



NYK Maritime College



NYK SHIPMANAGEMENT

NMC-67

DECK MAINTENANCE



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

2nd Edition (Apr. 2016)

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DECK MAINTENANCE

INTRODUCTION

Vessel maintenance includes inspecting, cleaning, servicing, preserving, lubricating, and adjusting (as required). It can also require minor parts replacement within the capability of the crew. As a seafarer, you must take an active part in keeping your vessel at its peak operating condition. This is not an easy or simple task because you are constantly battling against the corrosive effects of salt water and salt air. The wind and sea also subject a vessel and its engines to strong stresses and strains. It takes day-by-day work and watchfulness to cope with all of these conditions. Maintenance never ceases. This training covers the procedures and tools to be used for preventive maintenance and the required maintenance aboard ship. It should be used as a guide for all deck officer and rating responsible for shipboard maintenance.

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1. SAFE WORKING PRACTICE

1.1 Importance of Safety

Safe ships. It's at the center of everything we do. For each and every one of us it is paramount that we maintain our focus on safety at all times. Safety applies to every operation we perform, anywhere in the world. Whether preventing catastrophic incidents through integrity management or eliminating personal injuries and equipment damage through control of work, the goal is nothing less than an accident free, injury free operation. With zero incidents in mind, newly crewmembers in the industry must be capable of absorbing the available knowledge and taking on board industry safety objectives. Training must continue across the board to keep them safe.

Working on-deck safely is everyone's objective. Typically, seafarers learn practical seamanship and various kinds of repair work from their seniors, mainly through on board working. If deck crewmembers increase their knowledge and skills, the performance and effectiveness of deck work will improve adding to safety, this will help with maintain high quality of ship. In order to help learn such skills effectively, this course was developed, which is aimed primarily to help and improve deck officers and ratings working performance specifically on deck maintenance and safety awareness.

At the end of this course, trainees will be able to learn and understand the importance of doing proper maintenance on deck such as chipping, painting, greasing and rope handling without neglecting safety and company procedure.

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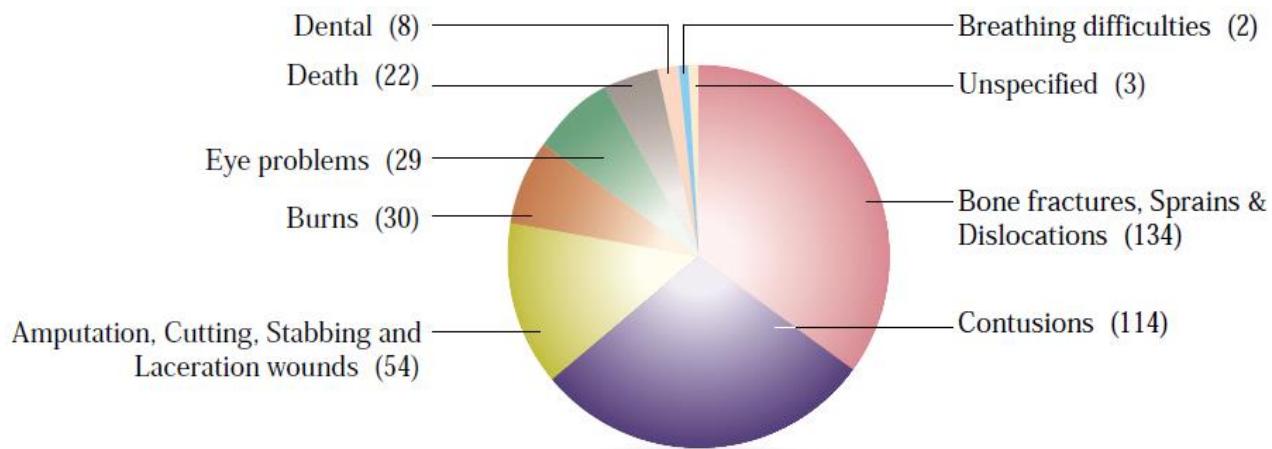
1.2 Analysis of Injury on board

(Reference : NYK Incident Report)

Injury on board has been analyzed the following categories.

Analyzed first are injuries and then deaths. For Ocean vessels 1,446 crew claims were brought to our attention for the safety policy year. Of these 387 were injury cases and 22 ending in deaths, persons missing or suicides.

(1) What kind of injuries were sustained?

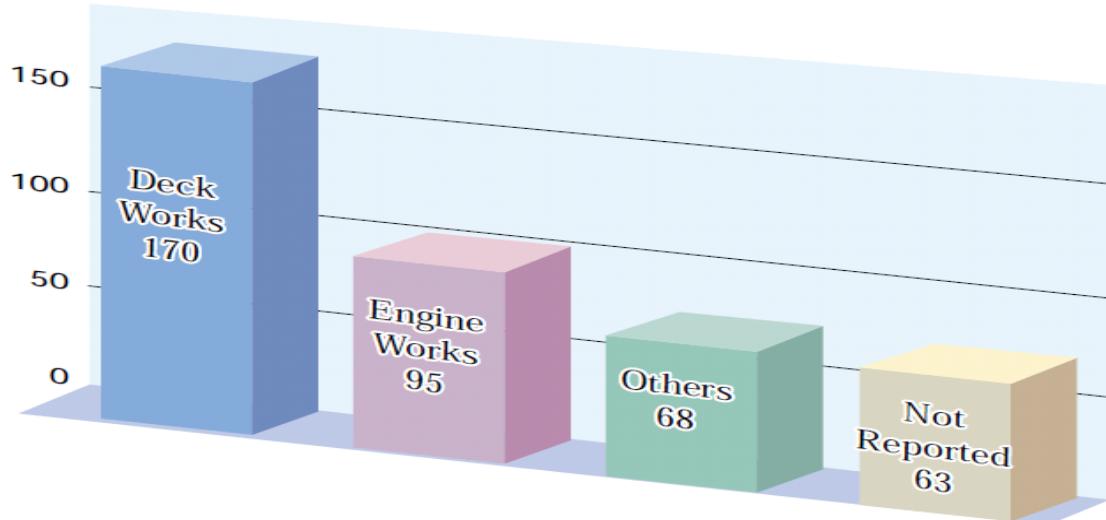


(2) What were the causes of their injuries?

- 1) Slipping / losing balance and falling / sprains (117)
- 2) Bumping into, sticking to, hitting and being cut by objects (75)
- 3) Wire or rope involved (30)
- 4) Steam, fuel, fire, liquid cargo, electricity involved (30)
- 5) Debris in eyes, bones stuck in the throat (29)
- 6) Squashed by doors / pontoons / cargo / machinery (24)
- 7) Touched / pinched / wounded by moving machinery (22)
- 8) Falling overboard, missing (11)
- 9) Falling from ladders / lifeboats (10)
- 10) Quarrel, suicide, assaulted by a ruffian (9)
- 11) Lifting heavy materials (5)
- 12) Traffic accidents ashore (3)
- 13) Knocked down by waves (2)
- 14) Others (24)

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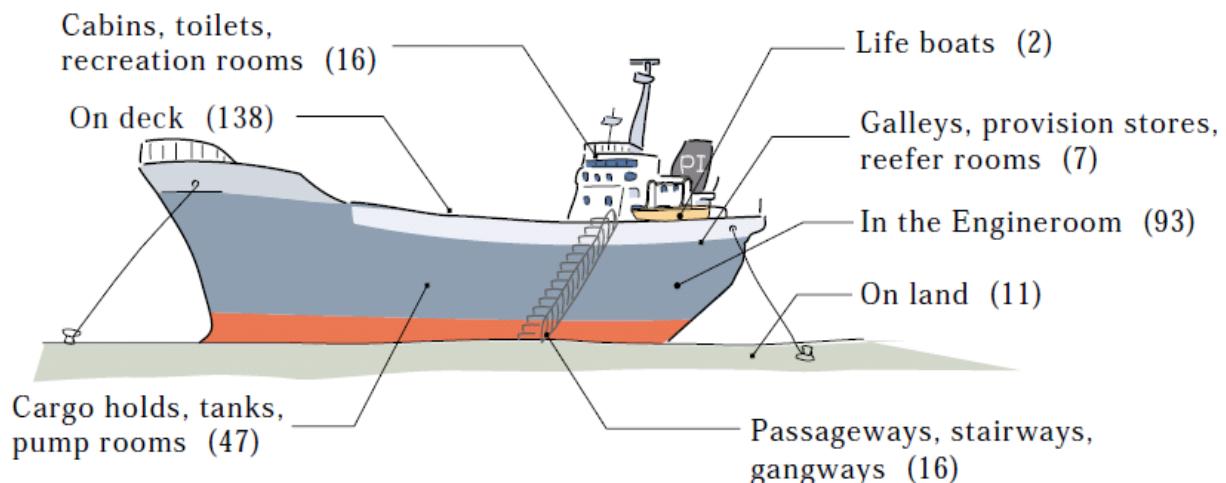
(3) What kind of work they were performing?



In total 170 cases happened during deck department work, details of which are:-

- ❖ Cargo work, preparation/finalization of cargo work : 60
- ❖ Maintenance work or watch-keeping : 42
- ❖ At duty stations for arrival/departure/shifting berth : 35
- ❖ Hold/tank cleaning, cargo shifting : 33

(4) The place where they got injured



Although some danger is involved in almost all on-board tasks, risks can be reduced when appropriate precautionary measures are taken by crews. Deck department members are more exposed to injury and their safety might be improved if crewmembers gave warning in a "loud voice" or confirmed by "signing checkpoints".

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1.3 Personal Protective Equipment

(Reference : SMS ZZ-S-P-09.10.01)

(1) General Use

In general, the more complete the cover, the better. Working clothes should be comfortable but sufficiently close-fitting so as not to catch on projections or machinery parts when you are working in cramped positions or are moving about the ship. Gaping pockets, trailing straps, sweat rags, watch straps and rings are easily caught in moving machinery. Remember, protective clothing is provided for your safety; be sure to use it.



Reference Attachment: SMS Personal Protective Equipment - Matrix

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(2) How to use ROLIP (Falling Arresting Device)

- 1) When fitting a ROLIP on to a father rope, be sure to confirm the carved mark "UP" so as not to fit it topsy-turvy.
- 2) When the safety device is moved with its locking lever kept in the "lock" position, there are cases where the locking mechanism of the device does not work, and is thrown open. Hence, be sure to move the safety device with its locking lever in the "open" position.
- 3) Check that the safety device is locked.
- 4) Operate the locking lever securely according to the purpose of use.
- 5) Set the ROLIP at a position above the safety harness.
- 6) As to the hooks to be fitted to the spectacle ring of the ROLIP, be sure to use only those which are highly safe.
- 7) Attach the "son" rope, fitted to the spectacle ring of the ROLIP, to the D ring of safety harness.



Descending (ROLIP is kept lower than the safety harness.)



Working at one place (ROLIP is kept higher than the safety harness.)

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1.4 Safe Working Practices

(Reference : SMS ZZ-S-P-09.10.05)

(1) Work Safety Measures & Dangerous Work Permits

The permit to work system consists of an organized and pre-defined safety procedures, which contribute in eliminating the hazards and improves safety on board. Department Heads, when having their crew engaged in dangerous work, shall ensure the safety of the workers.

Only the work specified on the permit shall be undertaken. Shall any checklist contain entry with negative answer; work is not undertaken until the Master has made a full appraisal of the situation. In this situation, only the Master can decide whether it is safe for a work activity to commence.

All Permits-to-Work are to specify the period of validity. This period shall NOT exceed twelve hours.

(2) Work at High Places / Aloft

When having work done in a high place of 2 or more meters from the floor and in a place where there is a risk of falling, the following measures shall be taken.

- 1) Have the worker use a protective helmet and safety harness.
- 2) When a bosun's chair is used, it shall not be driven by a machine.
- 3) When work is carried out near a funnel, whistle, radar, wireless communications antenna, etc. and there is a danger of harming the worker with the operation of the equipment in question, advise the time and nature of the work beforehand to the person handling the equipment. Lock out / Tag out procedures shall be complied with.
- 4) Advise the Duty Officer/Engineer when the work starts and when it ends.
- 5) Restrict passage under the work place by means of ropes and notice boards.
- 6) Have one of the workers or the lookout and the Duty Officer/Engineer carry transceivers so that



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communication between the two parties is established.

(3) Work over Sides

When having work done which has potential danger of dropping onto the sea, such as painting of the external hull plates, de-scaling, etc., the following measures shall be taken.

- 1) Use a safety harness and a work life jacket.
- 2) Use safe ladders.
- 3) When the work place can not be easily seen from a person on deck, post a sign on the bulwark over the work place, or on the handrail, or near the suspended scaffolding, etc, that work is in progress.
- 4) Prohibit the discharge or throwing overboard of bilge, sewage, waste, etc.
- 5) Advise the Duty Officer/Engineer when the work starts and when it ends.
- 6) Station a lookout for communications with the worker. However, this is not necessary when conditions are such that, when an accident occurs, measures necessary for rescue can be promptly taken and there are two or more workers on the job at the same time.
- 7) Have one of the workers or the lookout and the Duty Officer/Engineer carry transceivers so that communication between the two parties is established.
- 8) Have ready near the work place, life buoys, buoyant smoke signals, self-igniting lights and other lifesaving appliances that can be used immediately.

(4) Working on Pipelines and Pressure Vessels

When carrying out jobs involving lines under pressure.

- 1) Ensure that adequate man power is available for completing the job.
- 2) The emergency arrangements for de- pressurizing the tank or vessel shall be made known to all the persons involved in the job.
- 3) Wherever applicable the lines should be purged with inert gas or nitrogen. The duty watch keepers shall be made aware of the job in question.
- 4) Check if the job on hand affects any adjoining part of the line.
- 5) The personnel involved with the job shall be provided with proper protective gear.

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- 6) Precautions against static electricity hazards shall be considered and preventive measures taken.

(5) Painting and Paint Scraping Work

When having painting and paint scraping work done, the following measures shall be taken.

- 1) Prohibit smoking and the use of fire at the work place.
- 2) Do not use tools and equipment at the work place that let off sparks or become so hot, as to be become a source of combustion.
- 3) Do not leave rags used for the work and paint pilled or scraped.
- 4) Do not let persons other than those on the job approach the work place.
- 5) Have ready near the work place an appropriate fire extinguisher.
- 6) Have the worker use a mask, protective gloves and other protective gear.

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(6) De-scaling Work and Work Using Machine Tools (including use of Grinder On deck, Chipping etc.)

When having de-scaling work or work using machine tools done, following general precautions shall be followed:-

- 1) Worker shall be made to wear goggles and other necessary protective gear.
- 2) The work area shall not be subject to vapor release, or a concentration of combustible vapors, and shall be free of combustible material.
- 3) There shall be no inflammable vapor or liquid in adjacent compartments, which can give rise to fire by thermal conductivity through deck or bulkhead plates.
- 4) The area shall be gas free.
- 5) No chipping is allowed on pipes that carry inflammable vapor or liquid.
- 6) For the piping carrying inflammable vapor or liquid, and that has a flange within three meters (3M) of the working spot, areas adjoining oil tanks and oil piping, including those in machinery spaces.
- 7) Within three meters (3M) of a flammable substance (including heat insulation), a spark protection sheet and thermal protection shall be applied, other wise the substance shall be removed or isolated.
- 8) When working near or adjacent to electric instruments or cables, the cables and the ducts shall be protected or isolated.
- 9) Mechanical tools shall not be used when the ship is alongside a terminal, unless the express permission of the Terminal Representative has been granted. (Except working at engine room)
- 10) Adequate fire-fighting equipment shall be laid out and ready for immediate use.

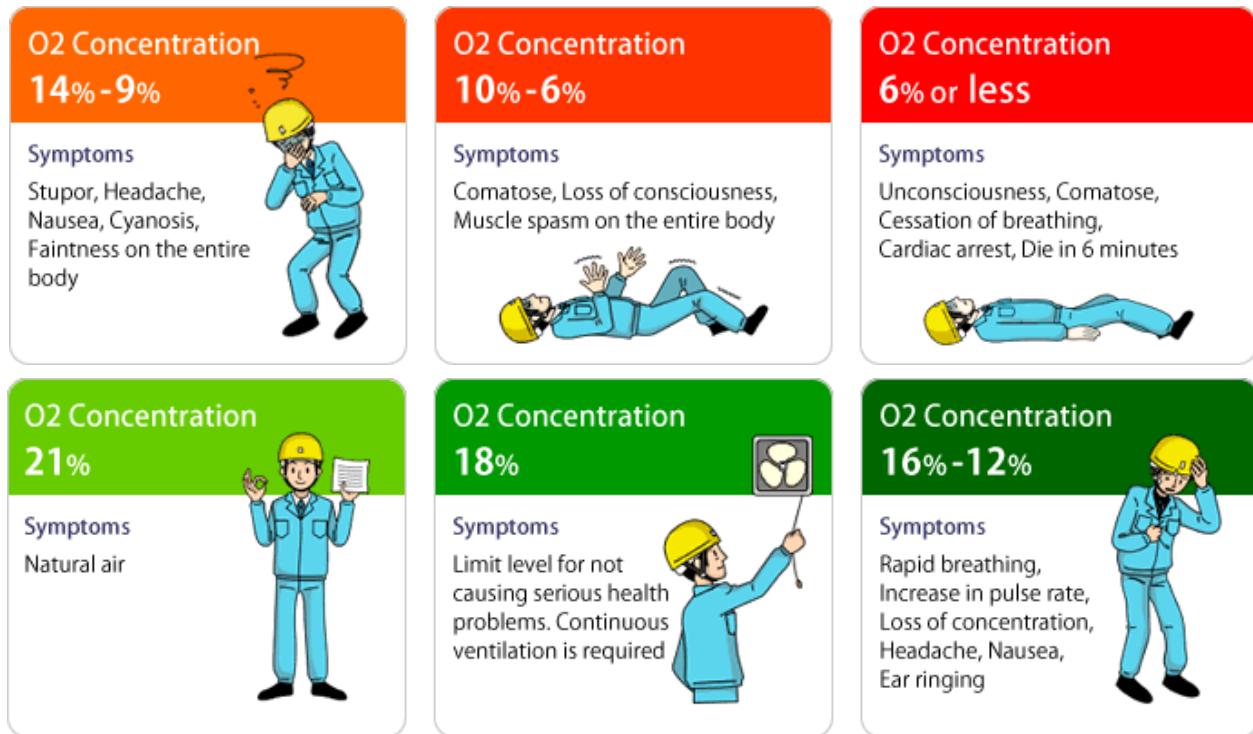


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1.5 HAZARDOUS Atmosphere

(Reference : Safety Bulletin GEN 2011 009)

(1) How Human Body React to Oxygen-Deficiency



(2) Effects of Carbon Monoxide (CO) on Human Body

Concentration (ppm)	Effects and Toxicity
100	No noticeable effects even after breathing for a few hours.
200	A mild headache in around 1.5 hours.
400~500	Headache, nausea and ear ringing in around 1 hour.
600~1000	Loss of consciousness in around 1 ~ 1.5 hours.
1500~2000	Headache, vertigo and disabling nausea in around 0.5 ~ 1 hour, and losing consciousness.
3000~6000	Headache, vertigo, disabling nausea...etc. in a few minutes.

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	10 ~ 30 minutes exposure can lead to death.
10000	Bring on immediate loss of consciousness and death.

(3) Effects of Hydrogen Sulfide (H₂S) on Human Body

Concentration (ppm)	Effects and Toxicity
0.025	Smell vaguely. (It varies according to the individual.)
0.3	Smell clearly.
3~5	Smell moderate degree of objectionable odor.
10	Lower-level to irritate eyes' mucus membranes.
20~40	A strong odor. Lower-level to irritate lungs' mucous membranes.
100	Sense of smell is impaired in 2 ~ 15 minutes. Eyes and respiratory tract are irritated in 1 hour. 8 ~ 48 hours continuous exposure can lead to death.
170~300	1 hour exposure is the limit for not causing serious health problems.
400~700	Life-threatening exposure in 0.5 ~ 1 hour.
800~900	Bring on loss of consciousness, cessation of breathing and death.
1000	Bring on immediate loss of consciousness and death.

(4) Ballast Tanks and Cargo Tanks in Ships

(Reference : ZZ-S-P-09.10.04)

Ballast tanks take in and expel water to maintain a ship's balance. The steel plating on the walls inside become oxidized with surprising speed.

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In the cargo tanks, massive amounts of oxygen are consumed by processes such as the respiration activity of fruits and grains or vaporizing dry ice used for the refrigeration.

(5) Portable Gas Detector

(Reference : ZZ-S-P-10.40.00)

For judging atmosphere, gas detector must be used absolutely when you enter the enclosed space. Followings are typical detectors.

	Portable single gas monitor (GX-8000 O2) 	Portable single gas monitor (GX-8000 LEL) 	Marine combination gas detector (RX-515) 
Category	Portable gas detector		
Type	Single gas (Oxygen)	Single gas (Combustible)	Multi gas
Detection Range	0-40%vol	0-100%LEL	<ul style="list-style-type: none"> • Methane(CH4) :0-100.0%LEL / 5~100.0vol% • Oxygen(O2) :0~25.0% vol% • Carbon monoxide (CO) :0-1000ppm • Carbon dioxide (CO2) :0-20.0vol%
Sampling method	Sample draw		
Type of alarm	Gas alarm, Trouble alarm		
Explosion proof	Intrinsically safe		

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Continuous operation	AA Alkaline battery: more than 12 hours Lithium-ion battery: more than 20 hours	AA Alkaline battery: more than 6 hours Lithium-ion battery: more than 12 hours	Approx. 30 hours (no alarm, no light, at 25°C)	
Operating temperature & Humidity	-20 to 50°C, Below 95%RH	-20 to 50°C, Below 95%RH	-10°C to 50°C, Below 90%RH	

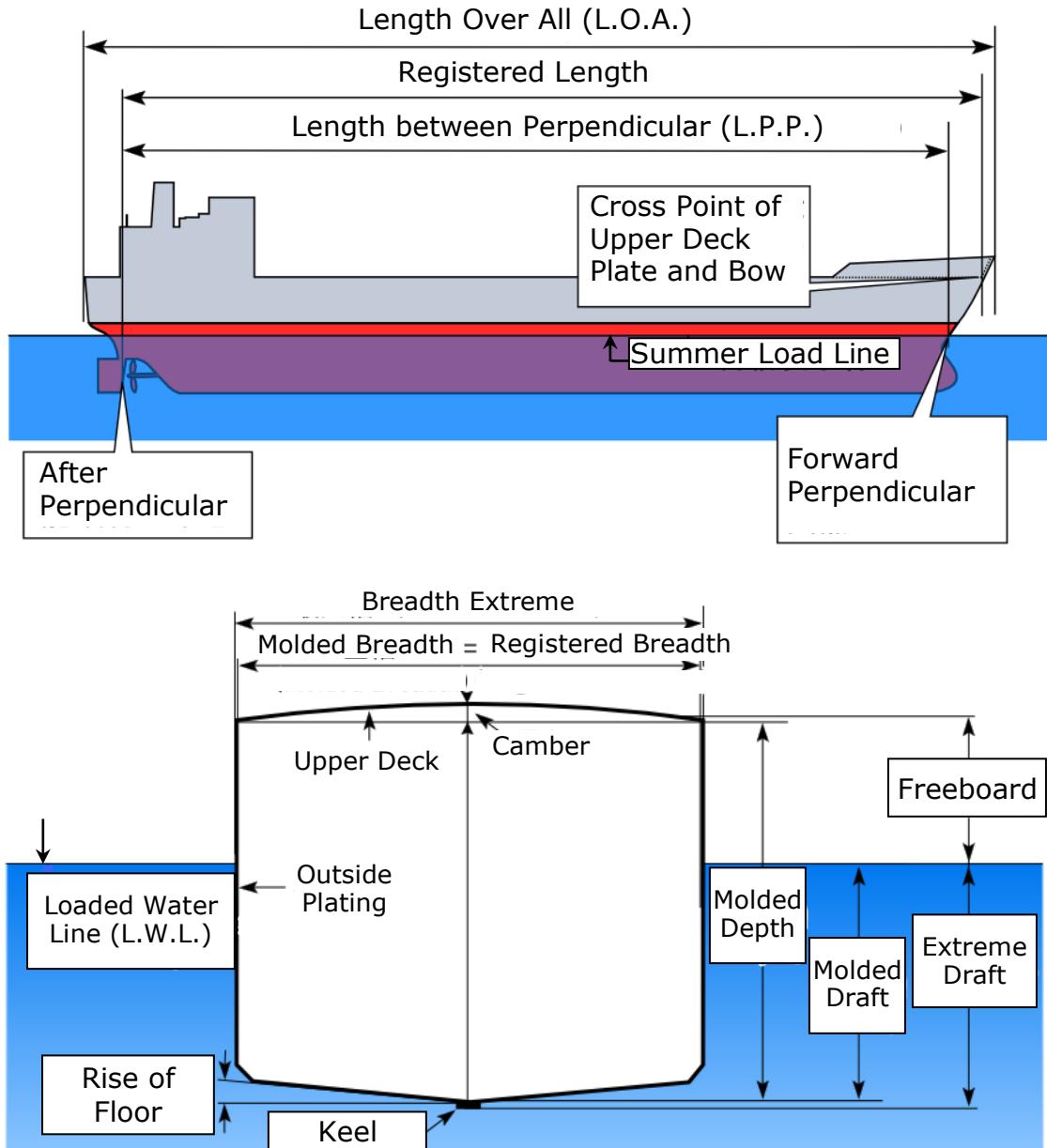
2. SHIP'S CONSTRUCTION

2.1 Ship Dimensions and Form

The hull form of a ship may be defined by a number of dimensions and terms which are often referred to during and after building the vessel. An explanation of the principal terms is given below:

Moulded dimensions are often referred to; these are taken to the inside of plating on a steel ship.

