Cape-size Bulker (Ballast)	Ave. 15 m/s
VLCC, Cape-size Bulker (Fully Loaded)	Ave. 20 m/s
Others	Ave. 15 m/s

(For reference only. Regardless of the above data, appropriate action should always be taken.)



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## 7.2 Detecting Dragging Anchor

Anchor dragging occurs in two stages. It is important to make full use of the GPS, ECDIS, and radar to detect dragging in the first stage, "swing dragging."

A dragging anchor could lead to drifting and result in a vessel colliding, capsizing, or grounding. It is therefore important to detect a dragging as early as possible to quickly regain control of the vessel.

Anchor dragging occurs in following two stages.

➤ 1st Stage: Swing Dragging

The swinging body of the vessel results in pressure on the vessel's lee side. This condition is indicated by the "B" section of Dia. 2. If the vessel can detect dragging at this stage, heaving up the anchor and regaining control of the vessel is relatively easy.

➤ 2nd Stage: Pressurized Dragging

The ship's body is pushed by the wind, resulting in constant pressure on the vessel's lee side. This condition is indicated by the "C" section of Dia. 2.



Time is needed to heave up the anchor chain if the vessel detects dragging at this stage. In addition, in most of cases, maneuvering is difficult until the anchor is heaved up.

It is therefore important to detect a dragging as early as possible — i.e., the first stage — to quickly regain control of the vessel.

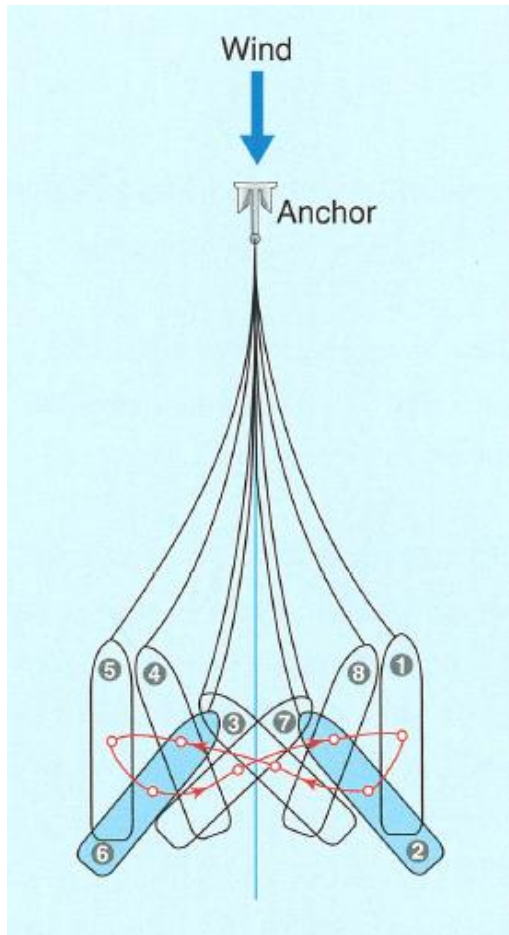
The common ways to detect a dragging anchor are as follows:

- The ship is not positioned where it should be inside the "Bridge Turning Circle". To check the speed OG by Doppler Log.
- The ship's heading is not directed windward. The anchor might be dragging when the Course Recorder stops drawing a steady sine curve.
- The ship is receiving wind from only the starboard side or the port side. The anchor might be dragging when the ship stops making steady swings and remains in one posture against the wind.
- Anchor cable remains tight even when the side of the ship receiving wind changes.
- Anchor cable has unusual vibration.