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After Perpendicular (AP)	A perpendicular drawn to the waterline at the point where the aft side of the rudder post meets the summer load line. Where no rudder post is fitted it is taken as the centre line of the rudder stock.
Forward Perpendicular (FP)	A perpendicular drawn to the waterline at the point where the foreside of the stem meets the

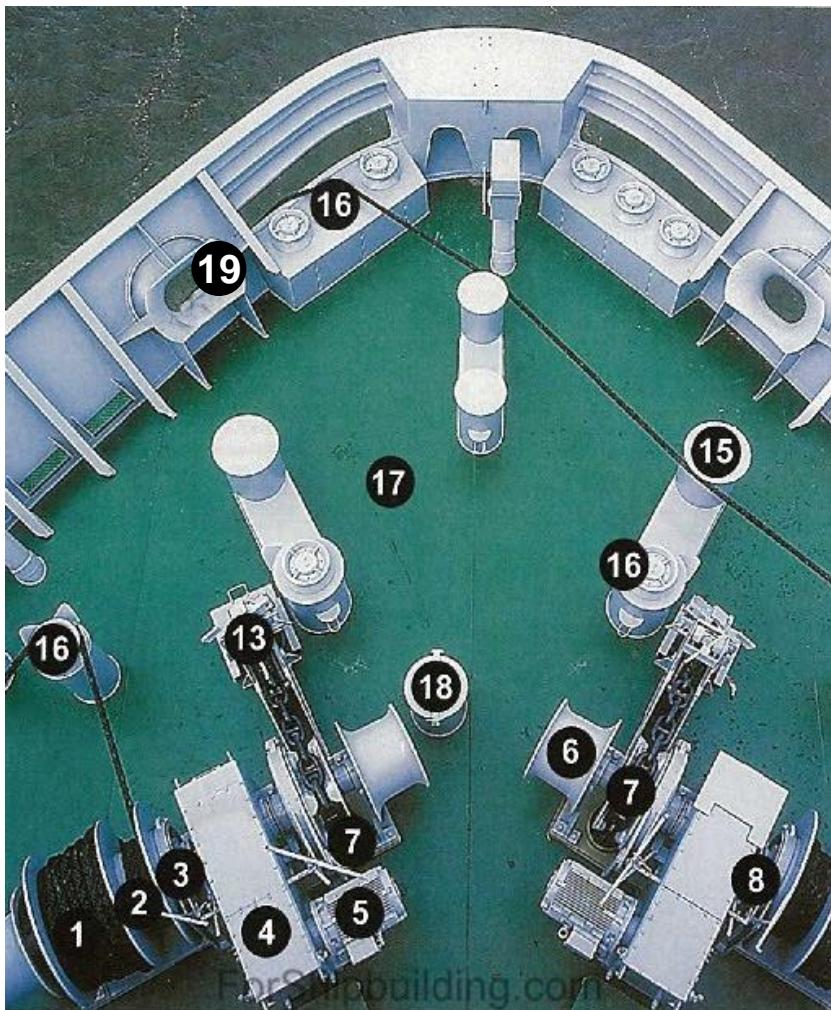
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	summer load line.
<i>Length Between Perpendiculars (LPP)</i>	Length between the FWD and AFT perpendiculars measured along the summer load line.
<i>Length Overall (LOA)</i>	Length of vessel taken over all extremities.
<i>Moulded Beam</i>	Measured at the midship section is the maximum moulded breadth of the ship.
<i>Moulded Draft</i>	Measured from the base line to the summer load line at the midship section.
<i>Moulded Depth</i>	Measured from the base line to the heel of the upper deck beam at the ship's side amidships.
<i>Extreme Beam</i>	The maximum beam taken over all extremities.
<i>Extreme Draft</i>	Taken from the lowest point of keel to the summer load line. Draft marks represent extreme drafts.
<i>Extreme Depth</i>	Depth of vessel at ship's side from upper deck to lowest point of keel.
<i>Freeboard</i>	The vertical distance measured at the ship's side between the summer load line (or service draft) and the freeboard deck. The freeboard deck is normally the uppermost complete deck exposed to weather and sea which has permanent means of closing all openings, and below which all openings in the ship's side have watertight closings.
<i>Camber</i>	Curvature of decks in the transverse direction. Measured as the height of deck at centre above the height of deck at side.

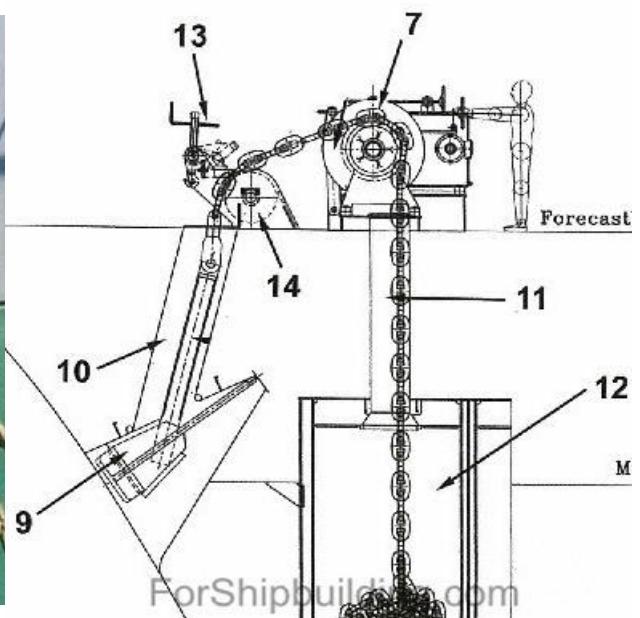
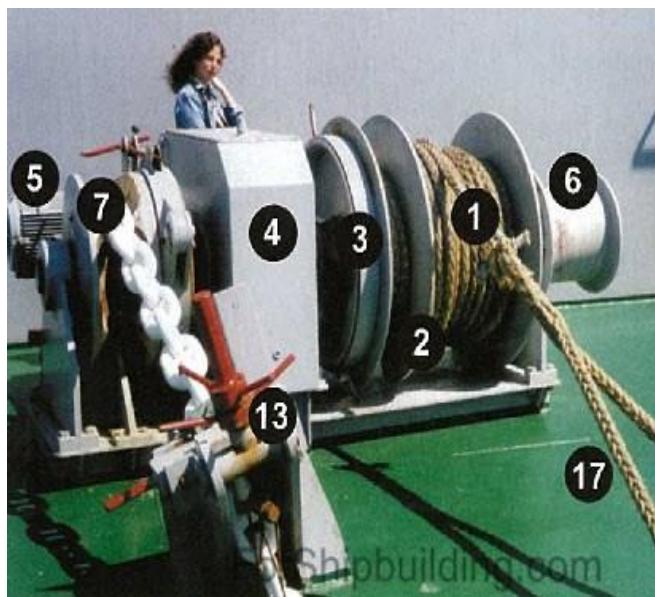
2.2 Anchor, Mooring gear

(1) Overview of Anchor and Mooring Gear

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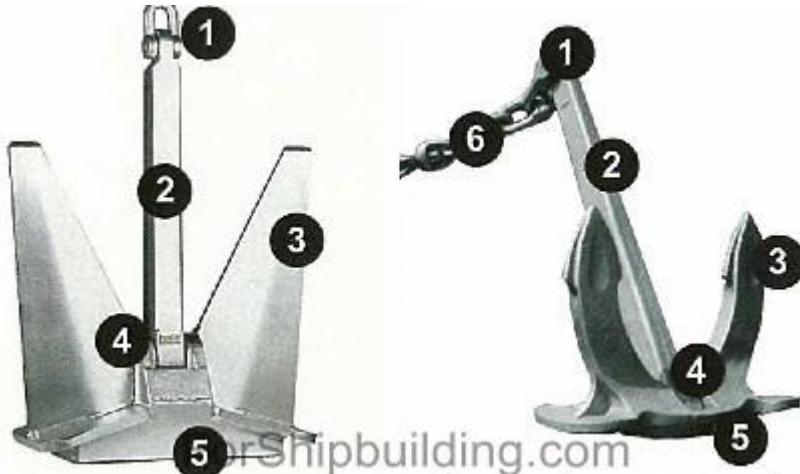


1. Storage part of the mooring drum
2. Pulling section of the drum (working part)
3. Brake band
4. Gear box
5. Electro-hydraulic motor
6. Warping end
7. Gypsy wheel
8. Cutch
9. Anchor
10. Hawse pipe
11. Spurling pipe
12. Chain locker
13. Chain stopper with security device
14. Guide roller
15. Bollard
16. Fairleader
17. Deck
18. Hatch to chain locker
19. Panama Hole

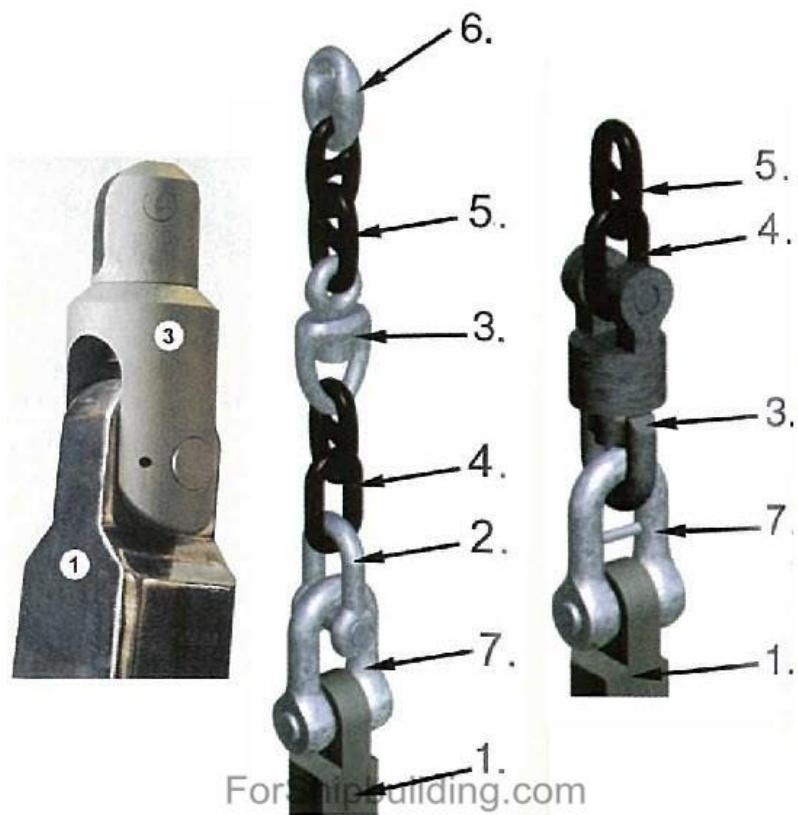


(2) Anchor Equipment

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

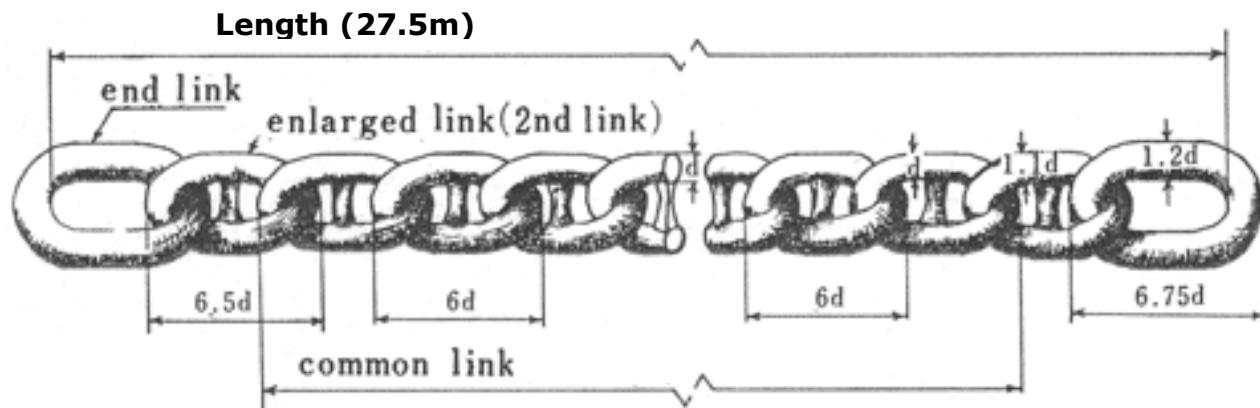


- 1. Anchor shank
- 2. Anchor/ link
- 3. Swivel
- 4. Open link
- 5. Enlarged link
- 6. Kenter shackle
- 7. Crown shackle

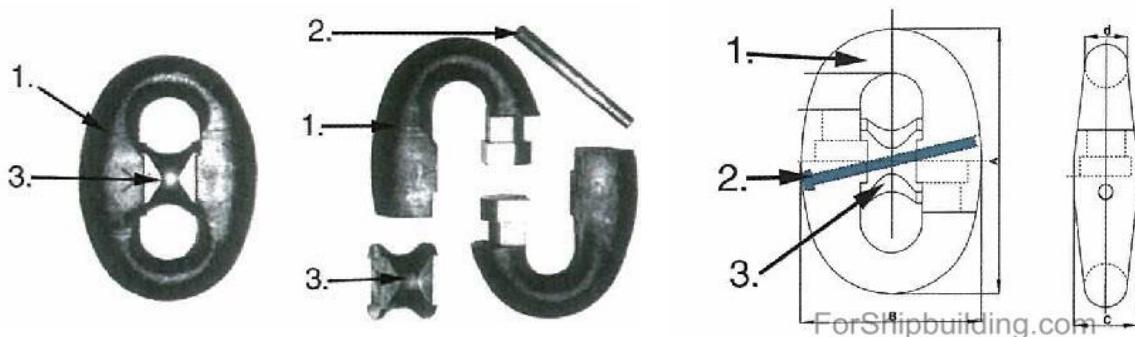
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(3) Anchor Chain

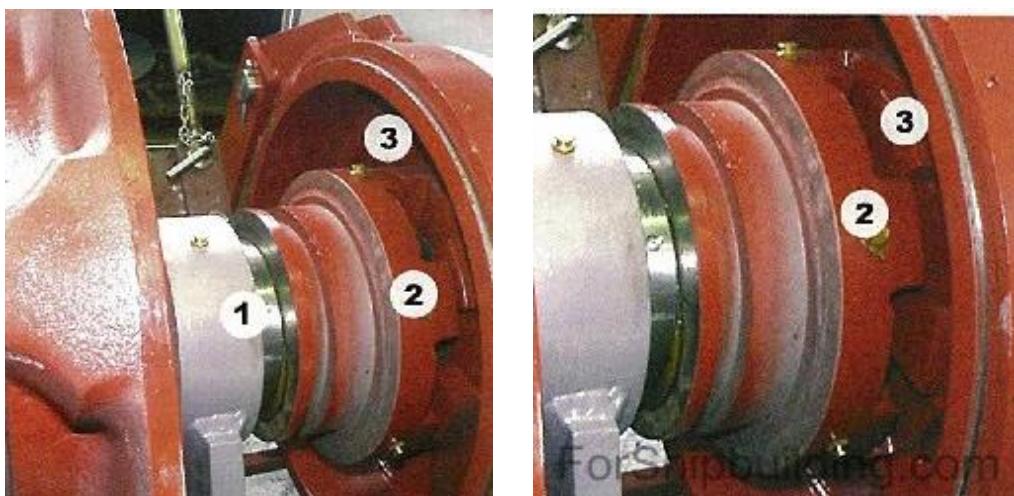


(4) Kenter shackle



1. Half link 2. Locking pin 3. Stud

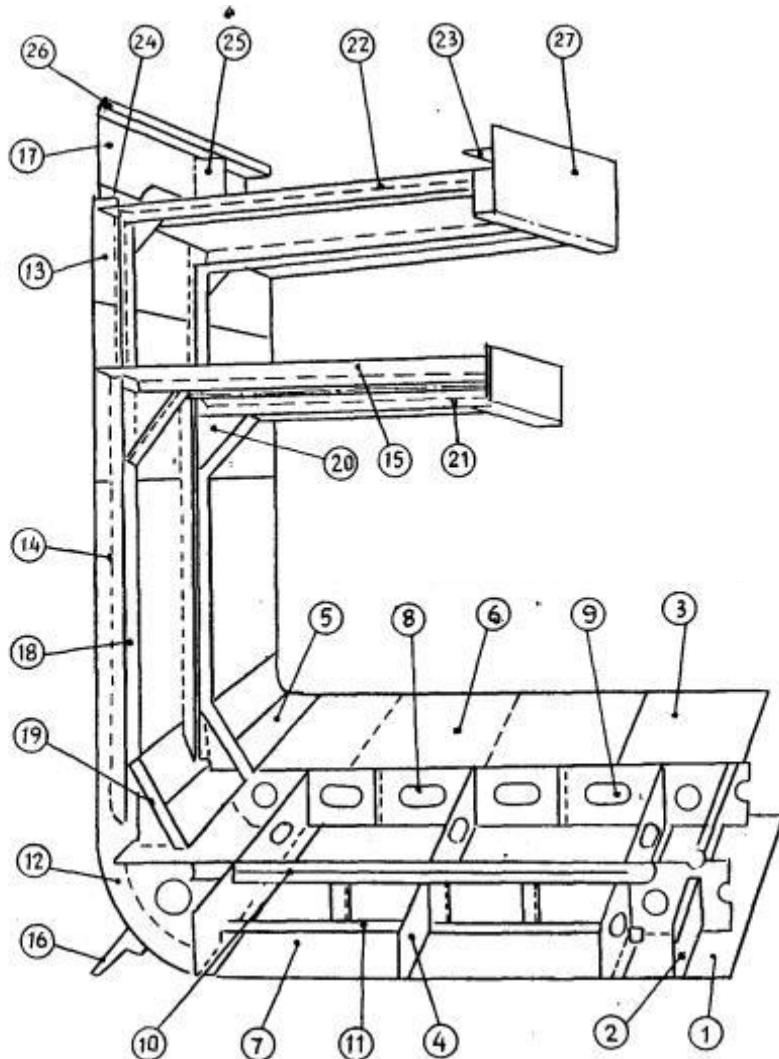
(4) Claw clutch out and in



1. Bearing 2. Sliding claw 3. Fixed claw

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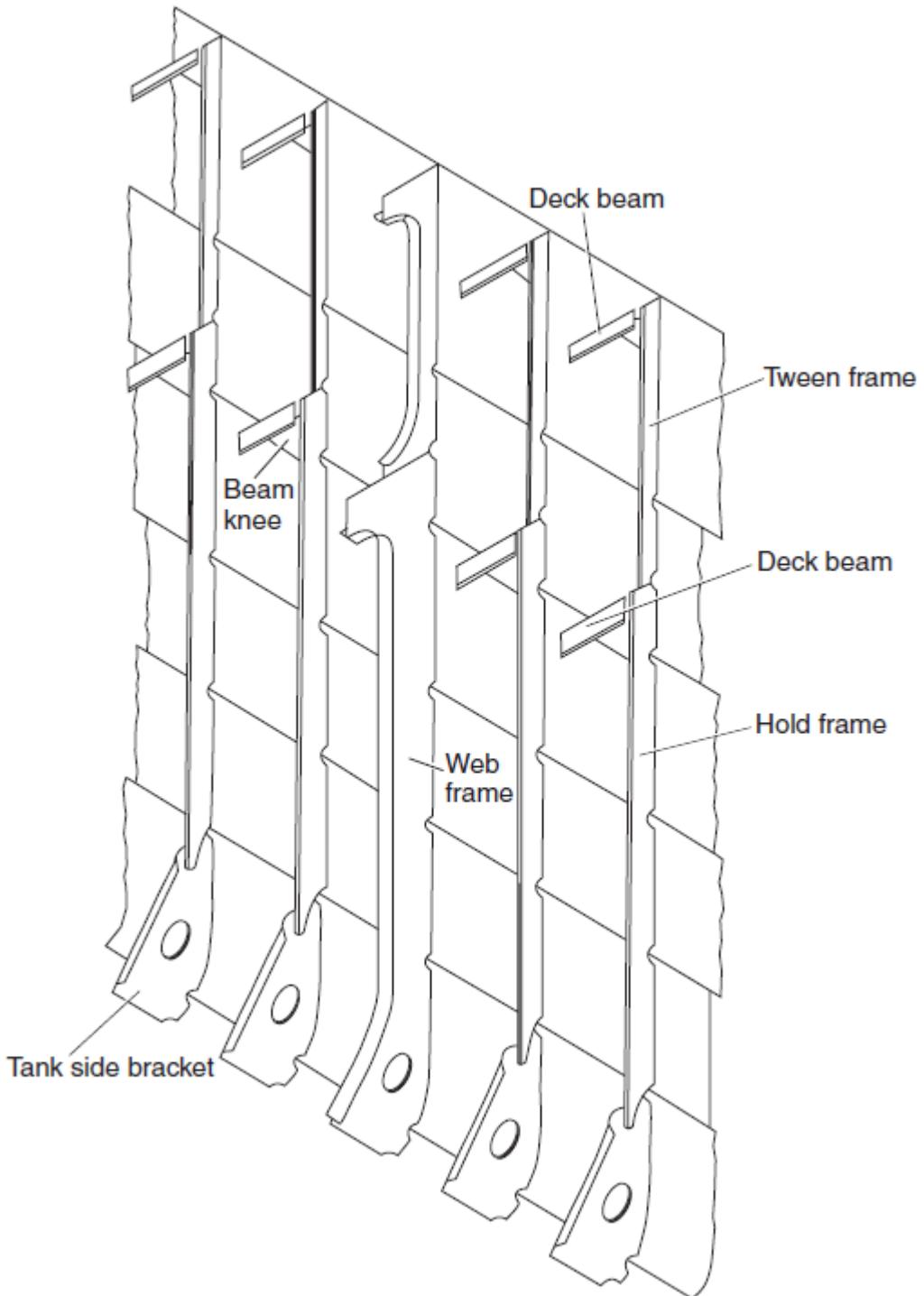
2.3 General Structure



- 1 . Plate Keel
2. Center girder
3. Center (line) strake
4. Side girder
5. Horizontal margin plate
6. Inner bottom plating
7. Bottom plating
8. Floor
9. Manhole
- 10 . Reverse frame
- 11 . Main frame
- 12 . Bilge strake
- 13 . Sheer strake
14. Side plating
- 15 . Upper deck
- 16 . Bilge keel
17. Bulwark plating
- 18 . Frame
19. Tank side bracket
20. Beam bracket
- 21 . Deck beam
22. Shelter deck
23. Horizontal stiffener
24. Gunwale angle
25. Bulwark stay
26. Hand rail
27. Hatch side coaming

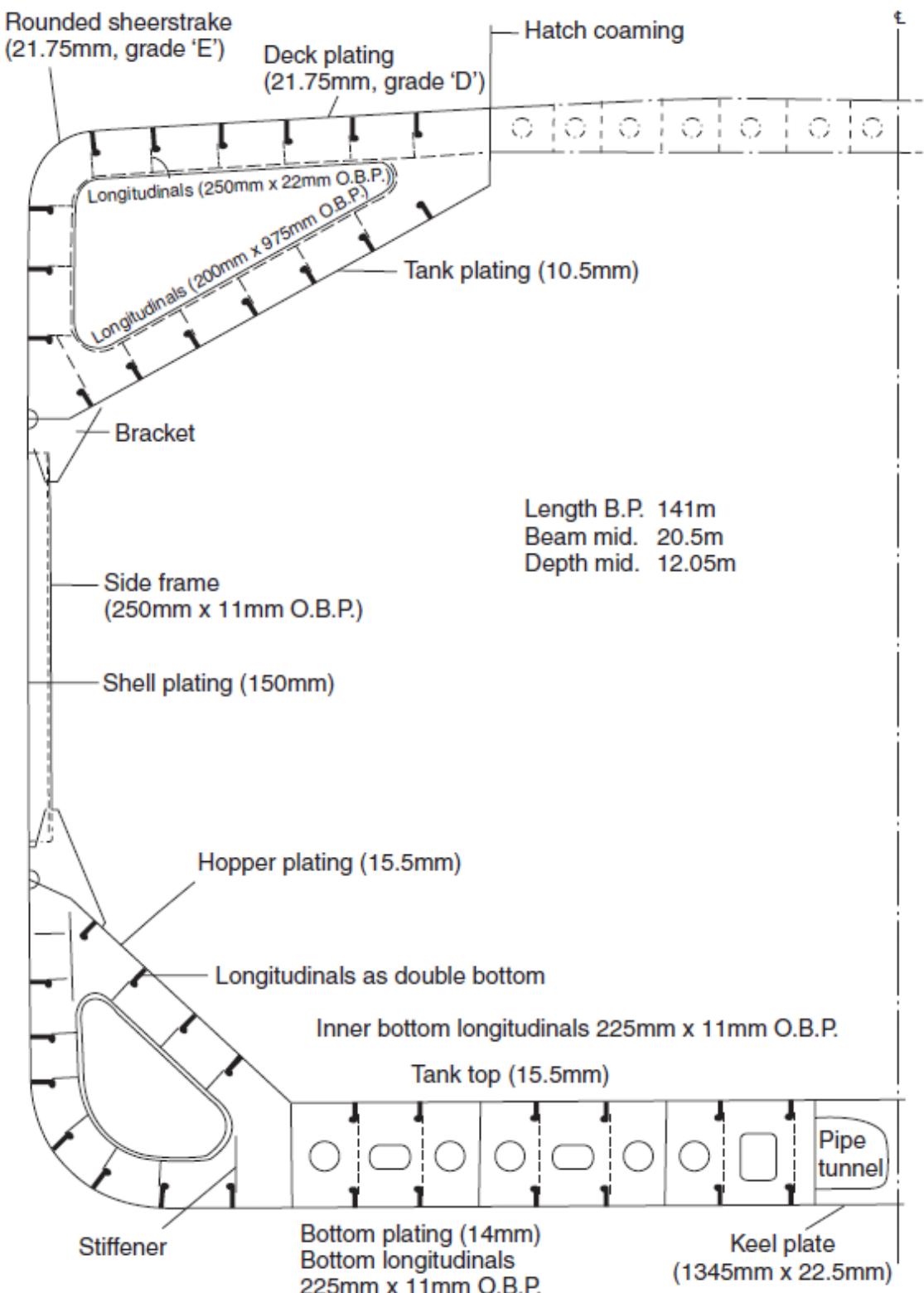
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2.4 Side Shell



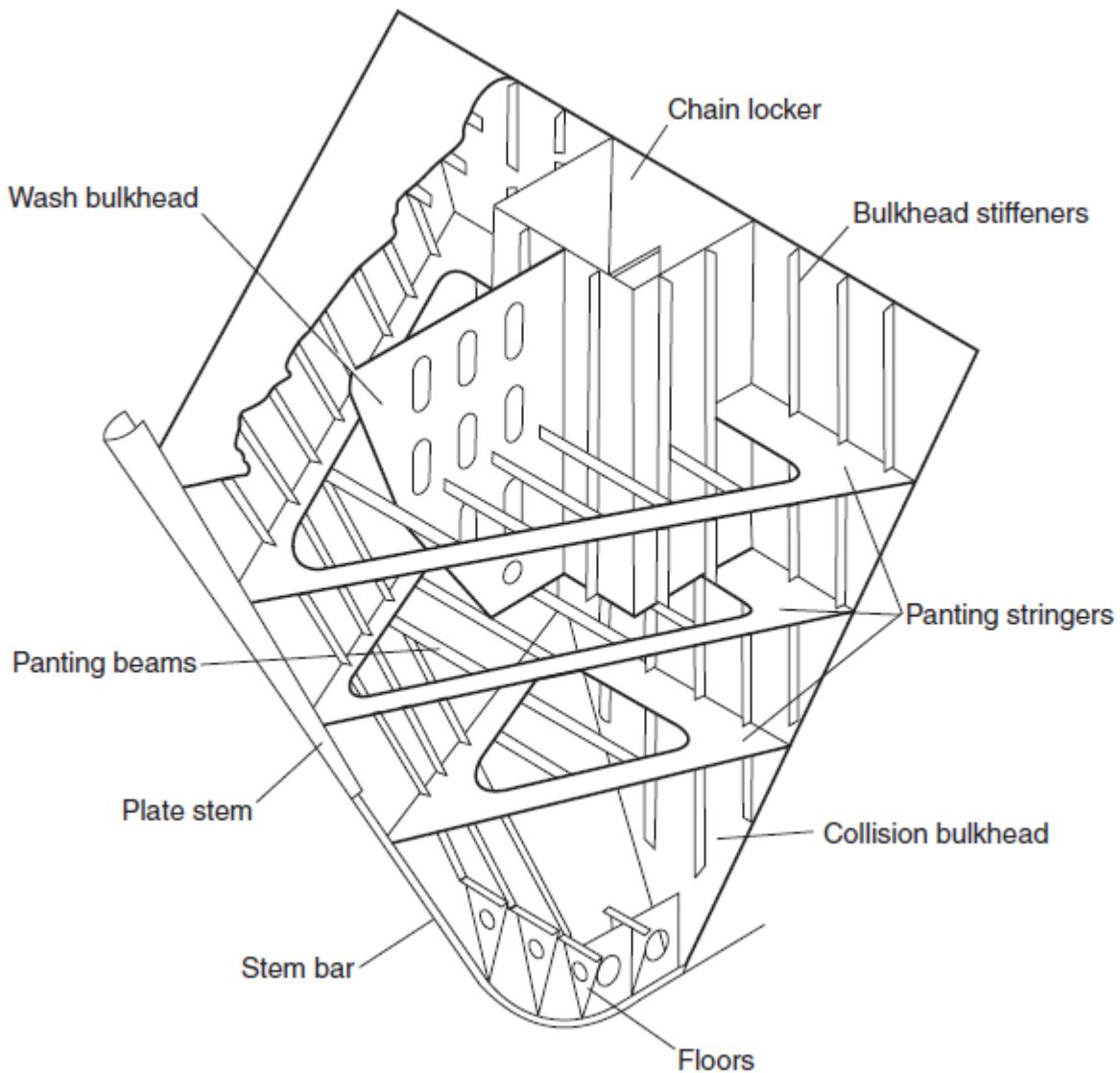
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2.5 Mid-ship Section of Bulk Carrier



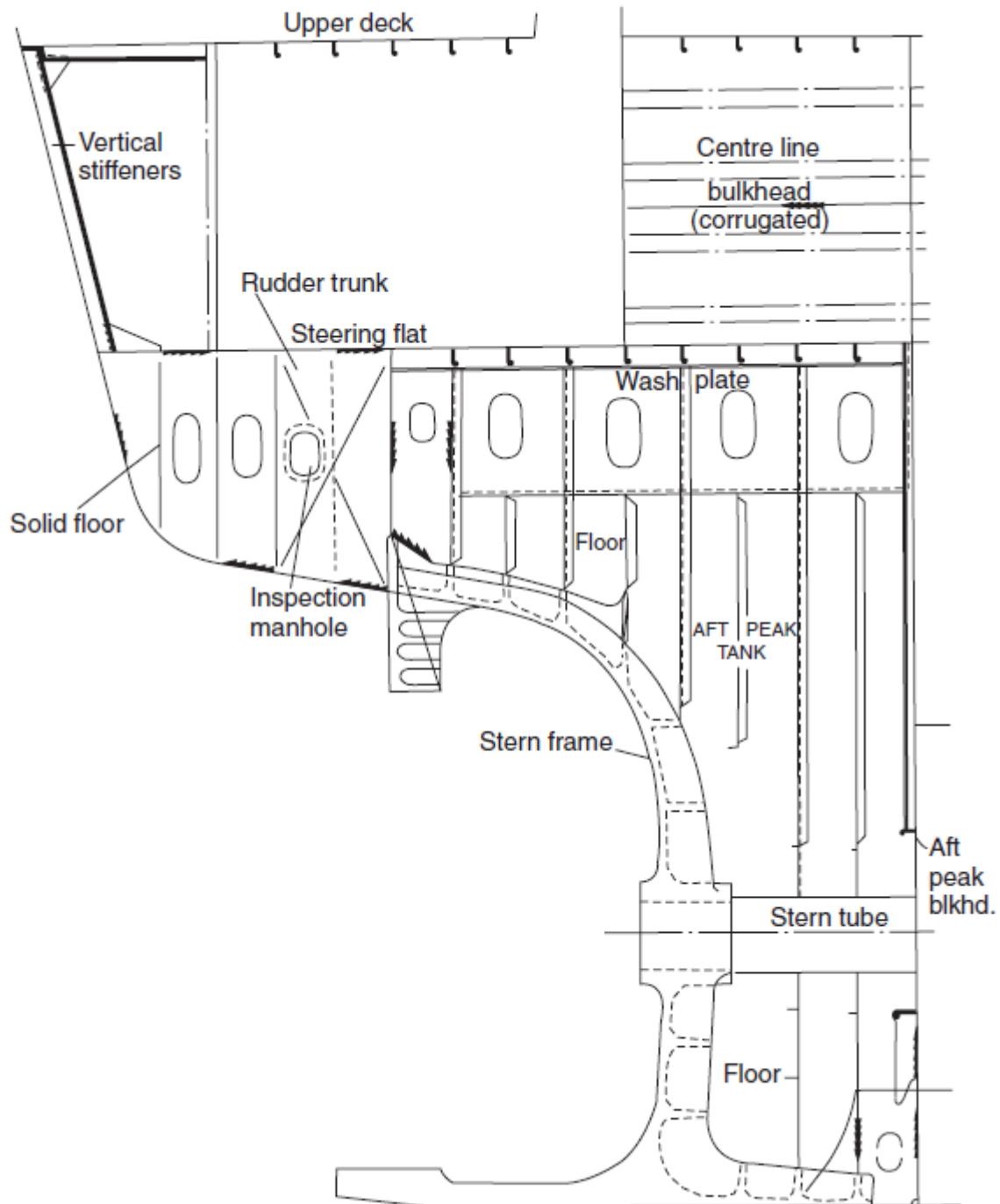
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2.6 Fore and Structure



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2.7 Aft and Structure



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3. CHIPPING OPERATION

(Reference : SMS ZZ-S-P-09.10.05)

3.1 Tools to be Used

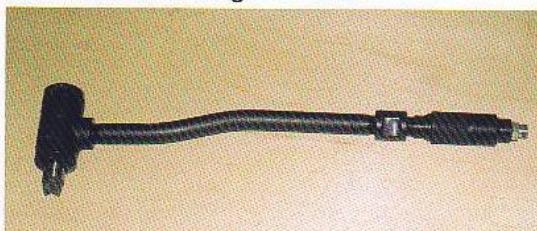
When the steel plates of a ship are new as in the case of new buildings, a tool called disc sander is sufficient enough to do most of surface preparation (chipping).

However, in the case of old steel materials, it becomes necessary to use the following tools in order to do the scaling work efficiently.

(1) Pneumatic hammer

- | | |
|-----------------|--|
| Hammer type ... | for scaling a wide area |
| Needle type ... | for scaling a narrow space, deep rust |
| Chisel type ... | for scaling a narrow space, thick rust |

Pnewmatic Scaling Hammer

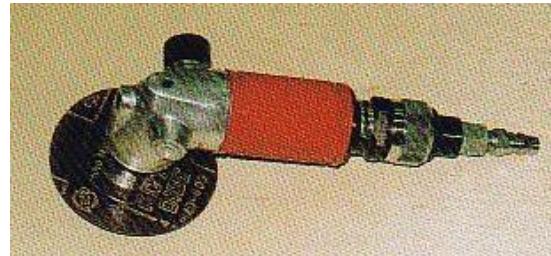


Are the length of the air hose and the thickness of coupling adequate?

Pneumatic jet Chisel

(2) Disc grinder

This is used for surface preparation (the removal of paint films, mill scales, and rust) and for the leveling off of the level difference - in the boundary area between scaled surface and painted surface. While coarse grained papers (#16, #30) are normally used, they are required in large quantities because the surface of papers is liable to get packed due to the adhesive nature of rubber and epoxy paints.



(3) Scraper

This is used for the removal of paint films and for the leveling off of the level difference in the boundary area between the scaled surface and painted surface.



(4) Wire brush

This is used for surface preparation, as well as for the purpose of scouring steel materials of uneven surface portions (tortoiseshell type, brush type).

(5) Chipping hammer

This is used for the chipping touchup of the rust that remains in even surface portions, and the scaling of coaming portions.

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3.2 Precautions when using Chipping Devices

- (1) Use protective devices, such as dust goggles, earplugs, dust masks, cotton gloves, leather gloves, and sun hats.
- (2) Avoid using these devices for hours, and do the operation in turn.
- (3) Workers, who have finished using these tools for surface preparation, should clean scaled surface to facilitate a visual check of these surface.
- (4) Touch up the machine-processed surface by using chipping hammers, and scour thereof by using disc sanders.
- (5) The painting in good condition depends on the cleanliness of the scaled surface.
- (6) Wash your eyes at once without rubbing them

3.3 Checking items for safety purpose concerning the chipping operation by using chipping machines

- (1) Is the machine fitted with a grounding cable? Is it properly grounded when in use?
- (2) Is the switch on hand in working order?
- (3) Is there any breakage or damage done to such parts as lead wire and socket? Are they fitted perfectly?
- (4) When these leads are stretched across the passage ways or the work area, are necessary measures being taken to prevent a person from tripping over them or to protect the work from interference?
- (5) Are deck hands wearing proper work clothing to prevent the cuffs of their outer garments or the hems of their trousers from being caught up by a machine?
- (6) Has the test operation of machines been made before the start of the work? Are they working properly?
- (7) Are workers provided with protectors? Isn't there a case where a worker is using a power tool for a long time?
- (8) Are workers washing their eyes after the work is over? (The use of a 1% boric acid solution is recommended.) Wash your eyes at once without rubbing them when you have a feeling that you have something foreign in your eyes.
- (9) Is there any worker working in the direction in which rust is hurled?

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4. PAINT WORK

4.1 Practical Knowledge of Marine Paints

In a bulk carrier, the paint coat applied to the inside walls of the cargo holds play an extremely important role in maintaining the service quality of cargo transport. For a deck officer working out a maintenance plan, knowledge of the properties of paints to be used aboard his vessel is indispensable.

It is not enough just to apply some paint.

When it is shipped out, any paint is still a semi-finished product, and does not become a finished product until it is applied to the surface to be painted in a way that best achieves its function and becomes a finished coat.

Meanwhile, the main purpose of painting the deck is to make it rust proof.

To achieve this purpose, the deck officer should choose the right paint, plan a rational painting plan based on adequate knowledge of the properties of the paint, and lead the deck crew under his command to accomplish the job in the most appropriate method.

4.2 Type of Paint

Oil paint	Boiled oil	Solvent oil for oil paint
	oil paint	Painting for interior and exterior of buildings. (wooden part, iron part)
	Ready mixed oil paint	Coating are durable, but slow in drying up (18 to 24 hours).
	Ready mixed synthetic resin paint	Has a gloss and weatherability Quick in drying up (10 to 12 hours)
	Oil varnish	Wood transparent coating s for fixtures, building materials, etc. Copal varnish (primary coats for interior work) Spar varnish (topcoats for interior and exterior work) Body varnish (top coats for exterior) Oleo phenol resin varnish (quick-drying and water-resisting qualities)
Synthetic resin paint	Epoxy resin paint	Amine cured epoxy resin paint (anti-corrosive paint for the ship's ballast tank, etc.)

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		Tar epoxy resin paint (heavy anti-corrosive paint for bridge, ship, pipe, etc.)
	Vinyl resin paint	Vinyl chloride resin paint (quick in drying up, has chemical-resistant and fire-retarding properties. Used for concrete.)
	chlorinated rubber paint	Quick in drying. Thick coatings are possible. Resistant to water, salt and chemicals. Used for outdoor structure, such as bridge, plant and ship
Special purpose paint	Anti-corrosive paint	Anti-corrosive paint for general use (construction, steel frame) <ul style="list-style-type: none"> ▪ Red lead anti-corrosive paint ▪ Lead sub oxide anti-corrosive ▪ Basic lead chromate anti-corrosive paint ▪ Lead cyan amide anti-corrosive paint
	Epoxy anti-corrosive paint (quick-drying)	<ul style="list-style-type: none"> ▪ Zinc dust anti-corrosive paint ▪ Zinc chromate anti-corrosive paint ▪ Red lead zinc chromate anti-corrosive paint Calcium phosphate anti-corrosive paint <ul style="list-style-type: none"> ▪ denotes lead base anti-corrosive paints for steel structures. ▪
	Ship's bottom paint	No.1 (A/C) Anti-corrosive paint No.2 (A/F) Anti-fouling paint No.3 (B/T) Boot top paint
Various thinners	paint thinner	Epoxy thinners, thinner for various kinds of synthetic resin paints (thinner for exclusive use)

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4.3 Precautions of painting

In planning a painting job, the choice of timing and area when at sea requires particular attention. It is normal for a ship while at sea to face vastly different weather conditions. The deck officer should have sufficient knowledge of the drying mechanism and characteristics of the paint to be used aboard his ship and accordingly choose the right timing and sea area for the paint application.

The basic requirement in choosing the timing of paint application is "to avoid low temperatures and high humidity".

(1) When humidity is high

When and where the humidity is high, no paint should be applied.

Under rainy conditions where the relative humidity is roughly 85% or above, the surface to be coated is moist and accordingly there is a risk of inviting deterioration of the coat's adherence and, consequently, a faulty finish.

Humidity calculation shall be based on psychometric tables.

The officer working out a maintenance plan should take note of the fact that high humidity does not always result from rainy conditions. He should be aware that if there is no adequate ventilation after painting the holds' inside surface or the underside of the hatch cover, the temperature difference between the atmosphere and the in-hold space could invite high humidity or dew condensation. He should work out an appropriate painting management plan that considers ventilation and other vital factors.

Similarly, in carrying out rust removal or painting of sealed areas such as the ballast tank interior, the officer should keep in mind that sufficient ventilation after finishing the painting is indispensable, and make arrangements in advance for appropriate ventilation.

(2) When atmospheric temperature is low

No painting should be done when the temperature is low.

A rough measure for a low temperature in this context is always 5°C or below.

A common marine paint, if applied at a low temperature, would suffer extremely poor hardening and drying, and give rise to problems such as color fading of the paint coat.

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Therefore, if the ship is scheduled to sail in chilly seas in winter, the maintenance should be planned in advance so that major painting jobs are completed before the ship reaches the cold temperature area.

(3) When atmospheric temperature is high

The temperature from the midsummer sun can raise the temperature of the surface to be painted abnormally high, causing the paint coat to foam.

If any foaming of the coat is noticed during painting, the work should be suspended immediately.

When the ship is sailing on the equator or other areas where it is similarly hot, the deck officer should make his crew aware of the risks of coat foaming when painting in this extreme condition, and have them properly address that risk.

4.4 Preparation for painting

- (1) After scaling, polish the surface to be painted by using such tools as a disc sander, removing the level difference in the boundary area between scaled and old paint surfaces, thereby to make the surface smooth.
- (2) Remove impurities, such as rust and dust, completely by sweeping.
- (3) Wipe off oily spots by using thinner, etc. As to salty or wet spots, wash them away with fresh water or wipe them off by using rags and dry them completely.
- (4) The concave surfaces of coatings are liable to attract moisture, which may cause rusting. The application of putty to these concave spots is conductive to a good finish.
- (5) Install a ventilating system in each of poorly-ventilated places.
- (6) When using spray guns, put masking tapes on scuttles, deck-lights, deck machinery, etc.
- (7) When painting side walls, ceilings, etc., cover the deck with old canvas covers to prevent paint splashes from sticking to the deck.
- (8) Before using a brush, confirm that it is well drained of water, free of loose hairs, and use it when its bristles are soft.
- (9) Each brush should be exclusively used for a specific color.

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4.5 Preparation of paint

- (1) Since paint tends to form sediments at the bottom of a container, stir it sufficiently enough for the entire amount to become even in quality.
- (2) If the viscosity seems to be high, dilute the paint with a little amount of thinner of the same type to an appropriate level of viscosity. An excessive amount of thinner may result in the deterioration in the quality of the paint or the loss of its gloss. Furthermore, the addition of a different type of thinner would cause paint to undergo changes in quality, thereby making it impossible to use it.
- (3) Add a hardening agent of an amount as precise as possible, and mix it thoroughly.
- (4) The paint to be mixed with a hardening agent should be limited to the amount to be used for that day.
- (5) Required amount of paint

Approximate amount of paint can be calculated with following formula.

$$\boxed{\text{Total amount of paint}} = \boxed{\text{Theoretical proper amount by makers instruction}} \times \boxed{\text{Ratio of painting tools}} \times \boxed{\text{Area}}$$

EX : Maker's Instruction=0.55kg/cm²

Ratio Brush=1.2, Roller=1.3~1.4, Splay=1.6~1.7

Total for 50m²(Paint by Roller)=0.55 x 1.4 x 50 = 38.5kg

38.5 / 20 = 1.9 cans

Coating thickness is strictly observed in order to maintain the minimum paint thickness. Durability is proportional to the paint film thickness.

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4.6 Mixing Ratio

- (1) Mix 'paint plus a hardening agent' (set) with thinner of 5 to 10%
- (2) In the case of epoxy resin paint, the coating area per 1kg is follows:

Primary coating	4 to 5 m ²
Top coating	6 to 7 m ²

- (3) Paint brush (hand brush, roller brush)

Because of the strong adhesiveness of the paint itself, one tends to hold a brush with force and, therefore, the brush may have distorted and splayed bristles.

- (4) Even if the brush is washed very carefully with the same thinner after use, the bristles are liable to become hard.
- (5) The use of a spray gun surely enhances the efficiency of painting a wide area, but it takes time to put things in order after use. When using a spray gun, it is better to add a bit more volume of thinner in order to soften the hardness of the paint.

After the use of a spray gun, pour new thinner into the paint tank, to circulate in through for, preferably, more than 30 minutes (the maker recommends 15 minutes).

(Immerse the nozzle portion in the thinner even after the washing is over. Take away the nozzle portion, disassemble and wash it in the thinner with a brush. Put the end of the hose the tank and circulate thinner for cleaning purpose.)

4.7 Painting procedures

- (1) Start with places where it is difficult to paint, e.g., corners.
- (2) In the case of anti-corrosive paint, give two to three coats. As to the undercoating covering the coats of the second and thereafter, mix the paint with a small amount of another paint closer in color to that of the top coat, because it will not only hide the primary coat, and prevent areas left unpainted, but also make it easier for a painter to know the number of coatings so far.
- (3) It is generally an established practice to apply three coats of anti-corrosive paint to steel plates after they are scaled, and then, one to two top coats, only after they are completely dry.
- (4) When painting over previous coatings, be sure to do so only after undercoats become completely dried up.

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- (5) Care should be taken to maintain paint films at a uniform level, and not to leave brush traces.
- (6) As to touch-up painting, the wider the covered area, the better the finish will be obtained.
- (7) Care should be exercised not to leave unpainted areas in the hidden sides of pipes, electric wires, etc.
- (8) Add an appropriate amount of thinner and stir it up whenever paint has hardened due to temperature, wind, etc.

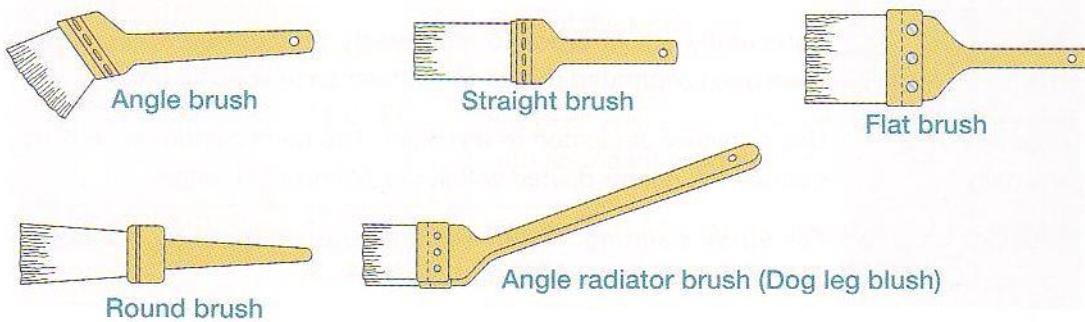
4.8 Checking items for safety during painting work

- (1) Do the workers know the properties of the paint to be used (such as flammability and toxicity)?
- (2) Are the necessary matters impressed on other workers and visitors? (Take such measures as posting notices, and stretching ropes, as the case may require.)
- (3) Are protectors properly used?
- (4) When working within a room or an enclosed space, is airing or ventilation being well maintained?
- (5) Are empty containers or used rags properly disposed of?
- (6) Is spilled paint or thinner left as they are without being wiped off?
- (7) Are the weather conditions good? Attention should be given to such factors as the ship's rolling and pitching, swells, weather and wind force, particularly when working outboard or aloft (including stepladders and ordinary ladders)?

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4.9 Kinds of paint brushes

(1) Type of Brush

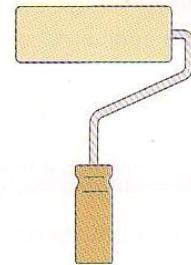


Selection of paint brushes

- The bristles have a gloss and a smooth feel.
- No broken as well as inverted hairs. Moreover, no loose hairs even against a shock
- The tips of bristles fall in line when soaked with a solvent and shaken.

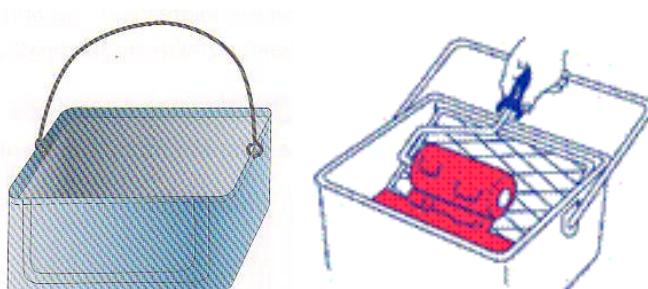
(2) Roller Brush

- Roller painting is a suitable method for coating places where it is not so wide for spray-painting or it requires excessive time by the brush-painting.
- A roller with a length of 200mm is easy to use
- A mini-roller is convenient for those who are not good at brush painting.



Paint can for roller brush

Make a convenient container out of empty can for thinner, etc.



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4.10 Painting

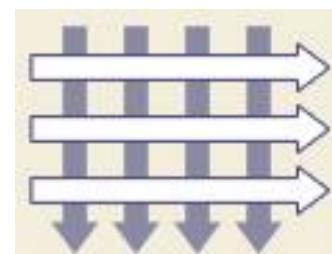
(1) Brush painting

- 1) Hold the handle of brush at a spot slightly above its center. Avoid holding it too tightly.
- 2) Relax your wrist and elbow to enable them to move easily.
- 3) Dip 1/2 or 2/3 of the length of bristles of the brush into paint, thereby to allow the tips of the bristles to become evenly soaked with paint.
- 4) Start painting after squeezing extra paint out of the bristles by pressing against the edge of a container, exercising care to prevent bristles from touching the inside surface of the container. In the case of slow-drying paints, such as oil paints and anti-corrosive paints, cover the object with these paints by moving your brush in every direction so that the paint may be evenly spread.



① Laying on (distributing work)

Distribute an equal amount of paint for each coating surface.



② Spreading work

Spread the paint so distributed on the entire coating surface (horizontal direction).

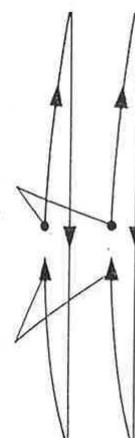


③ Laying off (finishing work)

Make the traces of brush uniform as the finishing coat of the spread paint (vertical direction).

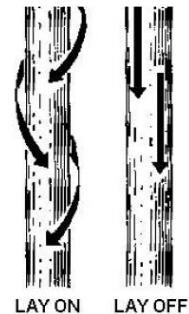
In the case of coating with quick-drying paints, such as synthetic resin paint, objects can be finished by painting in the vertical direction according to the width of the brush.

N.B.: Generally, the paint is distributed in the shape of 'W', and finish is obtained by painting vertically, horizontally and then vertically. The standard which is used as a yardstick is laterally 50cm and longitudinally 100cm.



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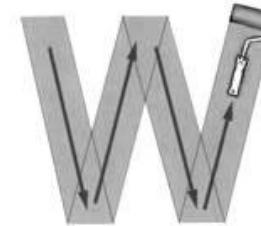
- 5) When painting pipes, stanchions, narrow strips, beams, and angles, lay the paint on diagonally. Lay off along the long dimension.



(2) Roller painting

1) Laying on (distribution)

Immerse a half of the diameter of a roller brush in paint and soak it with paint by rotating it.
Distribute paint by moving the roller in the shape of 'W'.



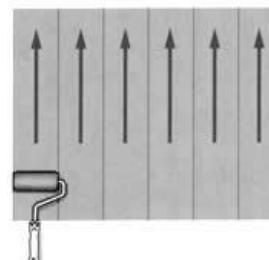
2) Spreading

Spread the paint with a light touch over a space as wide as about three to four times the width of the roller brush. Do this lightly at the start, then apply force gradually as if you squeeze out the paint.



3) Laying off (finishing work)

Level the surface of the coating of the paint by rotating the roller brush in a uniform direction, thereby to finish without leaving any overlapping traces.



(3) Air-spray painting

1) Preparation

- ① Check whether there is something wrong with the spray gun.
- ② Connection of each section.
- ③ Preparation of paint
- ④ Cleaning of the surface to be painted

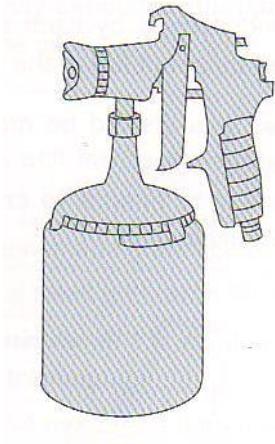
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2) Inspection

- ① Adjustment of air pressure (the pressure of general purpose air is set at 5kg/cm²)
- ② Check whether there is air leakage.
- ③ Confirm that the air cap and the air hole on the cap of the cup are not choked.