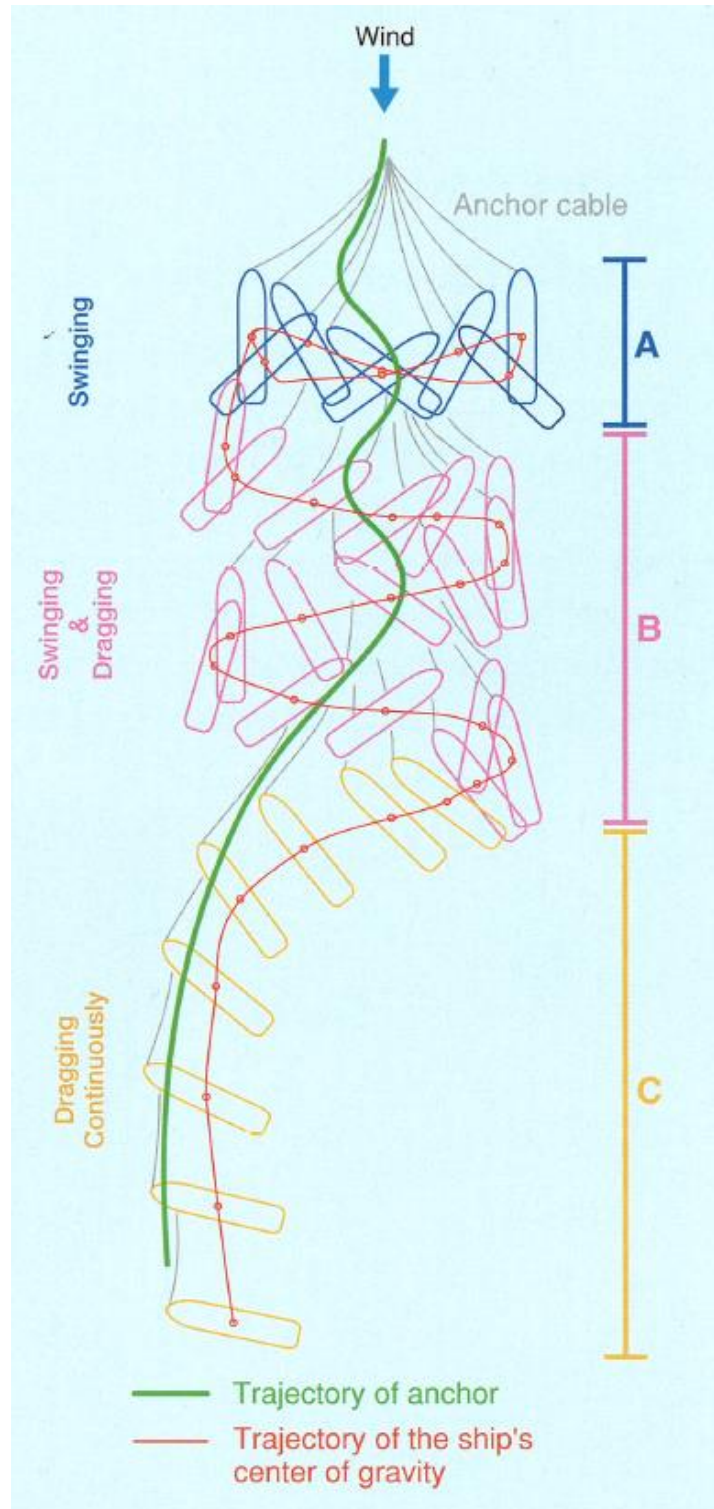
Even though these ways to detect dragging are widely known, it is difficult to use methods to detect dragging in the first stage because they normally appear in the second stage.

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To detect dragging in the first stage, it is important to have an accurate understanding of the ship's position and grasp vessel movement through use of the GPS, ECDIS, and Rader.