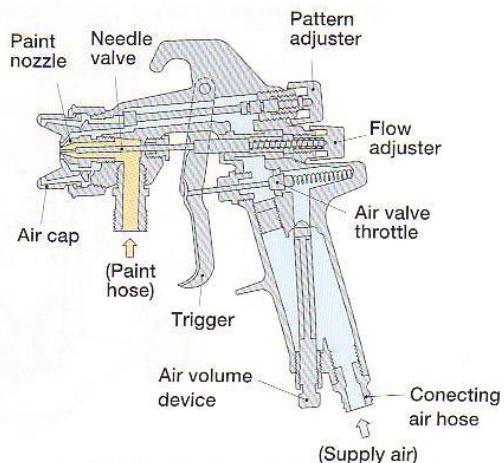
Suction Type

Paint is sucked at the mouth of gun.



Pressure Type

Paint is sent by compressed air from its tank to a spray-gun through a hose.



3) Pouring paint into the cup

- ① Pour paint up to 70 to 80% of the cup
- ② Keep your fingers off the trigger
- ③ Close the cap tightly

4) Adjustment

- ① Adjustment of the pattern (angle of spray)
- ② Adjustment of the volume of air
- ③ Adjustment of the spray volume

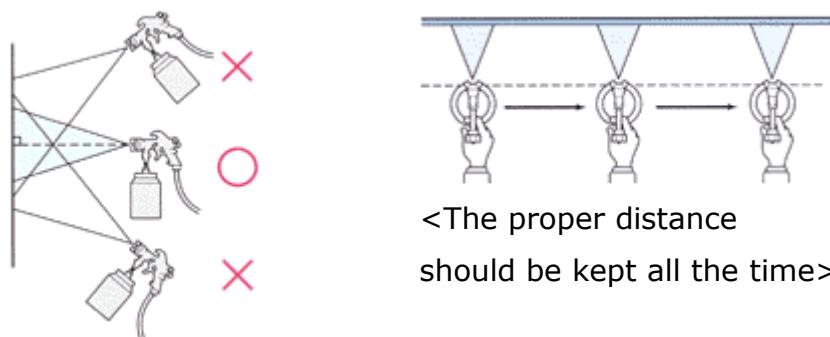
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5) Posture taking

- ① Decide the direction toward which the spray gun is moved
- ② Take a posture at the front of the object to be painted
- ③ Grip the handle and put the second joints of your forefinger and middle finger lightly on the trigger.
- ④ Hold the hose with your left hand

6) Spraying

- ① Decide the distance to the object to be painted
- ② For small-sized gun: 15 to 22cm
- ③ For large-sized gun: 20 to 30cm
- ④ Set the spraying angle at 90 degrees
- ⑤ Overlap coating about 1/3 or 2/3 of the width of painting and spread the paint evenly without spraying excessively.
- ⑥ Keep the moving speed of the spray gun at about 50cm per second



7) Cleaning of the air spray gun after use

- ① Pour thinner of the same type into the paint pot, and clean the spray nozzle thoroughly by spraying thinner
- ② Detach and disassemble the nozzle section and soak it in thinner
- ③ Clean it by using a brush after confirming that the paint has been dissolved. (Once paint adheres to the nozzle, it becomes inoperative)
- ④ Put the paint pot in place after soaking it in thinner and cleaning carefully

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4.11 Work after painting

- (1) Indicate the newly painted area by using chalk or rope and entry to the area should be prohibited until the paint becomes dry.
- (2) Soak a brush after use in thinner to prevent it from hardening, or wipe it off with rags after washing it with thinner, and stow away by hanging it in water.
- (3) As for paints whose containers or pots have been opened, put them in order by name and color after sealing them up.

4.12 Storage of Paint

It is normal for a ship sailing on a long trip to be loaded with a large quantity of paint to be used little by little. The method of storing paints on board the ship should conform to the following standards.

(1) Prevention of Paint Sedimentation in Long Storage

Paint stored for a long period usually suffers the sedimentation of its ingredients with greater specific gravity at the bottom of the can. Therefore, when paint is to be stored on board for a long period, the paint cans should be turned upside down once every three months or so, so that pigments may not be left as deposited at the bottom.

(2) Deterioration of Paint due to Long Storage

Paint usually degenerates when it is stored in excess of its specified shelf life, and therefore its quality should be checked before using after opening the can. Paint should be consumed within 6 months as pigments deposit or resins proceed with polymerization during the storage period, depending on the type of paint.

More specifically, since it is difficult to visually know whether or not liquid paint is normal, a very small amount of paint should be applied to an inconspicuous part to check its normalcy.

(3) Stirring of Paint

When paint is stored over a long period, it is normal for the composition of its upper and lower layers to vary as the component that is greater in specific gravity settles at the bottom of the can.

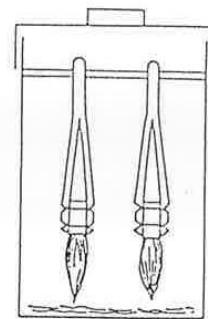
Therefore, when mixing a quantity of paint matching the area to be painted, be sure to thoroughly stir its ingredients to uniformity.

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4.13 Storing brushes (with no damage to hairs)

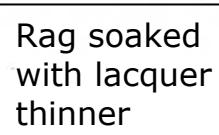
1) New brushes

After washing with water and drying in the shade, store new brushes by hanging in a dry place sufficiently apart from each other to prevent bristles from coming in touch.



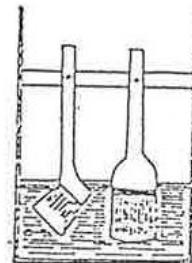
2) Brushes used for oxidation polymerization paints

Store them by color and type of used paint. First, remove paint by using thinner of the same type, and hang them in a container filled with semi-drying oil or water. Care should be taken to ensure that they are not exposed to air.



3) Condensation polymerization type paint

Since drying and hardening agents are contained in this type of paint, it is recommended that brushes be held in water after completely removing paint from brushes by washing to prevent it from hardening.



4) Volatile dry type paint

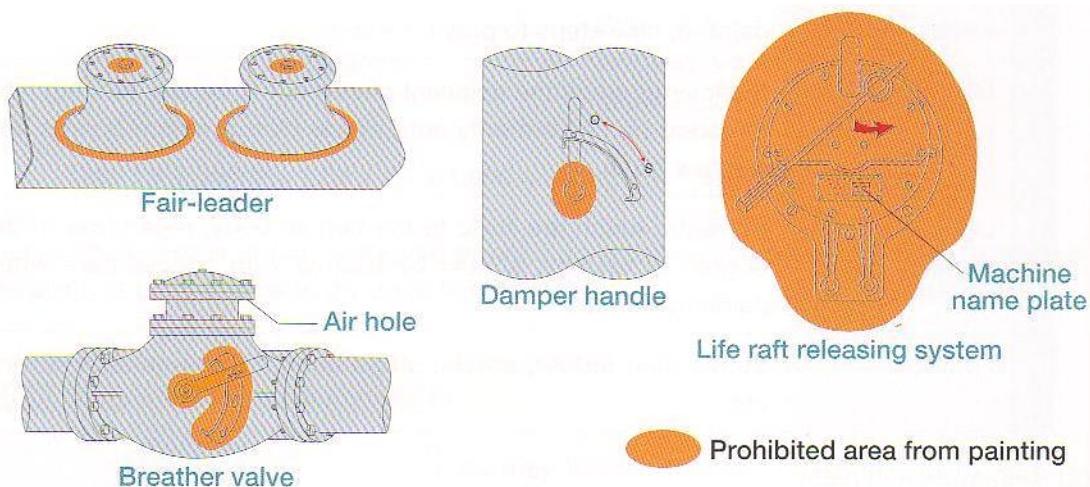
In order to prevent brushes from being dried up, brushes are stored in an airtight can in which a few rags are soaked with solvent are spread. In case where they are not to be used for a long time, store them after they are washed in a solvent, as well as in water, and dried up. Rags soaked with lacquer thinner.

4.14 Prohibition area from painting

There are many places in a ship where it must not be painted at all or not be painted out. Painting out for movable parts, name plates and safety marks brings about various problems. To avoid this "Painting Out", use various sizes (from small to large) of brushes which match the place to be painted properly. Using a masking tape is also useful. Sample of prohibited place for "painting Out".

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- Start-stop mechanisms of electrical safety devices and control switchboards on machinery.
- Bell pulls, sheaves, annunciator chains, and other mechanical communication devices.
- Exposed composition metal parts of any machinery.
- Identification plates.
- Joint faces of gaskets and packing surfaces.
- Lubricating gear, such as oil holes, oil or grease cups, zerk fittings, lubricators, and surfaces in contact with lubricating oil.
- Lubricating oil reservoirs.
- Machined metal surfaces of reciprocating engines or pumps.
- Rods, gears, universal joints, and couplings of valve operating gear.
- Ground plates.
- Springs.
- Strainers and sight glasses
- Threaded parts.
- Zinc.
- 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.
- Internal surfaces of ventilation ducts.



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4.15 Common defect of paint

A paint defect is in many cases due to a number of causes. In some cases, several defects may occur simultaneously and hinder the determination of the causes and redemption works.

To achieve good painting work, applicators and site supervisors should understand the causes and preventive measures of common defects that occur at different stages of works. They should also be familiar with the remedial measures that can be taken to rectify any unforeseen defect.

In general, paint defects can occur during:

- Paint storage
- Application, drying and curing
- Service life

(1) Paint compatibility

You should consider the paint compatibility to avoid the paint defect before applying the paint. Following table is just for your basic knowledge. Once you onboard, please confirm maker's specification. Each maker may have the different paint compatibility.

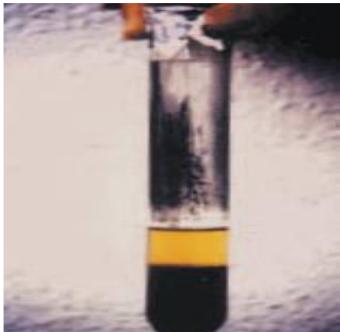
OVER →	ALKYD	CHLORINATED RUBBER	ACRYLIC	PURE EPOXY	EPOXY	URETHAN
UNDER ↓	ALKYD	CHLORINATED RUBBER	ACRYLIC	PURE EPOXY	EPOXY	URETHAN
ALKYD	•••	•	•	NO	NO	NO
CHLORINATED RUBBER	•	••	••	NO	NO	NO
ACRYLIC	NO	NO	•••	NO	NO	NO
PURE EPOXY	NO	•	•	••	••	••
EPOXY	••	••	••	••	••	••
URETHAN	NO	NO	NO	•	•	••

Rating : Best ••• Better •• Good •

NOTE : This chart is only for general guidance.
 For each vessel, maker's specification should be confirmed in advance.

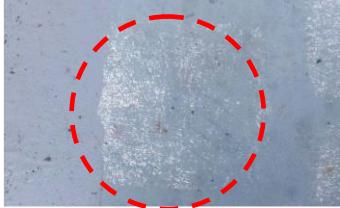
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(2) Defect and prevention during storage

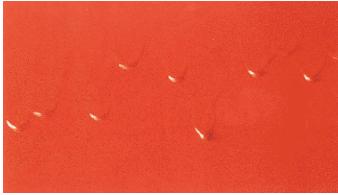
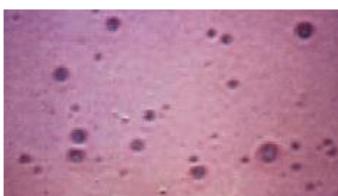
Defects	Causes	Preventive Measures	Remedial Methods
Skinning <p>Formation of a layer of skin on the container.</p> 	<ul style="list-style-type: none"> Use of non-airtight container Poor formulation such as lack of anti-skinning agent Storage under excessively warm condition 	<ul style="list-style-type: none"> Use airtight container Avoid unnecessary opening of can Store as recommended by manufacturer 	<ul style="list-style-type: none"> Remove the layer of skin and stir paint to homogeneous consistency Inform manufacturer for poor formulation Move to appropriate storage conditions as recommended by manufacturer
Gelling <p>Decreasing viscosity caused by bacterial degradation of the protein binder or other thickening agents.</p> <p>This is often accompanied by an offensive odour.</p> 	<ul style="list-style-type: none"> Use of contaminated tools and water / solvents Mixing of different brands or types of paints 	<ul style="list-style-type: none"> Use clean tools and water/solvents Avoid mixing different brands or types of paints 	<ul style="list-style-type: none"> Discard paint
Settling <p>Settlement of pigment to the bottom and failure to re-disperse.</p> 	<ul style="list-style-type: none"> Insufficient stirring during storage Storage for long duration or under excessively warm condition Excessive dilution or dilution with unsuitable materials 	<ul style="list-style-type: none"> Store as recommended by manufacturer Avoid direct sunlight and long storage Dilute with appropriate thinners as recommended by manufacturer 	<ul style="list-style-type: none"> Stir paint to a homogeneous consistency Employ mechanical stirring for heavy settling Move to appropriate storage conditions as recommended by manufacturer Discard paint

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(3) Defect and prevention during painting and drying

Defects	Causes	Preventive Measures	Remedial Methods
Bubbling <p>A flaw on a surface resulting when an applied substance does not adhere (as an air bubble in a coat of paint)</p> 	<ul style="list-style-type: none"> Directly painting after stirring it well High viscosity of the paint 	<ul style="list-style-type: none"> Do not stir strongly Make the paint thin and paint a thin layer 	<ul style="list-style-type: none"> Scrape the paint film off and paint again
Cob webbing <p>The expulsion of fibrous strands of dried or partially dried paint from a spray gun</p>	<ul style="list-style-type: none"> High viscosity of the paint Evaporation rate of the paint thinner is too high High pressure due to small nozzle of the spray gun 	<ul style="list-style-type: none"> Increase quantity of addition of the thinner Use the low evaporation paint thinner Use the spray gun with large nozzle for reduce the pressure 	<ul style="list-style-type: none"> If the condition of paint film is very poor, scrape it off and paint again
Flocculation <p>The new paint coat fails to fully cover the old coat, which remains visible. The color of the surface is uneven</p> 	<ul style="list-style-type: none"> Excessive add the paint thinner Layer of the paint film is not uniformity Not enough to stir 	<ul style="list-style-type: none"> Add the paint thinner appropriately Using brush strokes perpendicular and paint thick to avoid sagging Stir it well 	<ul style="list-style-type: none"> Grid it and paint again
Prolonged drying time <p>Paint is not drying for an appropriate time</p>	<ul style="list-style-type: none"> Low temperature, high humidity and poor ventilation Water or oil material 	<ul style="list-style-type: none"> Consider the painting environment Clean the surface before paint 	<ul style="list-style-type: none"> Scrape it off and paint again if it is not dry with leave long time

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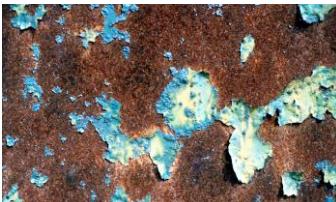
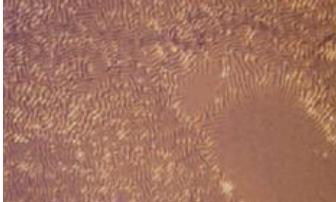
	<p>under the paint</p> <ul style="list-style-type: none"> • Use low evaporation thinner • Lack of hardener for two paints mix • Application of a coat of paint that is too heavy or overloaded 	<ul style="list-style-type: none"> • Use appropriate thinner • Add appropriate hardener and stir it well • Paint it following regular thickness 	
Sagging / Running <p>Flowing or dripping of paint from upper vertical surface to the lower part forming a tear-like or wavy appearance.</p> 	<ul style="list-style-type: none"> • Painting of excessively thick film layer at one time • Excessive dilution by thinner • Application of gloss paint on existing paints or surface without sanding 	<ul style="list-style-type: none"> • Increase frequency of painting thin film • Lower dilution ratio even where operability is poor • Sand and clean receiving surface before application • Apply with appropriate coat in accordance to manufacturer's recommendation 	<ul style="list-style-type: none"> • Remove paint film, sand, clean and re-paint as in "Preventive Measure"
Bleeding <p>Leaching out of the existing paint film.</p> 	<ul style="list-style-type: none"> • Frequent brushing on the same spot • Use of incompatible coats or thinner 	<ul style="list-style-type: none"> • Use proper application method • Apply with appropriate coat and thinner in accordance with manufacturer's recommendation 	<ul style="list-style-type: none"> • Allow drying before painting over with an appropriate "buffer" coat (refer to manufacturer's recommendation)
Crating <p>Formation of small bowl-shaped depressions.</p> 	<ul style="list-style-type: none"> • Painting over surfaces that are not prepared, e.g. sand, dirt and dust on the surface • Use of contaminated tools and water / solvents • much differences temperature between paint and surface 	<ul style="list-style-type: none"> • Sand and clean receiving surface before application • Apply with appropriate coat as recommended by manufacturer • Use clean tools and water/solvents • Heat the surface or paint to get similar temperature of them 	<ul style="list-style-type: none"> • Remove paint film, sand, clean and re-paint as in "Preventive Measure"
Blush mark	<ul style="list-style-type: none"> • Using short brush or 	<ul style="list-style-type: none"> • use good quality 	<ul style="list-style-type: none"> • Scrape or sand the

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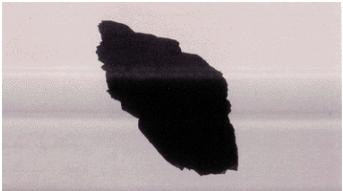
Remained brush mark and uneven the surface 	rough brush <ul style="list-style-type: none"> • lack of paint leveling (usually happen to compounding paint) • inappropriate thinner use 	brush <ul style="list-style-type: none"> • weaken by the varnish or thinner • use appropriate thinner 	surface and paint again
Orange peel Orange peel of a paint coat is a faulty finish of the coat surface having fine ruggedness like an orange skin. 	<ul style="list-style-type: none"> • use high evaporation thinner • high temperature surface or environment • spray gun distance or speed is improper 	<ul style="list-style-type: none"> • add appropriate thinner • consider the temperature condition • maintain the appropriate distance/speed from the spray surface 	<ul style="list-style-type: none"> • sand the surface to be smooth and spray on it again
Lifting Attacking by successive coating on existing paint. 	<ul style="list-style-type: none"> • Use of incompatible coats, which cause shrinkage of paint film or attacking of thinner on undercoat 	<ul style="list-style-type: none"> • Observe over-coating intervals as recommended by manufacturer • Allow undercoating to dry before application of successive coating • Sand and clean receiving surface before application • Apply with appropriate coat as recommended by manufacturer 	<ul style="list-style-type: none"> • Remove paint film, sand, clean and re-paint as in "Preventive Measure"

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(4) Defect and prevention after drying

Defects	Causes	Preventive Measures	Remedial Methods
Rusting rust colored stains on the paint surface 	<ul style="list-style-type: none"> improper surface preparation improper quality of paint 	<ul style="list-style-type: none"> remove the water, mill scales and other contamination from the surface choose appropriate paint 	<ul style="list-style-type: none"> Remove metal parts and treat the metal surface Clean the walls and prepare the surface to receive painting Repaint with appropriate system
Wrinkling Formation of undulating wrinkling film. 	<ul style="list-style-type: none"> Application of thick Oil-Alkyd, which causes shrinkage of paint film. This tends to occur when drying is expedited at high temperatures Painting over insufficiently dried paint 	<ul style="list-style-type: none"> Sand and clean receiving surface before application Apply with appropriate coat in accordance with manufacturer's recommendation Avoid accumulation of paint around bolts, angles, etc. Observe over-coating intervals in accordance with manufacturer's recommendation 	<ul style="list-style-type: none"> Remove paint film, sand, clean and re-paint as in "Preventive Measure"
Loss of Gloss Reduction of lustre on drying caused by severe absorption of undercoat.	<ul style="list-style-type: none"> Application on rough or unclean surfaces Inadequate or excessive dilution Use of unsuitable thinner Application of excessively thin film Result as blushing occur Drying occurs in the presence of excessive moisture and pollutant 	<ul style="list-style-type: none"> Increase frequency of painting in thin film Paint adequate thickness of film Use appropriate thinner as recommended by manufacturer Avoid painting at high humidity Prepare receiving surface and apply appropriate sealer 	<ul style="list-style-type: none"> Remove paint film, sand, clean and re-paint as in "Preventive Measure"

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Scaling / Peeling <p>poor adhesion is characterized by the paint peeling and separating from an earlier paint layer</p> 	<ul style="list-style-type: none"> paint over a surface or prior paint film that have oil, water or rust the undercoat is incompatible with the finish coat following wrong process of paint (e.g. paint vinyl paint as undercoat) mix the different kind of paint paint the excessive smooth metal surface 	<ul style="list-style-type: none"> proper preparations or cleaning of surface consider the compatibility with finish coat and undercoat follow the correct process of paint do not mix with products from different manufacturer apply sand paper and sandblast to the surface 	<ul style="list-style-type: none"> Arrest moisture source Prepare and treat the surface Repaint on receiving surface with moisture content not exceeding 6% (or refer to manufacturer's recommendation)
Chalking <p>Natural ageing of paint. The extent of chalking will depend on paint formulation and surface exposure to weather.</p> 	<ul style="list-style-type: none"> Use of non weathering resistant paint 	<ul style="list-style-type: none"> Use weather resistant paint for areas exposed to weather or UV 	<ul style="list-style-type: none"> Prepare surface and repaint with appropriate system
Blistering <p>This is a moisture-related phenomenon. The amount of moisture and flexibility of the paint film determine the size of the blister.</p> 	<ul style="list-style-type: none"> Painting on a warm surface Moisture migration through painted surface 	<ul style="list-style-type: none"> Paint on receiving surface with moisture content not exceeding 6% (or refer to manufacturer's recommendation) 	<ul style="list-style-type: none"> Remove defective paint and prepare surface accordingly to receive paint Repaint on receiving surface with moisture content not exceeding 6% (or refer to manufacturer's recommendation)
Cracking <p>The undercoat cracks as its surface contracts or</p>	<ul style="list-style-type: none"> only surface-dry condition due to paint thickness 	<ul style="list-style-type: none"> do not paint thick paint finish coat after undercoat dry 	<ul style="list-style-type: none">

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expands.	<ul style="list-style-type: none"> paint the finish coat with lack of dry of undercoat the undercoat is incompatible with the finish coat sudden drop in temperature 	<ul style="list-style-type: none"> consider the compatibility with undercoat and finish coat put off painting if expecting to drop in temperature 	
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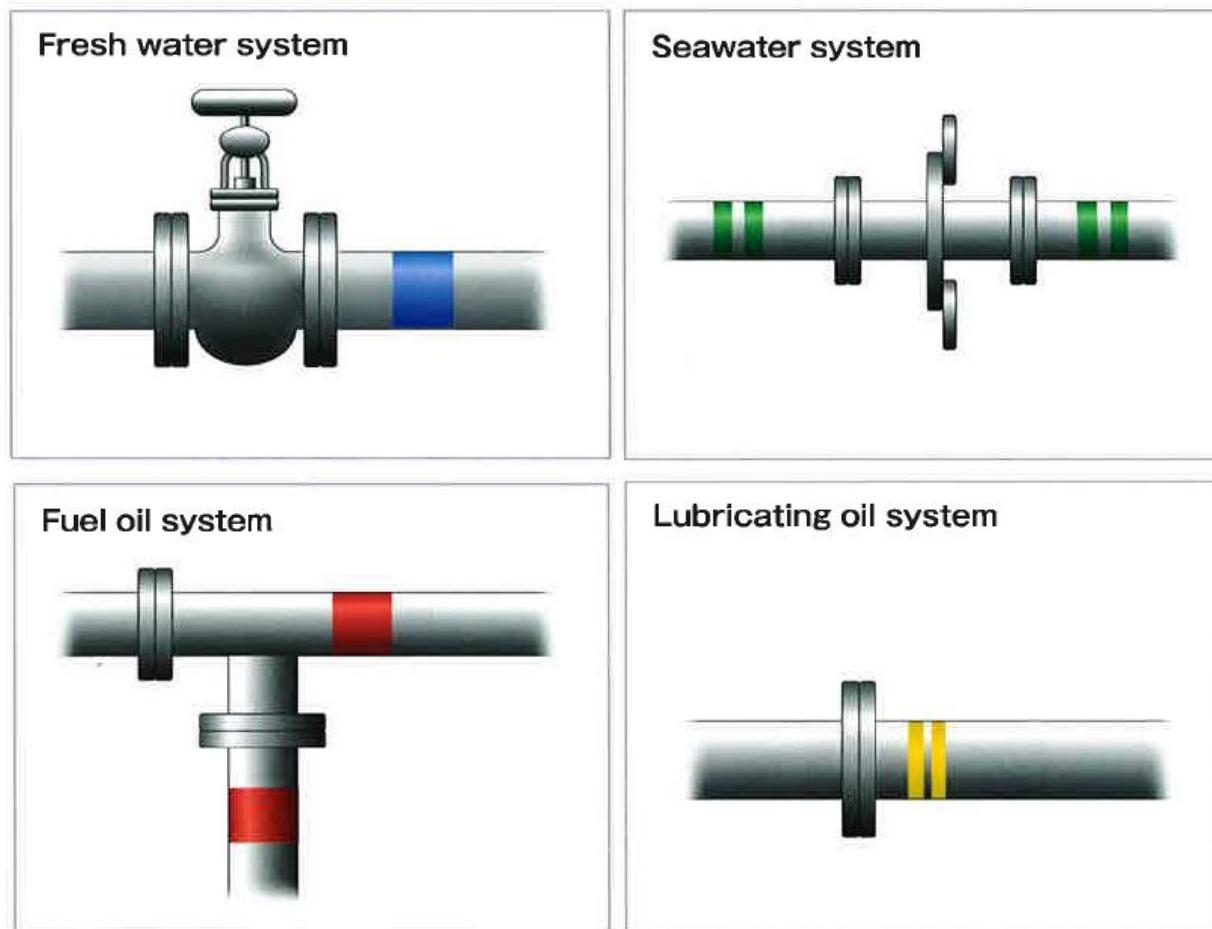
4.16 Marking of Pipes

Colors are used to identify and indicate the types of fluids following through piping systems. Piping systems handling fluids are identified by type through the use of colored paint or tape. The colors used to identify the fresh water, seawater, compressed air, steam, fuel oil, lubricating oil, bilge, exhaust gas, oxygen, acetylene gas (for gas welding), inert gas, and fire extinguishing systems are shown in bellow by type of fluid.