Dia.1 Swing Motion in Wind



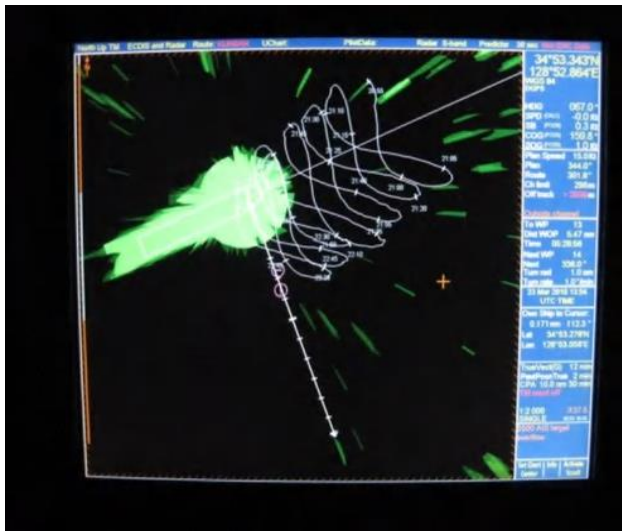
Dia.2 Stage of Anchor Dragging

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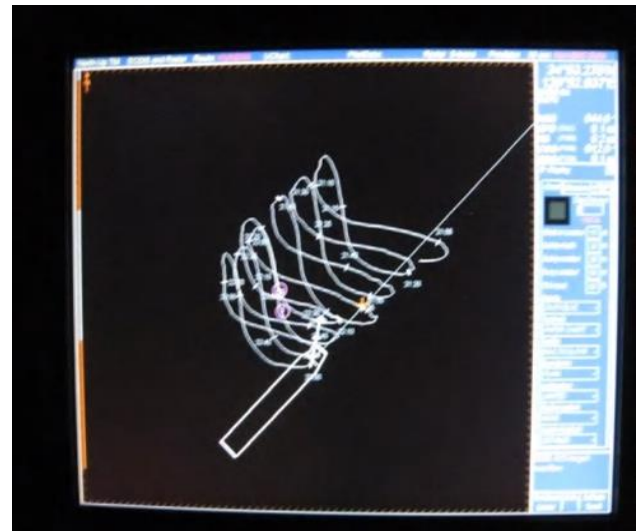
Dia. 3 shows a vessel's GPS track on radar while the PCC was dragging. We can easily identify the first stage of dragging.

Dia. 4 shows vessel's GPS track on ECDIS while the PCC was dragging. We can easily identify the first stage of dragging, as we did in Dia. 4.

To avoid a marine accident caused by dragging anchor, it is important to detect dragging during the first and take prompt action as early as possible.



Dia.3 GPS Track of Vessel Dragging Anchor (Radar)



Dia.4 GPS Track of Vessel Dragging Anchor (ECDIS)



### 7.3 Actions to be taken in case of Dragging Anchor

Under situations when cable is slipping or the anchor is dragging, Vessel shall review the situation. Consider paying out extra length of chain to avoid dragging or heave up anchor and drift at a safe location. At the time of anchoring, it is recommended that sufficient cable is available as reserve, which may be paid out later if deemed necessary.

Vessels with a large windage area (for eg. PCC) shall avoid paying out long lengths of cable, as it may not significantly prevent anchor from dragging and may pose additional risk of damage to machinery and equipment, if it is required to heave up anchor later.

When the Master detects signs of dragging anchor, the following countermeasures shall be taken (depending on the situation)

- Paying out an extra length of cable.
- Keeping the ship's head to the wind and easing tension on the cable by using the main engine, rudder and bow thruster (if applicable).
- Consider shifting anchorage or drifting off shore.

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## 8. Maintenance

### 8.1 Marking on the Winch and Windlass etc

The winch and windlass shall be marked boldly with following details

- Heaving and slacking direction of winch/windlass operating lever.
- Brake rendering capacity.
- Lowering and hoisting direction of winch drum.
- Date when brake was tested last. (Tankers & Gas Carriers)
- Date of rope change end to end or replacement

Other mooring equipments shall be marked with following details.

- The working area adjacent to mooring equipments shall be painted with non skid paint.
- Locations which require attention shall be painted by yellow
- SWL of fairleader, bollard and roller.



Lowering and hoisting direction





Locations which require attention



SWL of fairleader, bollard and roller



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## 8.2 Proper Stowage of Ropes

While under navigation, the sun's ultraviolet rays can damage exposed rope fiber. Never leave mooring lines in direct sunshine, as in the following measures. Also they should be stored in a clean, dry location, free from paints or chemicals. Where possible, they should be stored off the floor, on a palette allowing good air circulation. They should always be kept away from any heat source.

- If the ropes are not to be used for a long period of time, they shall be rinsed with fresh water prior to storing. After using mooring lines, let them air-dry. Ropes shall be kept as dry as possible.
- Ropes, when not in use, shall be kept covered canvas to avoid exposure to the ultraviolet rays from sun which can damage its fibers.
- Ropes shall be stored in a well ventilated compartment on wood gratings to allow maximum air circulation and encourage drainage.
- Ropes shall be protected from contact with solvent chemicals, acid and alkalis.
- Do not store ropes in the vicinity of boilers or heaters; do not store them on decks which may reach high temperatures.
- Spare mooring lines shall not be stored on deck after use but stored in the Bosun Store or Steering Room.