For indication systems, the color is would around pipes in distinct ring; the specified ring widths and number of rings are shown in next page.

These color rings are positioned at specific locations along the system – e.g. near valves, joints, bulkhead and so on.

When it comes to the fire extinguishing system, all valve handles, valve bodies and covers must be painted red.



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NYK STANDARD PIPING COLOR CODE

KINDS OF LINE		COLOR & DISTINCTION		Remarks (Muncell Color System) (Marking of piping)
FLUID	REFERENCE LINE			
FRESH WATER	FRESH WATER LINE (Including Fresh Water Fire Line)	BLUE		Blue 2.5PB 3.5/10, 50mm x 1 Blue stripe
Drinking Water	DRINKING WATER LINE	BLUE		Blue 2.5PB 3.5/10, 20mm x 2 Blue stripe
COOLING WATER	COOLING FRESH WATER LINE	BLUE		Blue 2.5PB 3.5/10, 50mm x 1 Blue stripe
Feed Water Condensate Water	FEED / CONDENSATE WATER LINE	BLUE		Blue 2.5PB 3.5/10, 20mm x 2 Blue stripe
SEA WATER	COOLING SEA WATER LINE	GREEN		Green 2.5G 4/5, 50mm x 1 Green stripe
	SEA WATER (FIRE LINE & DECK WASHING LINE)			Green 2.5G 4/5, 20mm x 2 Green stripe
	BALLAST LINE			Green 2.5G 4/5, 200mm x 2 Green stripe
FUEL OIL	F.O. LINE	RED		Red 7.5R 4/14.5, 50mm x 1 Red stripe
	D.O. LINE / G.O LINE	PINK		Pink 5PR 6/10, 20mm x 2 Pink stripe
LUBRICATING OIL	LUBRICATING OIL LINE	YELLOW		Yellow 2.5Y 8/12, 50mm x 1 Yellow stripe
HYDRAULIC OIL	HYDRAULIC OIL LINE	YELLOW		Yellow 2.5Y 8/12, 20mm x 2 Yellow stripe
STEAM	STEAM LINE	SILVER		50mm x 1 Silver stripe
	EXHAUST, DRAIN LINE			20mm x 2 Silver stripe
AIR	COMPRESSED AIR LINE, CONTROL AIR LINE	GRAY		Gray N6.5, 50mm x 1 Gray stripe
BILGE	BILGE LINE	BLACK		Black N1.5, 50mm x 1 Black stripe
	HOLD BILGE LINE			Black N1.5, 50mm x 1 Black stripe
Fire Fighting Line*	All Lines related Fire Fighting	RED		Red 7.5R 4/14.5, 50mm x 1 Red stripe
Acetylene Gas	ACETYLENE GAS LINE for Welding	RED		Red 7.5R 4/14.5, All Piping surface Red
Oxygen Gas	OXYGEN GAS LINE for Welding	BLUE		Blue 2.5PB 3.5/10, All Piping surface Blue

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5. HANDLING ROPES & WIRES

(Reference : ZZ-S-P-10.30.04)

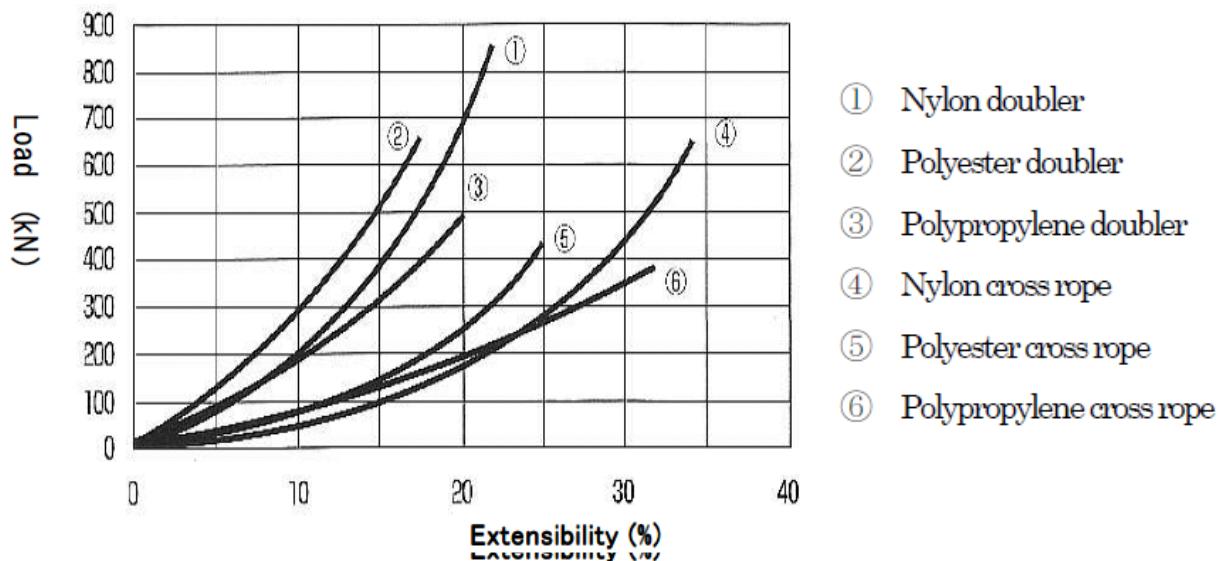
Ropes have a variety of usages on board a ship. Ropes were the most highly seen equipment on a ship's deck in the olden days. Though technology has reduced their usage to a certain extent, ropes still have many important applications in a ship's operation.

Some synthetic fiber ropes restore much of their original length rapidly once they are relieved of load, while others do so only gradually. The greater the rate of extensibility, the closer the return of the rope to its original length, thus, the crew should have sufficient knowledge of the

characteristics of the different types of ropes in order to use them properly.

Since simultaneous use of mooring lines differing in extensibility might invite concentration of the load on less extensible lines, care must be generally taken not to use mooring lines of different materials.

(Load/extensibility curves of different mooring lines [60 mm in thickness])



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5.1 Fiber Rope

(1) Type and Structure

	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

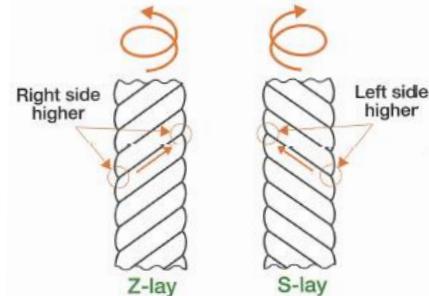
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(2) Lay of rope

A fiber rope consists of strands made up of fiber yarns twisted and layed into rope form.

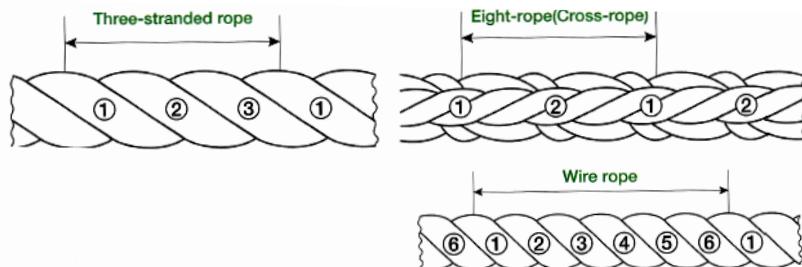
A strand is made by twisting yarns and a rope is made by twisting strands. There are two types of lay dependant on the direction of twist, Z-lay and S-lay.

When you see a rope and you can see "Z" on the rope as shown in, the rope is called Z-lay rope. On the contrary, when you can see "S" on the rope, it is called a S-lay rope.



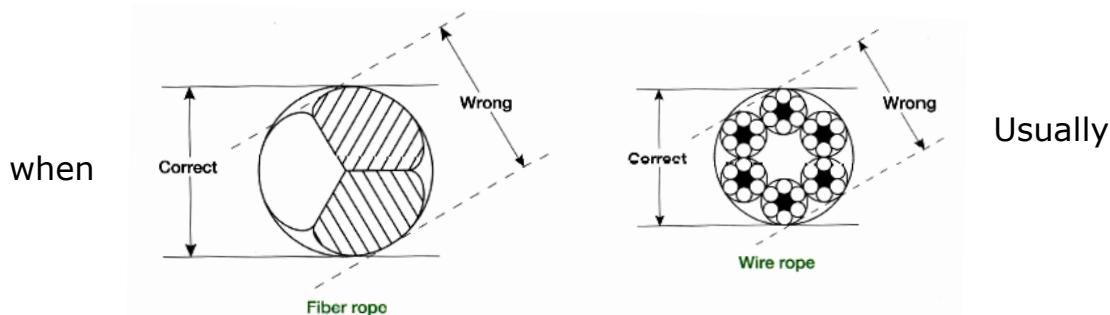
(3) Length of one lay: Pitch

To measure length between top and top of the same strand.



(4) Diameter

To measure length between top and top of the same strand.



measuring the diameter of a new rope, it is larger than the said standard. (Permissible range is $\pm 7\%$.)

- If you take a standard 18mm new rope and measure the diameter, it will show about 19mm.
- Generally the width of thumbnail of adult is 16mm.
- Length of rope: The standard length of a coil of rope is 200m.

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(5) Weight of rope

Weight of a coil of rope with a diameter of d mm.

(Formulae for rough calculations)

- Manila rope $d^2 \times 0.15$ (Kg)
- Wire rope $d^2 \times 0.7$ (kg)

(6) Strength

There are 3 methods of indicating strength; breaking strength, safe working load, tasting load.

Breaking strength (Metric tons)

- Manila rope $(D / 8)^2 \times 1/3$ or $C^2 \times 1/3$
- Wire rope $(D / 8)^2 \times 2.0$ (or 2.5) or $C^2 \times 2.0$ (or 2.5)

D: Diameter, C: Circumference

Coefficient of wire rope (2.0-2.5) varies with regulations and/or structure of strand.

Safe working load is 1/6 of breaking strength.

Safe working load shall be 1/10 and less of breaking strength when using it to hoist a person.

(7) Characteristics

Friction causes deterioration consequently and reduces the strength.

- Different materials (20mm in Diameter)

Material of rope	Breaking strength (M/T)	Safe working load (M/T)
Manila rope	2.08	0.34
Nylon rope	5.20	0.86
KUREMONA rope	2.70	0.45
Pylon rope	3.10	0.51
Wire rope	15.60	2.60

	Strength ratio	Expansion limit	Specific gravity	Characteristics
Manila	100%	Abt 16-20%	1.45	
Nylon rope	250%	Abt 40-50%	1.14	Large expansion Good restoration
KUREMONA rope	130%	Abt 25-30%	1.26	Less tensile Heavy
Hyzex rope	130%	Abt 25-30%	0.95	Light and floats in water
Pylens rope	150%	Abt 35%	0.91	Lightest
Tetron rope	180%	Abt 25-30%	1.38	Heavy

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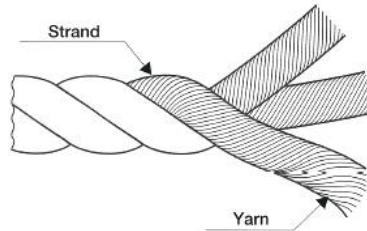
5.2 Rope Type Determined by Lay and Structure

(1) 3-stranded rope

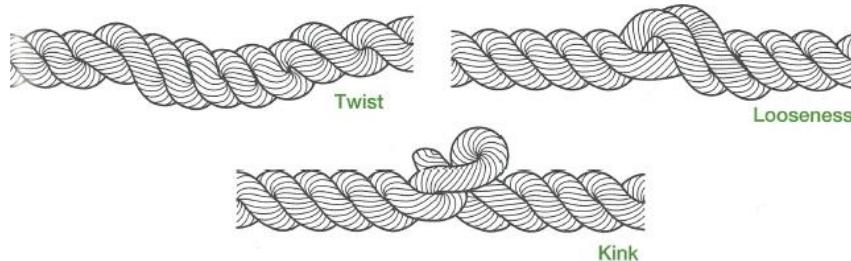
Z-lay is mainly used on board.

This type is no longer used aboard large merchant vessels.

A rope is easily kinked when twisted.

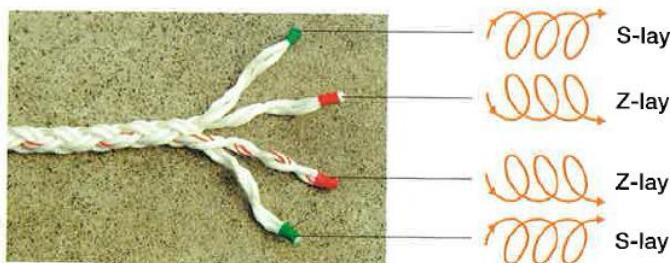
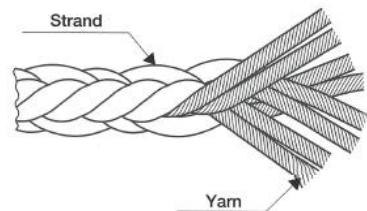


Once twisted or loosened, it should be removed or reformed, otherwise it will kink.



(2) 8-rope/Cross rope

In comparison with 3-stranded rope, this rope is more supple and kinks less and also more flexible. Its strength is comparable to a 3-stranded rope. Different from 3-stranded rope, each strand of cross-rope is differentiated by its twist as S-lay, Z-lay.

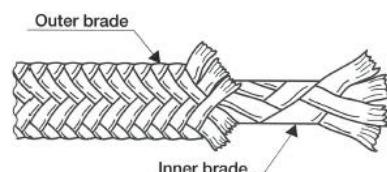


(3) Double braided rope

This rope is easy-handled, good flexibility and less-deformation.

Breaking strength is remarkably improved.

It is called 'Tafle Rope' or 'Doubler Rope' by each manufacturer.



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5.3 Handling and Stowing Ropes

(1) Selection of rope

The safe working load of any rope should always be observed, bearing in mind the more it is used, the more it deteriorates.

Ropes used for Bosun's chair, where the safety of life is involved, shall be used exclusively and kept with a tag to avoid being used for other jobs.

Proper ropes for the job. Avoid multi-purpose usage.

Rope ends should be either whipped with a twice or plastic tape temporarily.

(2) Stowage

Regularly check the condition of the rope when stowed under canvas.

Be aware of a humid locations when stowing ropes.

Ropes kept on deck for a long time will deteriorate.

Keep ropes away from chemicals.

(3) How to uncoil new rope

There might be many methods to uncoil ropes. But you have to select the correct way to do the job safely and to avoid kinks. For example, it will be a large scale job when we uncoil mooring ropes and wires. And we need to remove twists from 3-strand ropes or wires that are always likely to be twisted.

- Coil with a wooden reel

This is suitable for uncoiling mooring ropes wound around a wooden reel.

Insert a steel pipe and keep it on a strand, or hoist by crane.

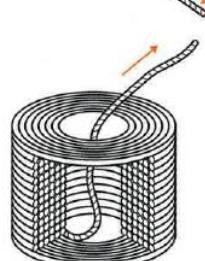
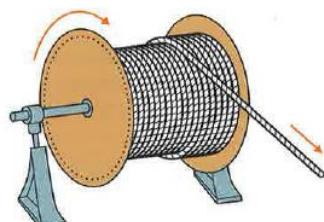
- Non wooden reel

Cross timbers and hoist it with a wire sling.

Steel bands binding the coil should be cut after hoisting it.

- Other than big mooring ropes

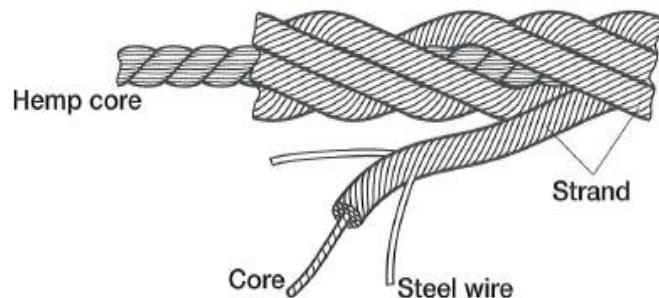
This method is applied when an ordinary size of fiber rope is uncoiled. (Do not use this for wire rope.)



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5.4. Wire Rope Structure

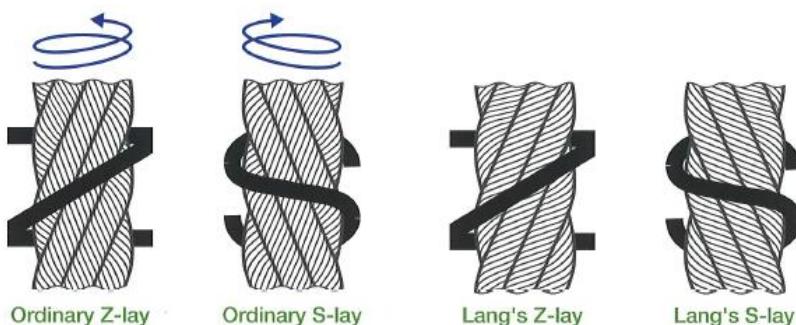
(1) Name of each part



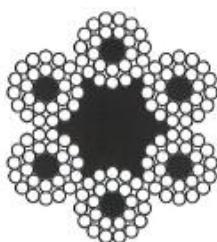
(2) Lay

The "ordinary lay" has the lay of the rope opposite to that of the strand. The most standard ropes found on board vessels are those of "ordinary Z-lay"

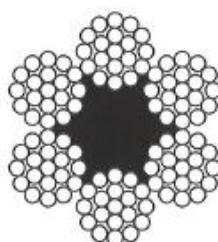
The Lang's lay rope has the same lay of the rope as that of the strand and has the tendency to unlay and is liable to kink. It is used in places where both rope ends are unlikely to rotate freely or the rope is kept tensioned at all times. It should not be used for general slinging.



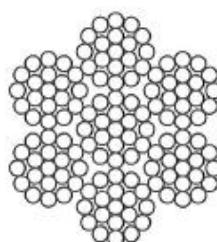
• Cross section



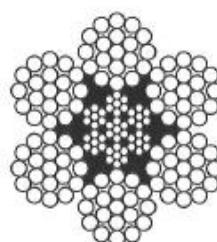
Core of each strand as well as the core of the wire rope is a fiber core mostly on a ship.



There is no fiber core in a strand. This is used for standing wire.



There is no fiber core in a strand. Wire core is used in the center of mooring wires.



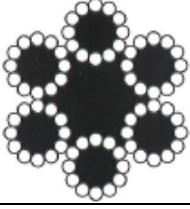
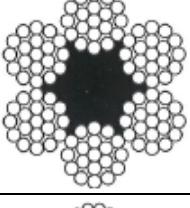
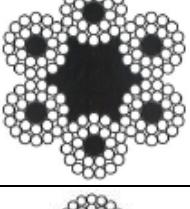
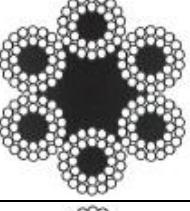
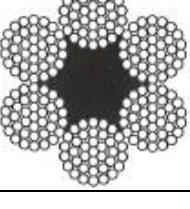
A strand is used as the core of rope (homo-centric). Used as the wire for suspension bridge.

• Structure of cross section

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Of JIS (Japanese Industrial Standard), No.1 to No.23 wire ropes, the following figure shows No.1 to No.6 wire ropes.

No.4 wire rope is mostly used for general and marine purposes.

No.	Cross Section	Symbol for Structure	Structure	Use
No.1		6x7	7-stranded wire, 6 stranded rope with fiber core	Standing wire
No.2		6x12	12-stranded wire with a fiber core, 6 stranded rope with fiber core	Running wire
No.3		6x19	19-stranded wire, 6 stranded rope with fiber core	Standing wire Running wire
No.4		6x24	24-stranded wire with a fiber core, 6 stranded rope with a fiber core	Standing wire Running wire
No.5		6x30	30-stranded wire with a fiber core, 6 stranded rope with a fiber core	Standing wire Running wire
No.6		6x37	37-stranded wire, 6 stranded rope with a fiber core	Running wire

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(3) Strength

- Strength by experiment

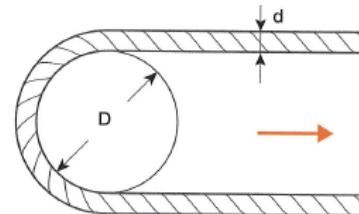
Although wire ropes are very strong when they are kept straight and gradually pulled, if they are pulled with sharp bends, the strength reduces to half of its original one.

$$\frac{\text{Strength in a bent condition}}{\text{Strength in a straight condition}} \times 100\% = \text{Strength Ratio}$$

- Pulling test

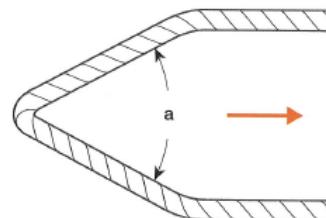
Pulling rope around a bend

D: Diameter of roller	Strength ratio in %
d: Diameter of rope	
2	53
6	70
10	79
14	86



Pulling rope around a sharp bent

Angle	Strength ratio in %
45°	53
60°	60
90°	65
120°	70



Pulling when kinked

When kinked, it reduces the ratio by more than half. When a rope is kinked, it should not be used.



- Causes of damage
 - The sheave does not rotate.
 - The groove of sheave has worn out.
 - The diameter of sheave is too small.
 - When a kink is formed.
 - When a rope is bent at sharp angles.
 - When load exceeds than that specified for the rope.

Above careless handling and insufficient daily check worsen the condition of ropes, and that lead to serious accidents/injuries.

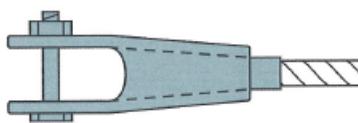
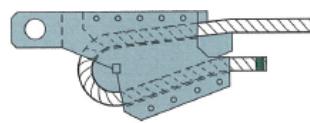
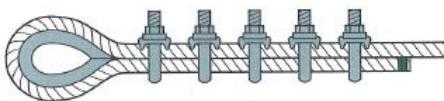
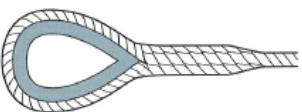
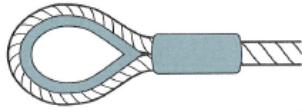
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5.5 Treatment of Wire End

(1) Strength by experiment

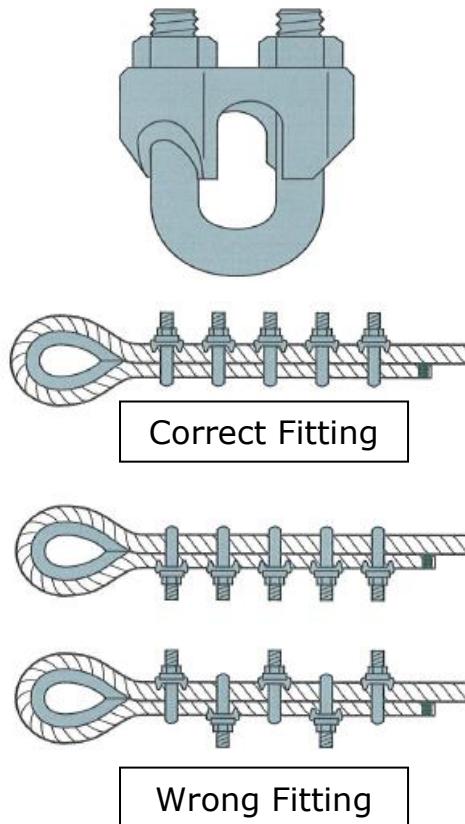
$$\frac{\text{Strength of the treated part}}{\text{Strength of wire rope}} \times 100\% = \text{Strength Ratio}$$

(2) Method of treatment

Types of treatments	Strength ratio (%)
Socket metal	100
End of the rope being untwisted is with lead and tin fixed by a socket.	
Wedge treatment	65 to 70
Pulling load tightens the wedge.	
Clipping	80 to 85
Treated by pieces of clip.	
Eye splicing	75 to 90
Most common and traditional method on board. The eye spliced portion should be made properly so that each strand may fit comfortably with each other, without any raised part. Rough eye splicing may drastically decrease the breaking strength.	
Press-ring	100
Squeezed with aluminum alloy sleeve.	

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(3) Clip treatment

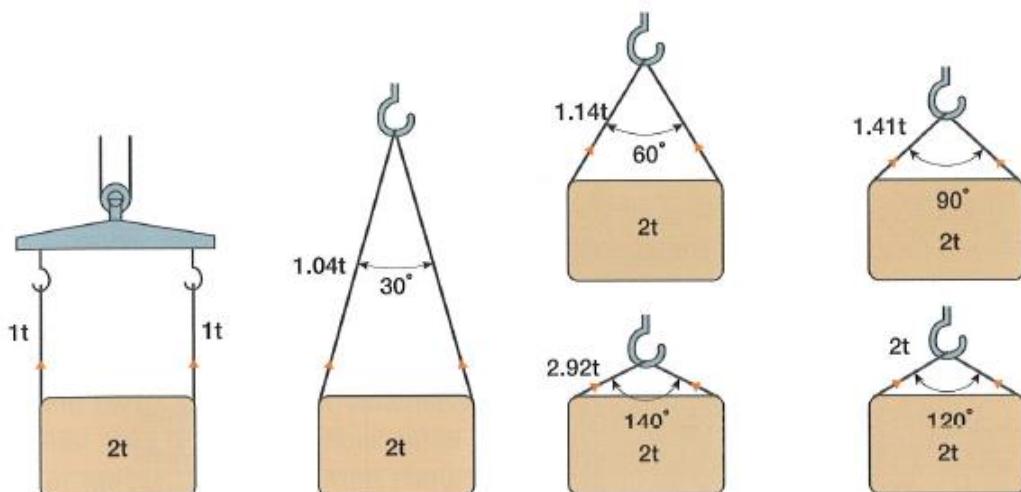


- Clips should be correctly fitted and secured sufficiently tightening the nuts.
- They should be tightened again after the rope is tensioned.
- Arrange and fit U-bolts on the end side of the rope with same intervals.
- Tighten U-bolt equally.
- Care should be taken so that the number of clips fit may be sufficient. A rule of thumb is about 4 units for 10 to 16 mm wire, and 5 units for 20 mm wire.
- If the U-bolts are fit in the opposite direction, the rope is pressed by the U-bolts, reducing its breaking strength.
- This method is seldom applied for slings.

5.6 Handling

(1) Tension imposed on wire sling

The tension applied to sling greatly varies, depending on the angle of hosting; the hoisting angle should be less than 60°.



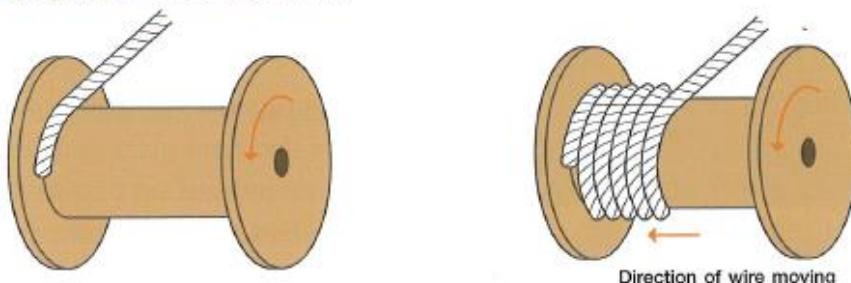
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(2) Winding on a wire drum

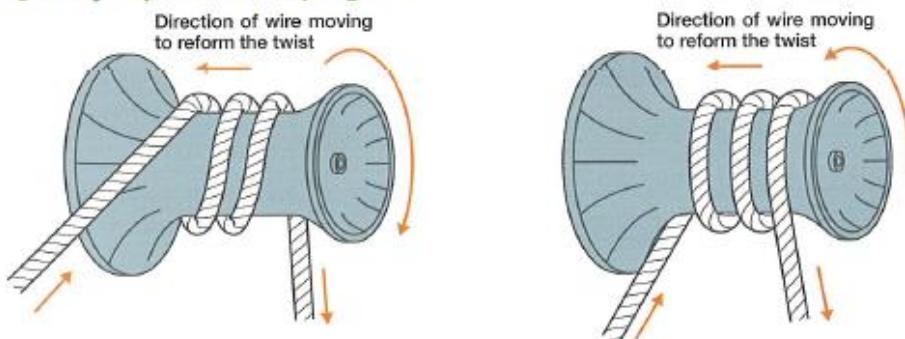
Tension on a wire rope will make it twist in its natural direction. This tendency should be used when stowing on a drum in order to maintain the evenness on it. The first layer serves as the base and guides the following layers to wind on correctly.

The winding direction on a mooring which is decided by the mechanism of its break system.

Winding Z-lay rope on a wire drum



Winding Z-lay rope on a warping end



(3)

Wire ropes gradually reduce in strength whilst in use. The same location is likely to be damaged by the drum or heave and they need to be partially cut or turned end for end.

Although it is difficult to set a standard guide to replacement of wires, according to fractures wires, excessive wear, deformation or rot, a rule of thumb is said to be as follows;

- Broken wires

Referring to the following table, decide whether usable or not, according to the situation of broken wire, i.e., whether concentrated or distributed among all strands of the rope.

Kind of wire rope (No. of strand x No. of yarn)	Distributed broken wires in one pitch	Concentrated broken wires in one strand
6x19	12 wires	5 wires
6x24	15 wires	6 wires
6x37	23 wires	9 wires

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- **Wear Down**

When wear down is easily observed visually, you should not use it.

If the measured value of the diameter has reduced to below 93% of the nominal one, it should not be put to use again.

Measure the diameter from 3 directions at a portion where the diameter has reduced; and the diameter is represented by their arithmetical average.

- **Deformation**

Wire ropes which have shown such symptoms as follows should be taken out of use.



wire rope which has kinked



wire rope whose core has protruded



wire rope whose strands have loosen and been raised

Prohibition of use of unsuitable wire ropes by safety regulations for cranes, etc.

- Wire ropes whose yarns have been broken to 10% of the total number within a pitch.
- Wire ropes whose diameter has reduced by 7% or more of nominal one.
- Wire ropes which are conspicuously deformed or corroded.

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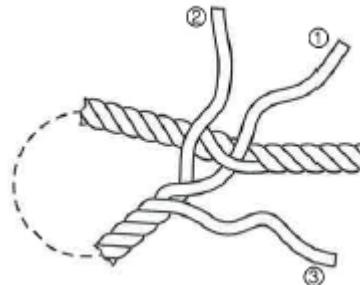
- Others
 - Date of replacement of wires being used for cranes, mooring lines, lifeboats and so on shall be recorded and inspected periodically, so as to find abnormality in early stage.
 - Greasing prolongs the wire ropes life by up to 2 to 3 times compared with no grease.
 - The most important thing to prevent kinking is to find signs of kinks and prevent them.
 - It is rather belated to notice the internal corrosion in the portion of a wire rope where serving is applied. At portions where waterproof covering is provided, corrosion develops more quickly than one may think, when they run out of grease. (The same care should be required for turnbuckles which are provided with waterproof covering.)
 - Wire ropes sometimes part instantaneously. But in many cases, wire ropes spring back while some of the strands parting and unlayed.

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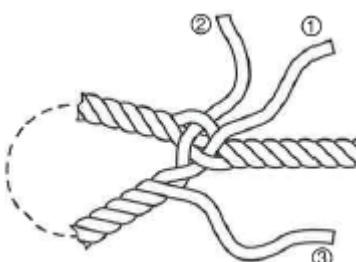
5.7. Splice for 3-Strand Rope

(1) Eye Splice

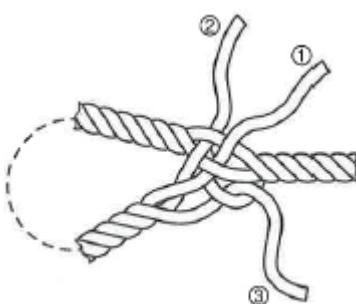
- 1) Loosen strands. Insert a spike from right toward left at place of the end. Insert strand ①. (Do not tighten it.)



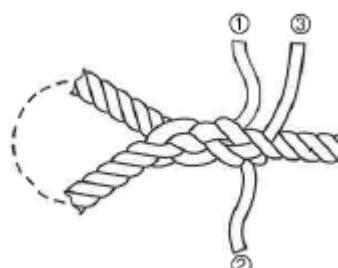
- 2) From the place of ① coming out, insert spike into the next strand to insert ②. (Do not tighten it.)



- 3) Turn over all. From the place of ②. Coming out insert spike into the next strand to insert ③. It is correct when each strand comes out from different ditch. Then, insert ③②① and tighten accordingly.



- 4) From the second insert, any of strands can be inserted next order. Insert a strand beyond the next strand. (5 tucks are preferable.)



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(2) Eye Splice with a thimble

- 1) Method is the same as making eye splice.

Measure length of circumference of the thimble.

Insert a spike from right to left at the point of length of the circumference from the point of loosening strands. Insert strand ①.



- 2) From the place of coming of ① coming out, insert spike into the next strand to ③ insert ②. (Do not tighten it.)



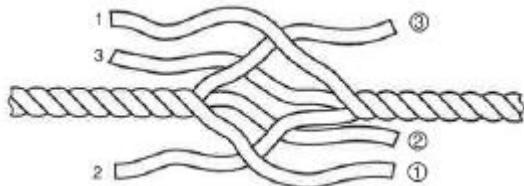
- 3) After 5 times inserting and cutting rest of strands, apply serving or taping.



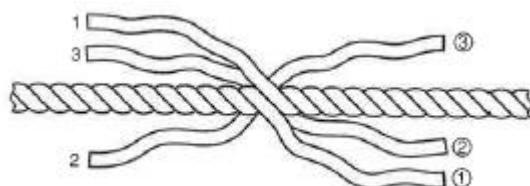
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(3) Short Splice

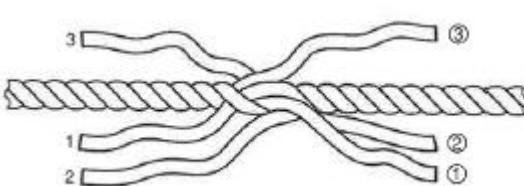
- 1) Combine strands each other.
(Left-in, Right-out)



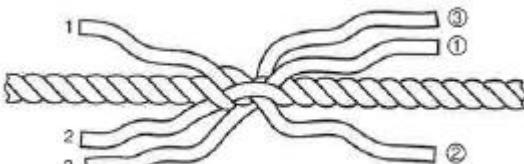
- 2) Closer each pair. Working end ①②③ are to be taped together with main rope in order to avoid loosening.



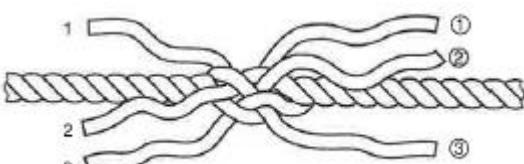
- 3) Insert 1 into next strand holding it by its pair strand ①. (Do not tighten before all of 3 strands first tuck finished.)



- 4) Insert strand 2 holding by strand ②.



- 5) Insert strand 3 holding by strand ③. It is correct when each strand comes out form different ditch. After inserting all of 3 strands, tighten up and apply tape all together with main rope.



- 6) Remove the first taping and do the same. Tighten both sides. Make insertion more than 3 times for each strand and adjust and smoothen splice.

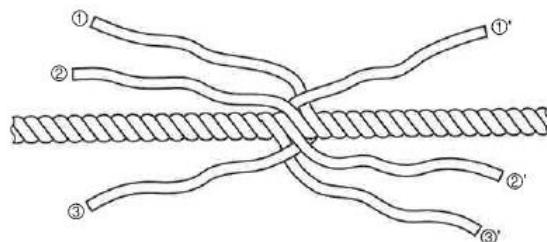


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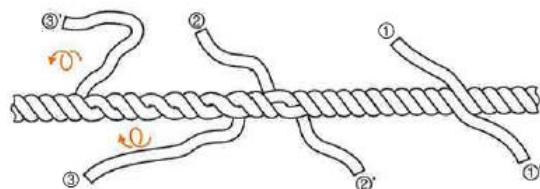
(4) Long Splice

This splice is used when the part of splice can not be as large as short splice. The length of the part of splice is longer than short splice. For a small size diameter rope, the length of strands needed is about 1.5m-2m. Large size diameter rope will need more than 3 m.

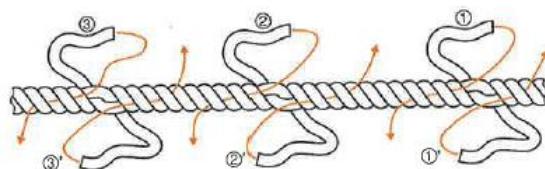
- 1) Combine strands each other (Left-in, Right-out). Unite ① rightward and wind ①' toward the place of united ①.



- 2) Untie ③' leftward and wind ③ toward the place of united ①.



- 3) ② & ②' are united with a half hitch instead of untie.



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5.8 Splice for 8-Strand Rope

(1) Eye Splice



- 1) Measure a length of the rope from the working end and tape the same. Open the rope by way of strand pairs. i.e. S-lay and Z-lay strand pairs up to the point where tape had been applied up strands pairwise. Culminate by placing S-lay pairs 'right in left out' and tape along working end.

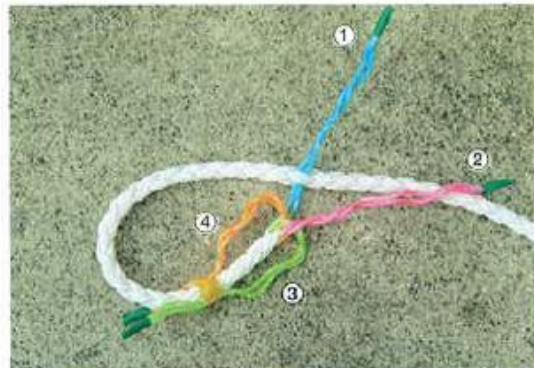


- 2) Decide the size of the eye splice. (Inserting order is ①②③④.)

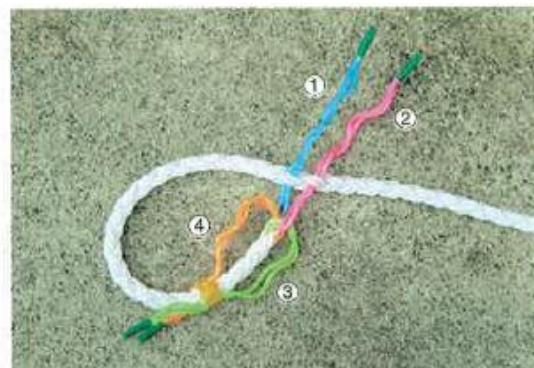


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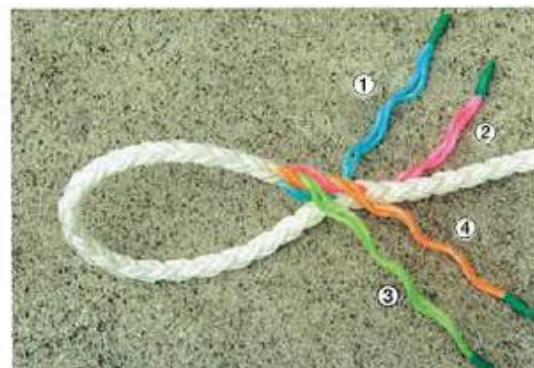
- 3) Insert the spike under S-lay strands to open and insert ① from right to left. Try to take out the twist tendency when inserting. Before finishing 4 strands, do not tighten them.



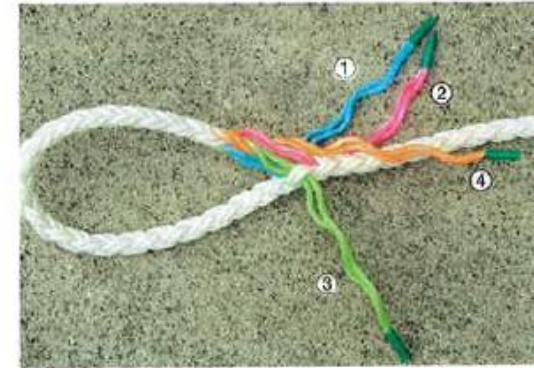
- 4) Insert the spike under S-lay that is next to inserted. Insert from right to left.



- 5) Remove taped that are binding S-lay strands. Keeping S-lay ④ on Z-lay ② from left to right and S-lay ③ being kept under the main rope, turn all over. S-lay ③ is to run on Z-lay strand between ① & ②.

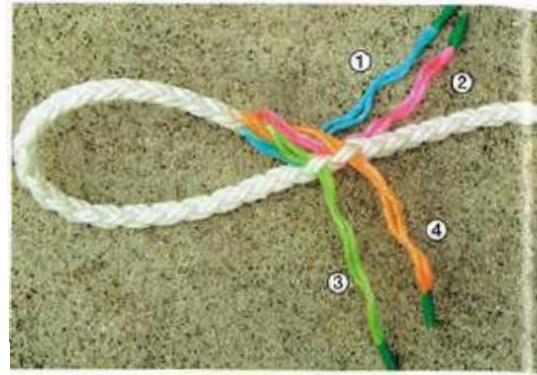


- 6) Insert S-lay strand from left to right.

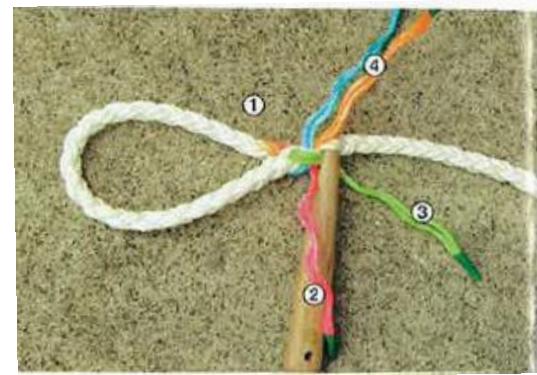


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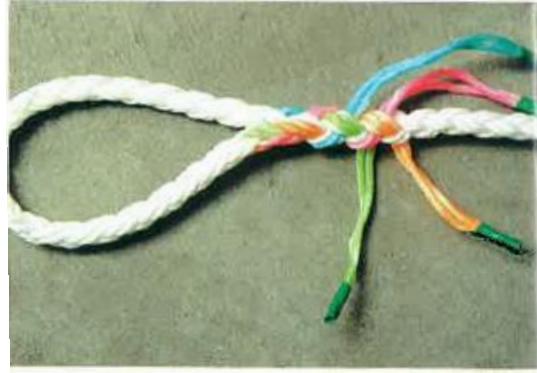
- 7) Take ④ to left to right, then that comes to next to ③. Same as this, insert ④Insert S-lay strand from left to right. This is the end of first tuck of each strand. Each strand (① - ④) should be tightened equally.



- 8) Second round of inserting. The order is ①②③④ in order to work easily. Hitting with hammer the spike, when a large rope like a hawser is applied.



- 9) 3 tucks should be used. Cut the rest of the strands.



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(2) Short Splice

This is same as eye splice. Do not make a mistake when setting the first tuck. All of strands are set firstly same as 3-strand short splice.

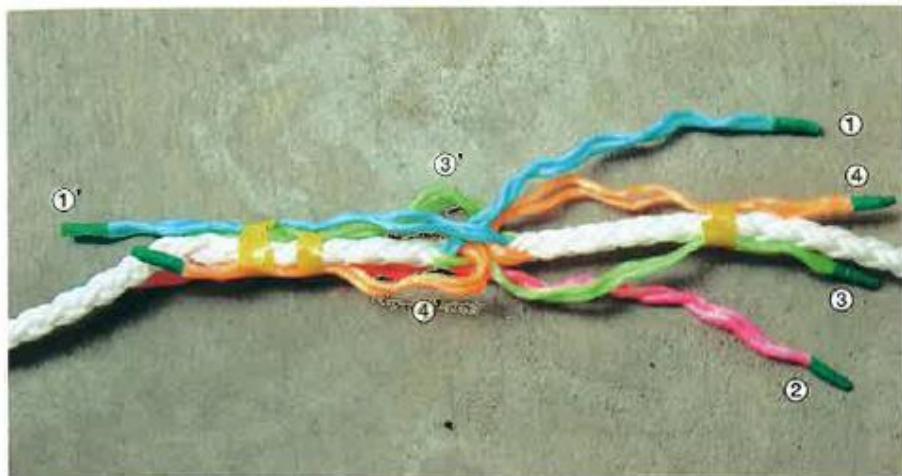


- 1) Untie strands. S-lays are crossed and tapped. It is favorable if color of each tape can be different in order to differentiate each strand. Z-lays are opened and S-lays are taped.

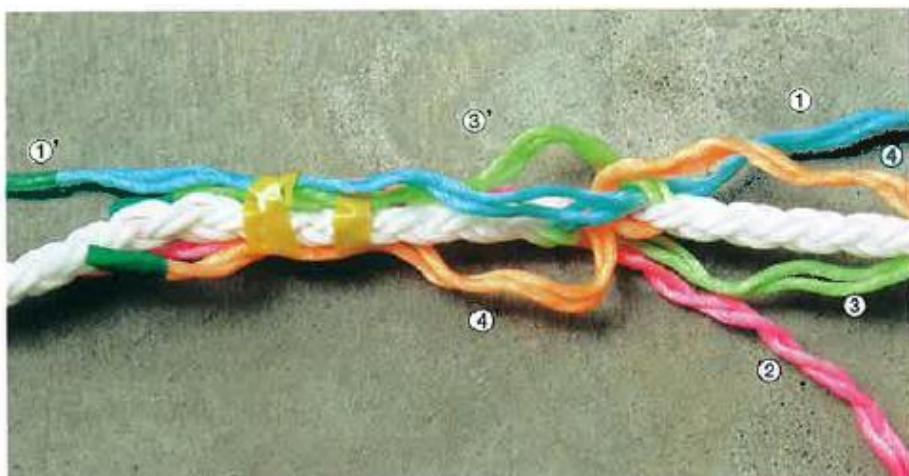


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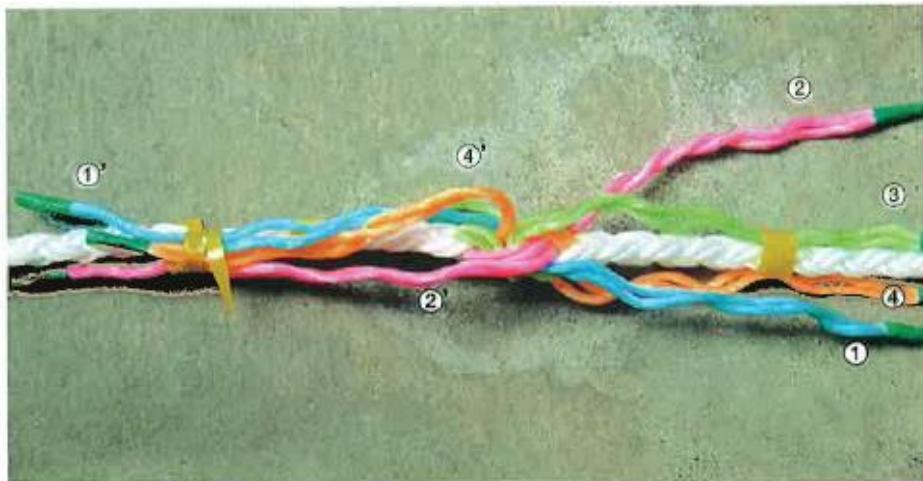
- 2) Cross each Z-lay. Right strand in, left strand out situation. (①-①', ②-②' are crossing.). After crossing, Z-lays are also taped.



- 3) Insert Z-lay ① along ①' from in to out.



- 4) Insert Z-lay ② along ②' from in to out.



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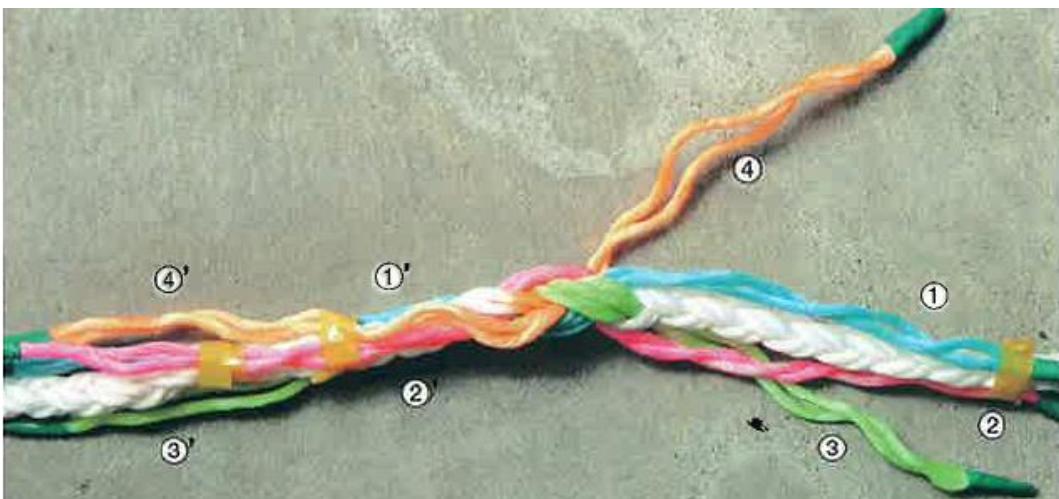
5) Z-lay are inserted.

6) Insert Z-lay ②'

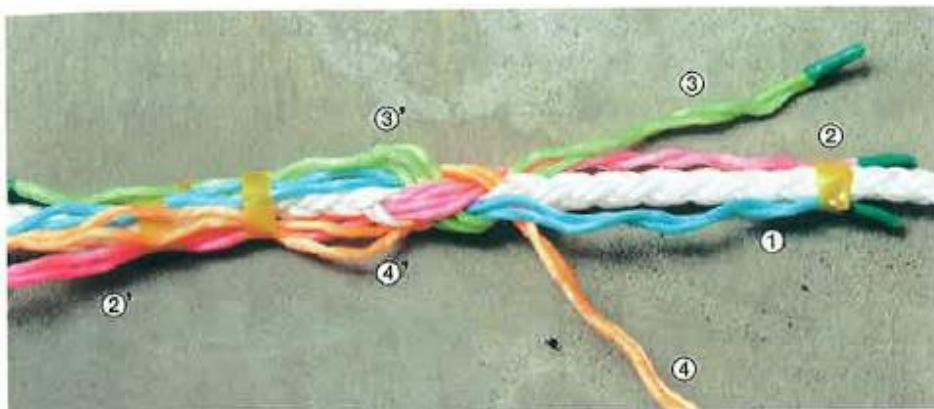


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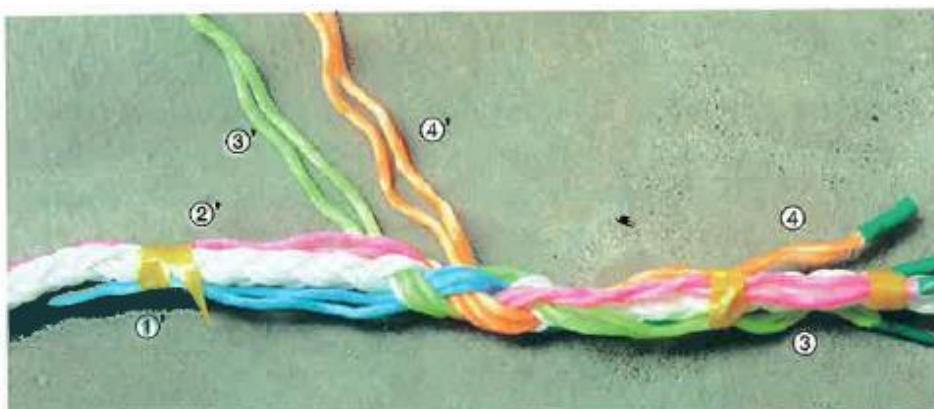
- 7) Fix S-lays by tape. Insert S-lay ③ from left-out to in along S-lay ③', after picking the spike under the Z-lay.



8)



Insert S-lay ④.

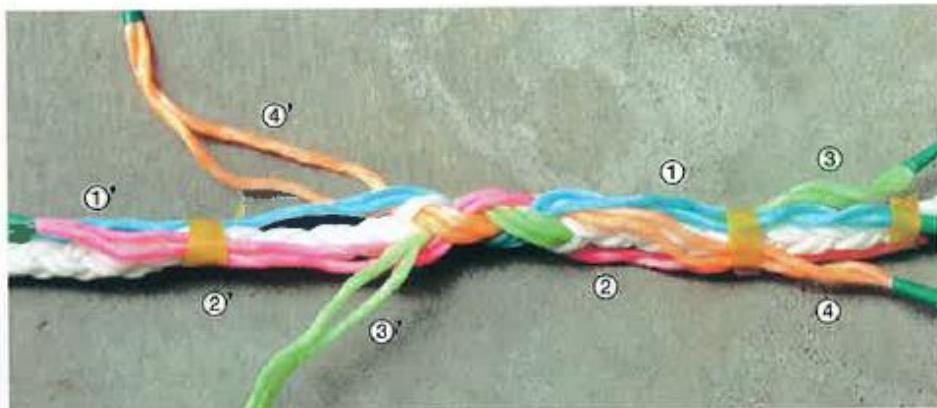


9)

Insert S-lay

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10) Do S-lay ④' is inserted. First round finished. Tighten up.