Ropes correctly stowed off deck



Ropes badly stored on wet deck





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### 8.3 Windlass and Mooring Winch



(Reference : ZZ-S-P-07.51.00)

- Check all grease nipples on mooring equipment to ensure the nipples remain usable. Yellow marking of grease nipples are recommended in order to prevent them from being overlooked.
- Oil, moisture or heavy rust on the brake linings and the drums be checked as it reduces the brake holding capacity.
- The brake lining thickness should never be less than 9mm. Always check the wearing out state of the brake band, brake drum, and the hole and pin of the break link.



- Check the safety pin on winch clutch lever. Risk of causing the operational mistake of the winch due to the clutch lever not positioned appropriately. Safety pins should be kept with chains or wires connected to the lever.
- Apply the grease to the gears and bearing bushes of the windlass properly.



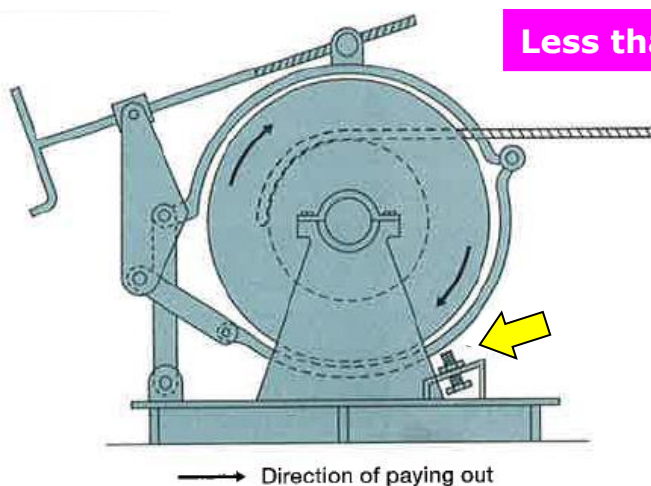
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- Confirm that the working/operation area are not slippery and damaged
- Check the condition of Bollard, bitts and fair-leader and ensure that the fair-leader is working well
- Ensure that the strength, materials and shape of stoppers are appropriate
- Confirm that the mooring has a handling rope
- Adjust the brake band support appropriately. This is installed in the lower part of the brake to prevent abrasion or wearing out of the upper part of the brake band.

Proper clearance between the brake band and the bolt should be less than 2mm. If the clearance is much wider, only upper brake band will work by own weight even loosing the brake.



<How to adjust of brake band support>

- 1) Tighten Band brake to braking position.
- 2) Loosen lock nuts and support screws.
- 3) Tighten screws until they touch the band brake (clockwise).
- 4) Turn the screws back one turn (counter clockwise).
- 5) The clearance should now be 1-2mm, check.
- 6) Test opening function of brake. The band brake should be free from drum surface all way round.



Less than 2mm



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#### 8.4 Fairleader & Pedestal Roller



Rollers are to be properly maintained in good working condition and checked internally and externally. Check the smooth rotate and apply grease periodically.



Greasing up of roller shaft

Rust on chocks, fairleaders, rollers or winches can and will harm mooring lines. Areas damaged by mechanical means or rust and corrosion should be attended to immediately.



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## 8.5 Mooring Wire

Regular application of good quality wire rope grease will fulfill the purpose of corrosion prevention, weather protection and lubrication.

The wire on board shall be lubricated periodically. During maintenance following shall be followed.

- The rusty parts on the wire shall be removed by wire brush or sand paper / emery paper.
- The wire shall never be allowed to dry. The wire shall be greased up using adequate grease as per vessel lubricating chart.
- The un-accessible part of the wire such as wire under the sheave, anchoring point etc, shall be paid careful attention while greasing.
- Wire Ropes which are stowed on drum, when not in use, shall be kept covered with canvas or other material to avoid exposure to the ultraviolet rays from sun.
- All the spare ropes and wires shall be stowed inside a store and shall be stored on wooden gratings to allow air circulation and encourage drainage.