11) Insert 3 times. The last round can be inserted by each strand separately.



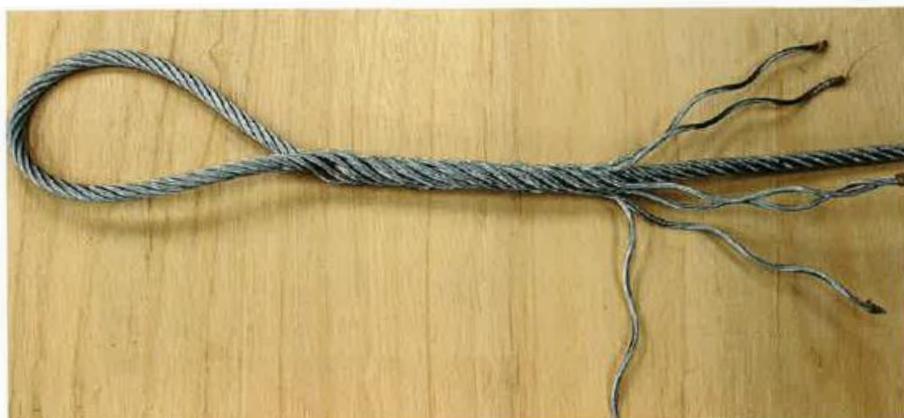
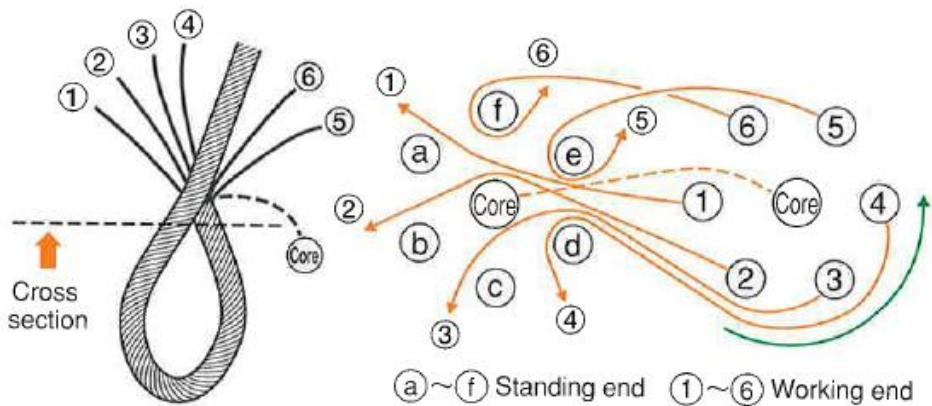
5.9 Wire

Splice 5 tucks at least.

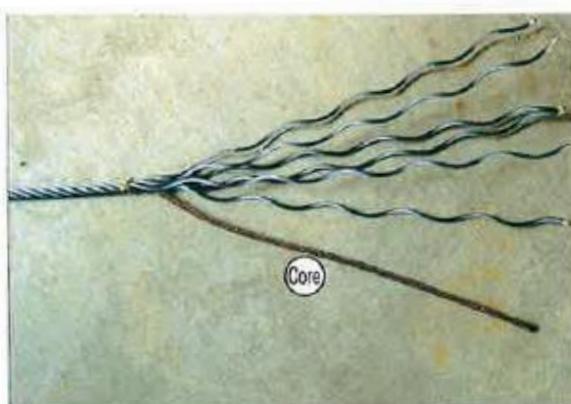
Lay a sheet of plywood for splicing job to avoid slipping of a spike on a steel plate.

4:2 Method

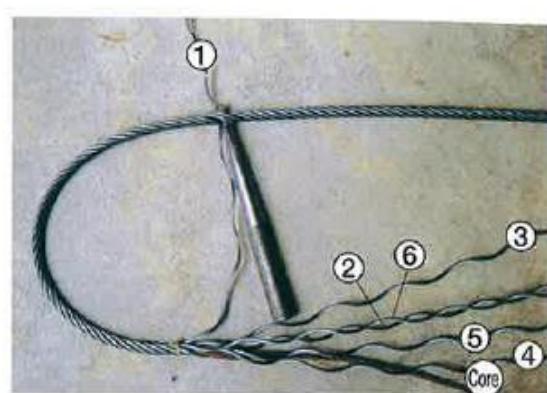
Cross section is a view from arrow side as shown.



- (1) Measure a distance* of approximately 45-50cm (for 16mm wire) from the working end of the wire rope and tightly seize the same. Open the rope so as to separate the individual strands. Clean each strand with a cotton rag. Seize the end of each strand with twice.

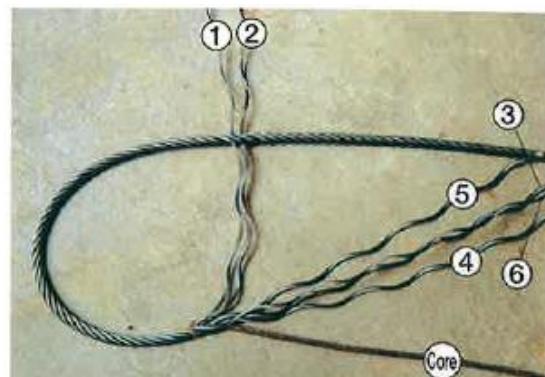


- (2) Make an eye twisting anti-clockwise. The inner most strand of the working end is called ①. Lift 2 strands of standing end closest to strand ① of working end with spike and insert ①.

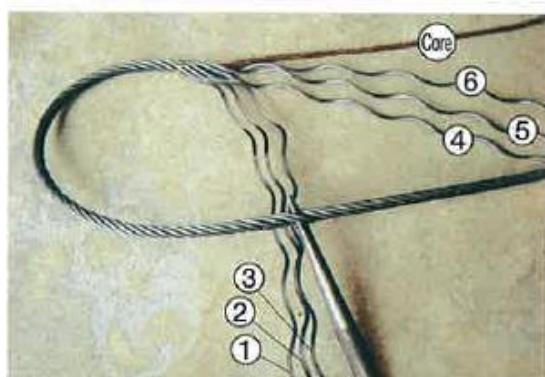


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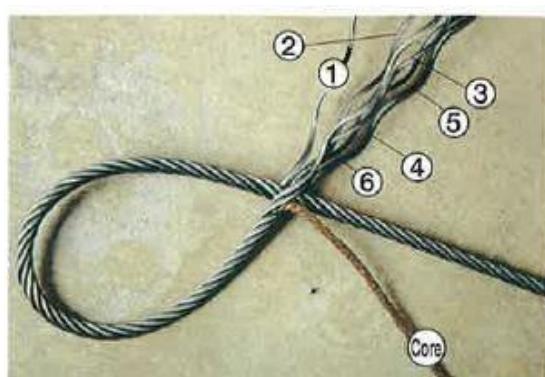
- (3) Lift 3 strands of standing end with spike and insert strand ② of working end, using same insertion point.



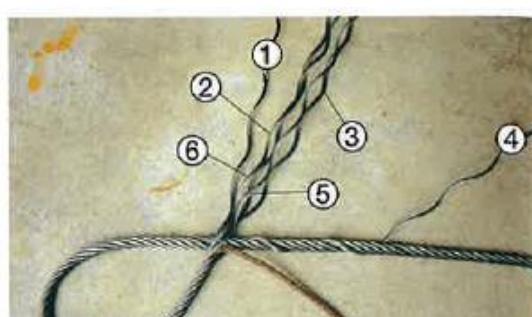
- (4) Turn the complete slice over in order to insert a spike from the back side because it becomes very hard to insert a spike from the top side.



- (5) Insert the spike from the back side and lift 2 strands of standing end and insert strand ③ of working end, using same insertion point. Lift 1 strand of standing end, using same insertion point. Holding all 6 strands and the core, hit the stranding end with a spike so that. An eye begins to form.



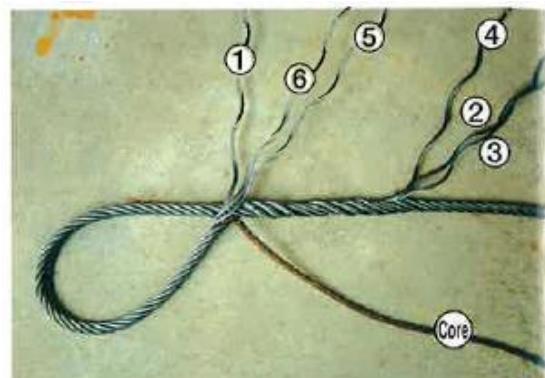
- (6) Before the eye is completed, release the core and hit the standing end till the seized point of the working end touches the



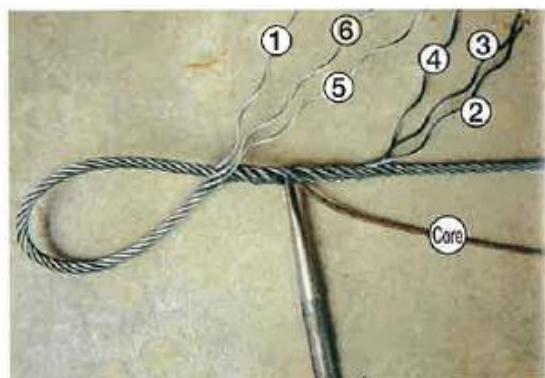
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standing end. Wind strand ④ on to the standing part and tuck the same 5 times. (Note: Wind the strand normally for the 1 st tuck, but give the strand a twist for the remaining 4 tucks. This holds good for all 6 stands)

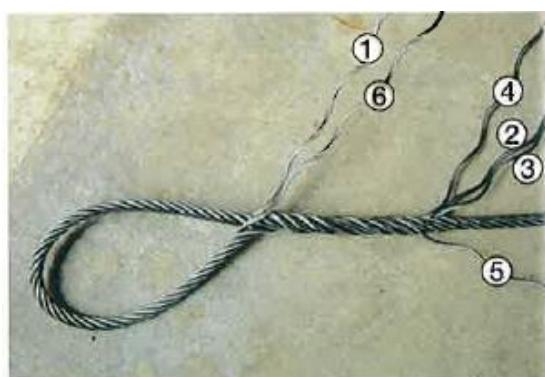
- (7) Wind strand ③ on to the standing part and tuck the same 5 times. Wind strand ② on to the standing part and tuck the same 5 times.



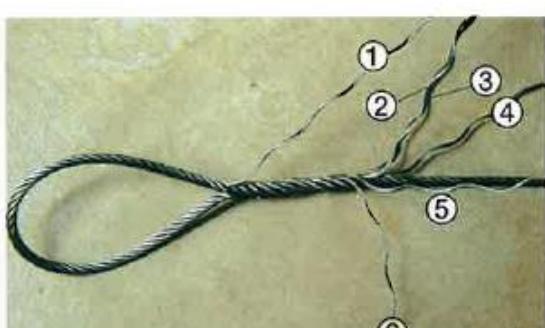
- (8) Lifting strand ⑤ and of the working end, insert the core into the standing end.



- (9) Wind strand ⑤ on to the standing part and tuck the same 5 times. (Be careful not to make a mistake ⑥. ⑥ strand is closest to the conjunction part.)

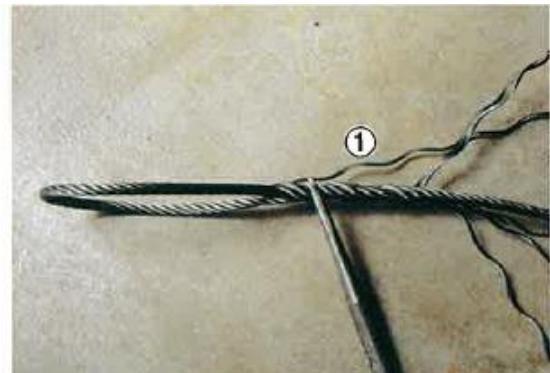


- (10) Wind strand ⑥ on to the standing part and tuck the same 5 times.

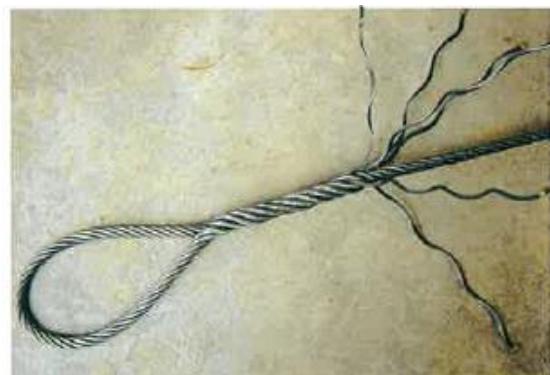


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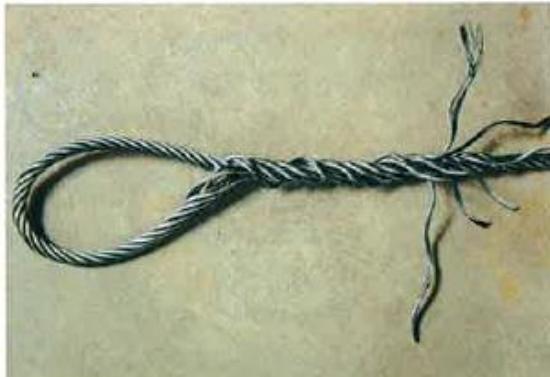
(11) Hit the spliced with a spike along the eye so as to bring strand ① of the working end parallel to standing end. Wind strand ① on to the standing part and tuck the same 5 times.



(12) Hit the spliced part of the wire away from the eye to ensure fit.



Bad example:



5.10 Tie of rope

While there are many kinds of knots, it is not necessary to learn many of them. It is wise to learn several types of knots which serve actual

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purposes and to gain a full knowledge of their advantages and disadvantages through familiarizing with those knots.

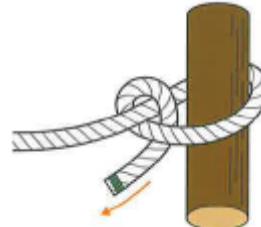
Basic Methods

There are 3 categories by name.

- A hitch is named when a rope is used to tie it to something.
- A knot is named when a rope is used for tying itself or a ring by rope
- Bend is named when 2 ropes are connected.
(Some of them are called hitch or knot depending on)

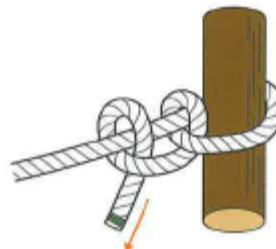
Half hitch

It is used a basis of knots and used along with other knots.
It is rarely used alone.



Two-half hitch

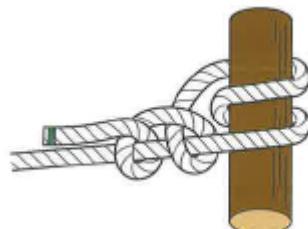
It is often used because it is secure and simple, but when taut difficult to open



Round turn and two half hitch

Since the rope under tension can be tied without loosening, it is employed to hang an object from a hand rail, etc.

The hitch will not shift when another turn is added.

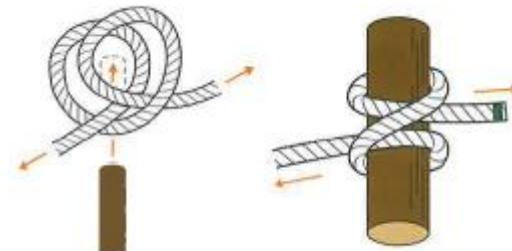


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Clove hitch

It is extensively used to bind a rope around an object. It is particularly effective when both ends are under even stress.

It should be finished with another half hitch when only one end is under load.

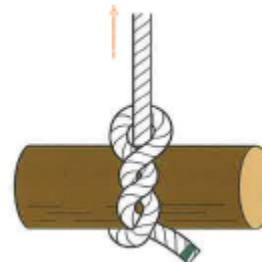


Timber hitch

This will never work loose when the rope is under tension.

When safety is the primary concern as it is not infallible it should not be used.

It is important to leave the rope end sufficiently out of the hitch.



Timber and half hitch (log hitch)

It is used to hoist a slender and long object.

it is convenient to pay out a mooring line to the opposite side of the ship.



Marline hitch

It is used to secure the parceling around the eye of a hawser.

If one point is cut, all of that comes apart. So it is important to contrive the direction of the hitch or the hitch itself.



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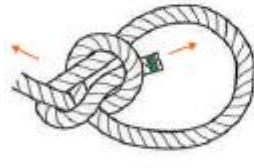
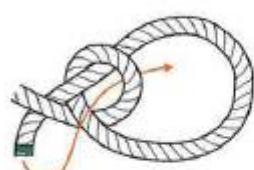
Bowline knot

Called the king of knots, it is known as the most popular knot on board ships.

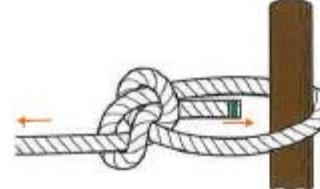
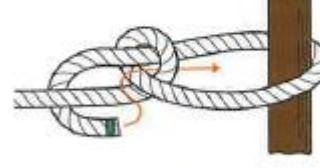
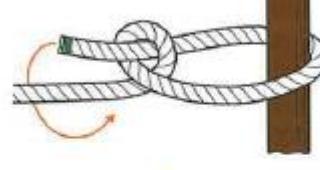
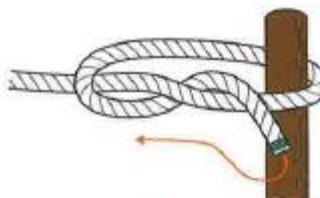
You should master this knot in order to be able to use it easily. Bowline is highly reliable and safe and there is no worry about it working loose or slipping.

- Even if it is worked taut, it is easy to untie it.
- It has many varieties and you can use it extensively.

Basics 1



Basics 2



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5.11 Boatswain's Chair

Setting

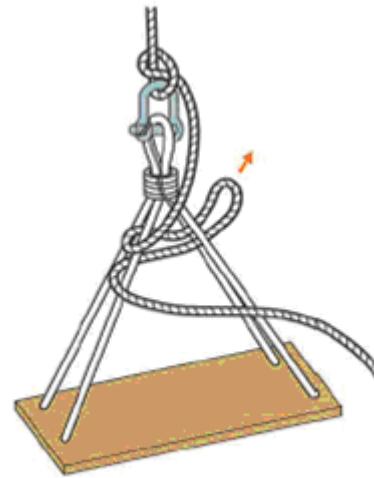
Connection of the boatswain's chair is done with a shackle through the hanging rope. Make sure that the shackle is the right way up. If the shackle pin is set on upside, the pin probably turns as the rope is slacked and comes off finally.

Make sure the rope hanging off is of sufficient length.

Descending

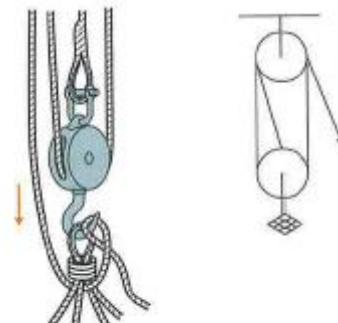
Slip the rope upward through your right hand holding the upper part of the hitch by your left hand, the chair will descend under your weight.

Tighten the hitch when it is lowered to desired position and put the hanging rope caught in between the stair's rope



Ascending

When you need to ascend, you can use tackles.



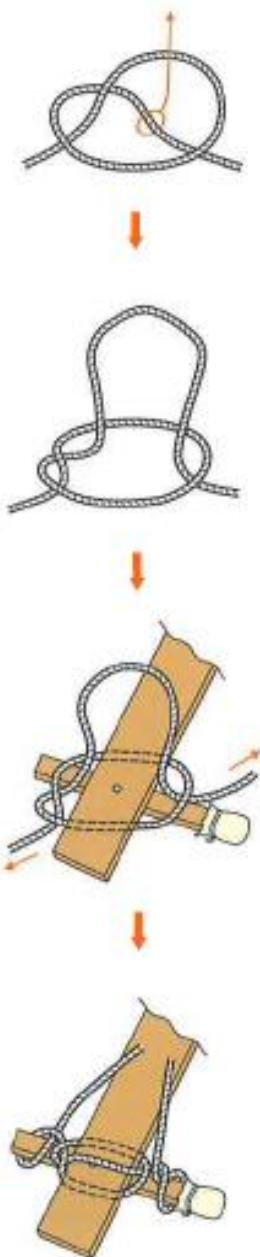
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5.12 Stage board

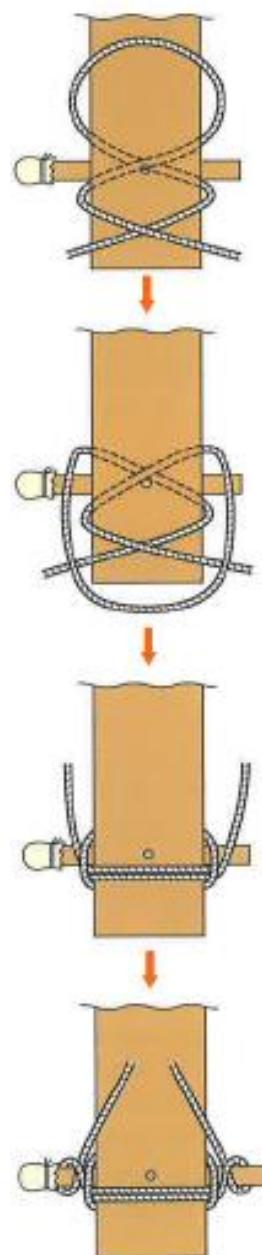
Setting a Stage Board

- (1) Tie a stage rope on a stage boar with following methods keeping about 3 meters from the rope end.

Method-1



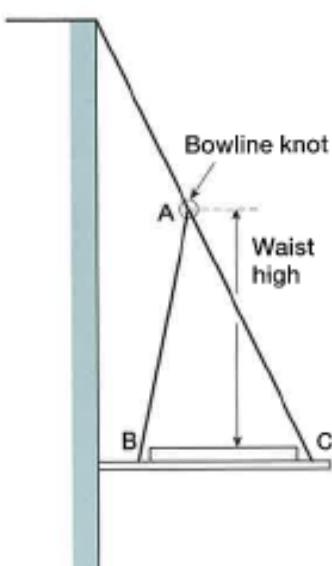
Method-2



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- (2) Make a bowline knot at one's waist high. At this point, 1 meter of rope end is recommendable to be left. This 1 meter of rope end is useful for various purposes, such as solidity of connection and/or hanging some tools to it.

When working on a wall, length of the rope shall be adjusted as shown.

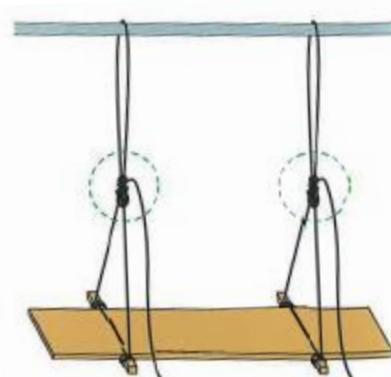


Bowline knot is made at point A. AB is shorter than AC in order to set the board horizontally.

Hanging a Stage Board

The stage board is hung from a handrail or a pipe that should be strong enough for descending.

Where two members work as a team as they lower themselves, such as for ship's funnel, two ropes firmly with a hand can sufficiently support your own weight even when the knot is untied.



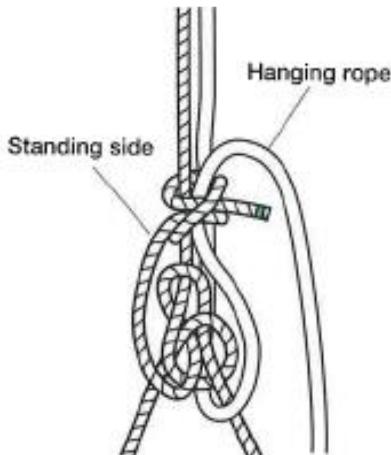
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Working on a stage board

There are 3 methods of tying the stage rope for descending.

Method-1



Pass the hanging rope under the bowline knot and hold it together with the standing rope. Bind together by Clove hitch with the 1-meter rope end mentioned **3-1(2)**.

When you descend, firstly hold 2 ropes above the bowline knot firmly. (Once two ropes are held firmly, your hand can sufficiently support your own weight even when the knot is untied.) Then push the hanging rope upward little by little. The stage board is lowered by your own weight. When the board comes to the next position, pull the hanging rope downward. The rope is halted.

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Method-2

Pass the hanging rope under the bowline knot and hold it together with the standing rope. Bind together by Two half hitch with the hanging rope. Tuck remaining end into 2 ropes.



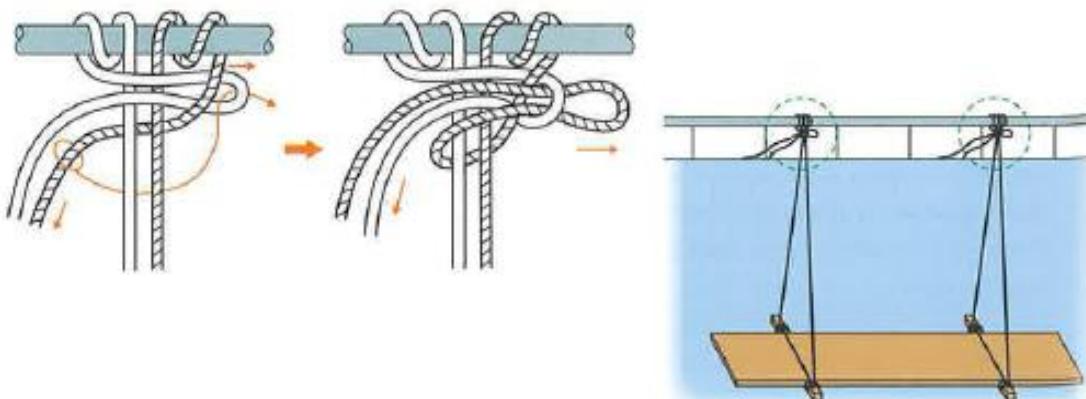
When you descend, firstly hold 2 ropes above the bowline knot firmly. Then, untie the two half hitch once. Adjust your hand and slack the hanging rope holding the hanging rope with the other hand. Tie again with two half hitch.

Method-3

Take the hanging rope to the board directly and wind 5 times on the board outside of the workers. The board is held. When you descend, move the hanging rope little by little carefully. This method is good when you work on a board sitting.

- Fixing a board at one place

When the work is being carried out at a fixed position, tie the stage rope as follows keeping an altitude of the board at desired position.



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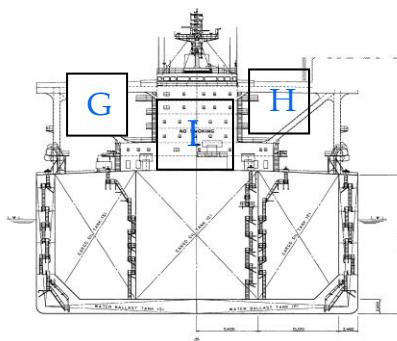
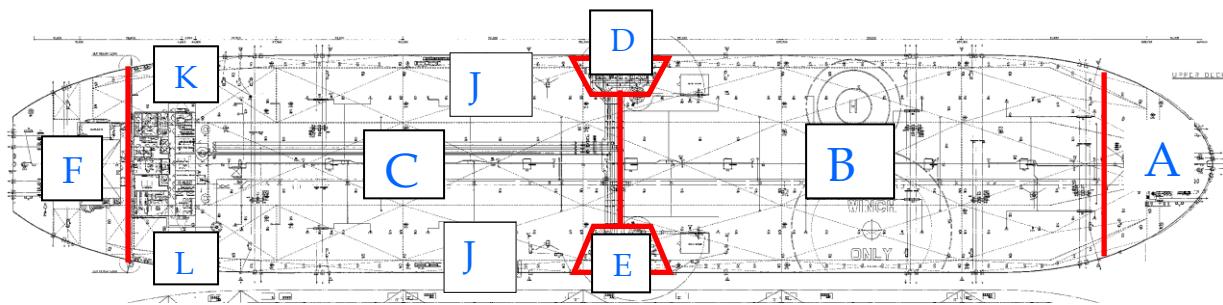
6. MAINTENANCE WORK ON DECK

6.1 Deck Maintenance Plan

To conduct the deck maintenance, maintenance plan is very important. Without plan, how can you manage your ship's condition ? The maintenance on an ad hoc basis should be avoided.

To manage your maintenance, categorization of the ship's construction is effective.

Following example should be considered when you make the plan.



Categorization of the ship's construction (Example)

- | | |
|----------------------------------|--------------------------------------|
| Section A: Forward station | Section B: Main deck (Forward part) |
| Section C: Main deck (Aft part) | Section D: Manifold (Port side) |
| Section E: Manifold (Starboard) | Section F: Aft station |
| Section G: Bridge wing (Port) | Section H: Bridge wing (Starboard) |
| Section I: Accommodation area | Section J : Gangway(Port, Starboard) |
| Section K: Lifeboat davit (Port) | Section L : Lifeboat (Starboard) |

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Voy. No.	12		13		14	
Voy.pattern or Port to Port	Ballast	Laden	Ballast	Laden	Ballast	Laden
Voy.Days	10	8	7	9	8	9
Section	A,B	C	D, E	F	G	H,J
Job details	De-rusting & Touch up	De-rusting & Full coat	De-rusting & Touch up	De-rusting & Touch up	De-rusting & Full coat	De-rusting & Touch up
Remarks (If any)	Deck machinery	Pipe line (Chipping / Full coat)	Pipe line (Chipping / Touch up coat)	Deck machinery		

Deck maintenance plan (Example)

Priority of maintenance section should be considered following items.

1. Maintenance condition at each section
2. Seasonal factors (wind direction, rain, sea spray from the waves etc.)
3. Days of voyage
4. Other maintenance jobs (mooring line, deck machinery, LSA, FFA deck pipeline, cargo cranes etc.)

【NOTE】

1. Categorization may be differed depend on your ship type. For more detail refer to owner's/manager's circulars/instructions.
2. If you have any maintenance instruction from VM, you have to comply it.

6.2 Preventive Maintenance

These are the routine daily tasks that must be done aboard ship to prevent, or at least to hold back, the formation of rust or deterioration of the ship's equipment. The first and most important step in proper maintenance is to keep a vessel clean. This is necessary to good health and efficient operation.

(1) DECKS

Wash and scrub decks often to prevent tracking dirt throughout the vessel. If it can be obtained, canvas or cocoa matting can be laid on the deck wherever people walk. Scuppers must be kept clean and open so water can flow overboard freely and not leak into spaces below.

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(2) TOPSIDES

Topsides and superstructure must be washed often, using fresh water when possible. A small amount of washing soda can be added to the wash water to help in the cleaning. Parts washed with soda and water must be given a final wash down with fresh water, if possible, or salt water.

(3) BILGES

The rounded parts of a vessel's bottom, known as the bilges, collect water, oil, fuel, trash, and so on. Keep them clean and well aired because dirty bilges are a fire hazard, produce disagreeable odors, and are harmful to vessels.

(4) CARGO HOLDS

Keep cargo holds clean. Stow and secure excess dunnage. Trace and eliminate sources of fumes and odors.

(5) SOUNDING OF TANKS & BILGES

Sounding of the FW tanks, cargo hold bilges, ballast tank, chain looker, void space, etc must be done and recorded every morning. Additionally for vessels not fitted with an alarm monitoring system, shall sound the tanks & cargo hold bilges at a specified time in the evening.

For ships, other than bulk carriers and general cargo vessels, fitted with level gauges for monitoring ballast tanks soundings, daily manual soundings may be replaced by confirming from level gauges.

Purpose of sounding is early detection of leaking seawater, liquid cargo and FO from adjoining tank which was damaged shell, bulk head or pipe line.

6.3 Greasing Deck Machinery

(Reference : ST/005/11)

There are many different machinery and equipment exposed on the open deck, such as windlass, mooring winch, cargo gear, accommodation ladder, life boat and heavy door, etc which all have built-in moving gears for parts, the purpose of greasing is not only to keep them in good condition, but also protect them from the elements.

(1) Caution during greasing

- Do not apply excessive grease. This causes an increase in temperature in high speed rotating machinery, also causing grease to drop off.
- Where a grease nipple is located in a different access area, it should be marked so as not to miss it.

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- An appropriate grease nipple suitable for narrow should be used.



(2) Covering of Grease Nipples

Grease nipples are used on various machines installed on board, and their greasing is an indispensable part of the crew's duties.

However, when working on grease nipples, paint could accidentally become attached.

The bellow photo show how a grease nipple is protected with a rubber pipe.

When paint is to be sprayed onto a whole machine or a large scale rust removing or coating project is to be done, it is more efficient to cover grease nipples in advance than having to warn deck hands assigned to the painting job against smearing the nipples with paint.

Though initially it is a troublesome task, once all the grease nipples have been covered, the effort will improve the subsequent operation and the after-work inspection will be simplified.



6.4 Windlass and Mooring Winch

(Reference : ST/005/11)

(Reference : ZZ-S-P-07.51.00)

- Check all grease nipples on mooring equipment to ensure the nipples remain usable. It is a good idea to highlight these items 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.

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- 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.



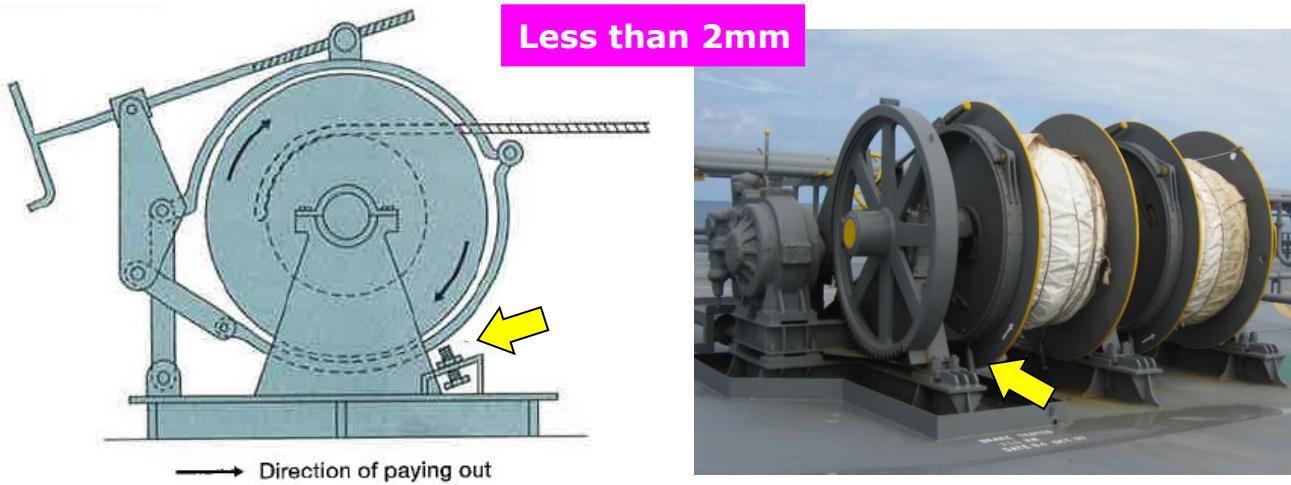
- Confirm that the working/operation area are not slippery and damaged
- Check the condition of Bollard, bitts and fair-leader and ensure that the fair-leader is working well
- Ensure that the strength, materials and shape of stoppers are appropriate
- Confirm that the mooring has a handling rope
- Adjust 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.

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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.



6.5 Pilot Ladder

(Reference : Safety Bulletin GEN 2011 001)

The pilot ladder usually uses Manila rope, made of natural plant fibers, requires particular attention to the following points in its maintenance.

- 1) The two photos on the left show how a pilot ladder is stowed, wound around a stowage reel.

If no dedicated stowage reel is provided, the pilot ladder is stowed in a store. In that case, it has to be kept mounted on a suitable pallet to prevent it from coming into direct contact with the floor surface.

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- 2) While at sea, the ladder should be protected with a canvas cover from sun, water and so forth.
- 3) Normally, Manila rope gradually loses its oils through volatilization over time and becomes discolored. As the loss of oil results in reduced strength, linseed oil should be applied once a half year, in principle.

Coating the wooden steps of the ladder with ordinary paint to prevent deterioration is not approved because it would make the steps slippery and any damage on them less noticeable visually.

Yet, it is permitted to coat the steps with an anti-slip agent.

A pilot ladder is made of relatively heavy materials because if it were swung by wind when the pilot is trying to get on board, he would be exposed to great danger.



- 4) Other check points are follows

- Confirm that the steps do not have cracks, oil stain and damage
- The steps must be equally spaced
- Check the seizing of marline condition for step boards
- Check the ropes condition (Abrasion, strong twist, discoloration)
- Man-ropes shall be stored in a proper place to prevent damage to the ropes. (No dirty and wet area)

6.6 Accommodation ladders and Gangways

(Reference : ZZ-S-P-10.30.06)

- Check the condition of hoisting wire (Abrasion, strong twist, discoloration) and ensure that there are spare wire ropes
- Confirm that pulley and lead roller are turning smoothly (no damage on sheave)
- Check the condition of remote control

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- Check the condition of the tackle, shackle and arms (damage, corrosion, deformation)
- Ensure that the shackle pin has a stopper pin
- Confirm that the steps have an appropriate slipping prevention to remove slipping hazards
- Air winch
 - Confirmation of switching off the air drain
 - Supplement of grease into each lubrication part
 - Proper Air pipe, Valves and cocks
 - Check the operating of the air motor



6.7 Wire (Mooring, Crane, Boat Fall, Accommodation Ladder)

(Reference : ZZ-S-P-10.30.05)

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.

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- 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.



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6.8 Air Motor

Deck machinery that has air driven motors often suffers problems with their rotary vanes, which are driven by compressed air across the vanes.



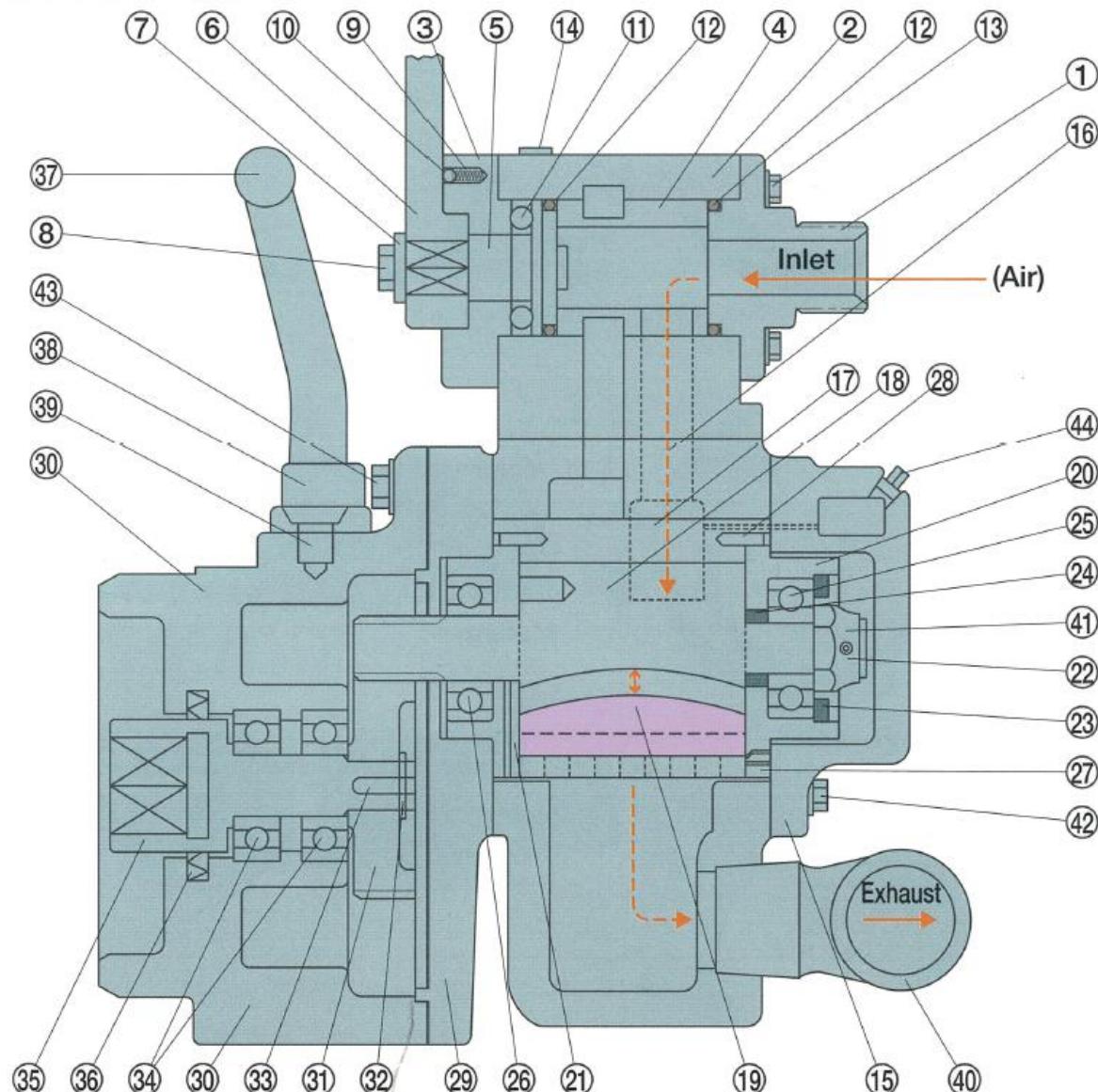
(1) Instruction for use.

- Dirt or rust and lack of lubricant in motor cause often engine trouble.
- Valve lever's position should be neutral and put on a horse cap at inlet port when not in operation.
- Blow out air lines before connecting to motor to remove foreign particles.
- Don't run with no load beyond necessary time. This causes abrasion of the rotary vanes.
- Oil filter should be installed close to the motor.

(2) Disassembling and Assembling

- Blow air in motor so that dust or other foreign particles be cleaned out of motor.
- For disassembling engine section, remove gear case and housing cover and blow end of rotor with a hammer attaching a wooden piece of soft metal on it.
- All parts should be cleaned using oil.
- Supply gear case and ball bearings with grease.
- Test operation after assembling should be kept minimum time not to wear out rotor vanes unnecessarily.

<<Cross Section of Air-Motor>>



- | | | |
|----------------------|----------------|------------------|
| ① Upper valve casing | ⑯ Main casing | ⑳ Reduction gear |
| ② Valve casing | ⑰ Cylinder | ㉑ Stop ring |
| ③ Lower valve casing | ⑱ Rotor | ㉒ Key |
| ④ Change valve | ⑲ Rotor blade | ㉓ Ball bearing |
| ⑤ Valve shaft | ㉐ Upper lid | ㉔ Socket |
| ⑥ Change lever | ㉑ Lower lid | ㉕ Oil seal |
| ⑦ Washer | ㉒ Lock nut | ㉖ Commode handle |
| ⑧ Bolt | ㉓ Ring nut | ㉗ Cap nut |
| ⑨ Spring | ㉔ Spacing ring | ㉘ Stud bolt |
| ⑩ Ball | ㉕ Ball bearing | ㉙ Elbow |
| ⑪ Thrust ball | ㉖ Ball bearing | ㉚ Sprit pin |
| ⑫ "O" ring | ㉗ Knock pin | ㉛ Bolt |
| ⑬ Bolt | ㉘ Knock pin | ㉜ Bolt |
| ⑭ Marking plate | ㉙ Lower casing | ㉝ Oil plug |
| ⑮ Upper casing | ㉚ Gear casing | |

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6.9 Fairleader & Pedestal Roller

Rollers are to be properly maintained in good working condition and checked internally and externally. Check points are as follows;

How to check: Periodical inspection

Check item: Does it rotate smoothly?

Action to be taken: Grease applied periodically.



Greasing up of roller shaft

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6.10 Pipe Line and valve

Pipeline and valves are to be properly maintained in good working condition and checked internally and externally. Check points are as follows;

(1) Dresser Joint

How to check: Visual & Periodical inspection

Check item: No leaking from dresser joint?

Action to be taken: Overhaul and remove the paint on joint. Packing should be changed if damaged.



Inspection of Dresser Joint

(2) Valve open/shut is not smoothly

How to check: Periodical inspection

Check item: Open/Shut is smoothly?

Action to be taken: Overhaul valve and apply grease



Greasing up

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6.11 Mechanical Ventilator

Mechanical ventilators are to be properly maintained in good working condition and checked internally and externally. Check points are as follows;

(1) Corrosion or Wastage of the Casing of Ventilator

How to check: Visual inspection and hammering

Check items: No corrosion or wastage of the casing of ventilator?

Action to be taken: Corroded or wasted casing of ventilator is to be renewed.



Holes of the casing of ventilator



Wastage of the casing of ventilator



Temporary repair by tape
→ *Not acceptable!*

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(2) Wastage or Holes of Fire Damper

How to check: Operation test of fire damper Open up inspection

Check item: Are damper flaps structurally sound?

No wastage or holes of fire damper?

Action to be taken: Wasted fire damper is to be replaced with new one.



Wastage/holes of fire damper



After repair

(3) Marking of "Close-Open" and Operation of Fire Damper

How to check: Visual inspection

Operation test of fire damper

Check item: Is "Close-Open" clearly marked?

Is the internal damper operating normally?

Action to be taken: "Close-Open" is to be clearly marked.

Inoperable handle is to be greased up.



No marking of "Close-Open"



Clear marking of "Close-Open"

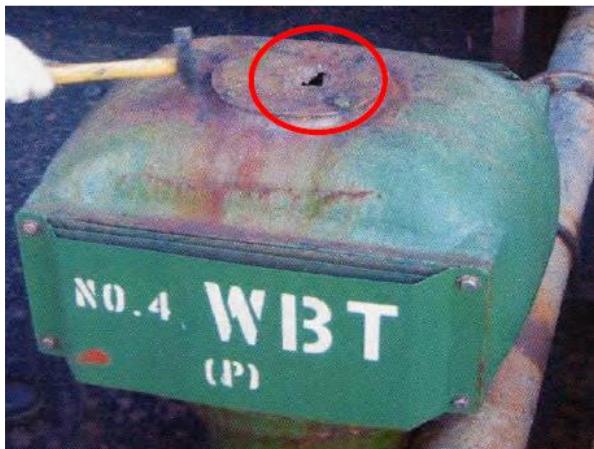
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6.12 Air Pipe and Natural Ventilator

Air pipes and natural ventilators are to be properly maintained in good condition and checked internally and externally. Check points are as follows;

(1) Corrosion or Wastage of Air Pipe

- How to check:* Visual inspection and hammering
 Open up inspection
- Check item:* No corrosion or wastage of air pipes and their head?
- Action to be taken:* Corroded or wasted air pipe is to be renewed.
 Corroded or wasted air pipe head is to be replaced with new one.
 (Repair by putty is not acceptable.)



Wastage and holes of air pipe head



Temporary repaired by patty
 → *Not acceptable!*



Wastage of inside of air pipe head

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(2) Damage or Stuck Disc Float

How to check: Open up inspection

Check item: No damage or stuck of disc float?

Action to be taken: Damaged disk float is to be replaced with new one.
Stuck disk float is to be adjusted.



Damage of disk float



(3) Corrosion or Wastage of Natural Ventilator

How to check: Visual inspection and hammering

Check item: No corrosion or wastage of ventilator?

Action to be taken: Corroded or wasted ventilator is to be renewed.



Wasted wall ventilator



Wasted gooseneck ventilator

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(4) Missing nut or bolt

How to check: Visual inspection

Check item: No missing nut or bolt?

Action to be taken: Missing nut or bolt is to be provided.



Missing butterfly nut of gooseneck ventilator



Missing bolt of air pipe head

6.13 Cargo Hatch Cover and Small Hatch

Hatch cover and small hatch are to keep satisfactory weather tightness. Check points are as follows;

(1) Corrosion or wastage of cargo hatch cover and small hatch

How to check: Visual inspection and hammering

Check item: No corrosion or wastage of hatch cover and small hatch

Action to be taken: Corroded or wasted hatch covers to be repaired.



Wastage of small hatch

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(2) Missing nut and bracket

How to check: Visual inspection

Check item: No missing nut and bracket?

Action to be taken: New nut and bracket are to be provided.



Missing nut of small hatch



Missing nut and bracket

(3) Deteriorated or Cracked Rubber Packing

(Reference : GI/FLT/006/13)

How to check: Visual inspection

Check item: Is rubber packing deteriorated or cracked?

Action to be taken: Deteriorated or cracked rubber packing is to be replaced with new one



Deteriorated rubber packing



Deteriorated and cracked rubber packing

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6.14 Others

Following constructions are also to be properly maintained in good condition.

(1) Drain Plugs

Defective condition	Good example
<p>Drain plugs for save-alls under oil tank air vents, bunker stations or oil coamings for hydraulic machines missing.</p> <p>Names of air vents and save-all capacities not marked.</p> 	<p>Risk of pollution when there is leakage of oil.</p> <p>Appropriate markings can assist crew when pollution occurs.</p> <p>Drain plugs should be kept with chains or wires connected to save-alls or coamings.</p> 

(2) Naming & Marking

Defective condition	Good example
<p>Names of related tanks for sounding pipes, air vent pipes, valves or man-hole covers not marked.</p> 	<p>Identification can help prevent operational mistakes and assist crew when in emergency.</p> 

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(3) Platform and gratings

Defective condition	Good example
<p>Stairway, platform plates or gratings corroded heavily.</p> 	<p>Well maintained stairway and grating minimizes risk of physical injury.</p> 

(4) Water-tight Door

Defective condition	Good example
<p>Weather-tight doors in poor condition.</p> <ul style="list-style-type: none"> ① Rubber gaskets hardened, over painted, missing, or improperly fitted or its retaining channels corroded. ② Handle levers (Dogs) seized with rust or paint. Open/close marks and the name of the compartment not identified. 	<ul style="list-style-type: none"> ① Risk of water-ingress due to poor sealing. Risk of causing damages to equipment stored in the compartment. ② Risk of failure in achieving weather-tightness. Risk of causing delay in action in an emergency. 

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(5) Fire Hoses

Defective condition	Good example
<ul style="list-style-type: none"> • End coupling incorrectly secured to fire hose • There is a risk of injuring personnel with rusty jubilee clips 	<ul style="list-style-type: none"> • Hose/nozzle ready for immediate use • End coupling correctly secured to fire hose • Hose connected to coupling with bronze wire and not hose clips. 

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6.15 INSPECTION & TESTING of Deck equipment

(1) Accommodation Ladders and Gangways

Monthly inspection for all accommodation ladders shall be carried out in accordance with "Monthly Checks Guidance".

Visual check and arrangement of equipments	Ladder
	Winch, air hose & oil unit
	Stanchions
	Guard rope
	Lifting equipment
	Wire rope
	Moving parts, connection & link
	Sheave & sheave box
Checking of bolt & nut's tightened condition.	
Operating condition (include the air motor and the winch)	
Supplement of grease into each lubrication part.	

(2) Brake test of mooring winch for undivided drum

(Reference : ZZ-S-P-07.51.00)

For vessels fitted with undivided drums the brake holding capacity is affected by the number of layers of wires on the drum. It is therefore important that the operator of an undivided drum winch, knows the number of layers of wires on the drum that the manufacturer states will develop the design brake capacity. The brake of mooring winch is generally designed to hold the 80% of minimum breaking load of a specified mooring rope or wire, at its first layer on winch, which is specified to be used on the mooring winch. In practice the brake is adjusted to render the rope/wire at load equal to 60% of minimum breaking load of wire/rope. Therefore, Brake holding Capacity and Brake rendering capacity of winch could be defined as 80% and 60% of MBL of wire respectively. It could be expressed in Tonnes or in KN.

Care must be taken to ensure that brakes are kept in good condition and clean. Oil,



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moisture or heavy rust on the brake linings or brake drum can reduce the holding capacity by up to 75%. A careful record shall be kept of all mooring equipment onboard. Each wire and rope must have a record when put into service and on which particular winch and when wires were turned end for end. Each rope tail must have an identification tag to indicate for which particular winch it is used for. The number of times each rope tail is used must be logged in order to affect the replacement date. Certificates must be available for all wire ropes, synthetic lines, links and tails.

(3) Brake test of mooring winch for split drum

Vessels fitted with split drum winches should have the brakes set to hold a minimum of 60% of the minimum breaking load (MBL) of the rope on the first layer of the working drum.

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7. FUNDAMENTAL OF VALVES

A valve is inserted into piping for direct control of the flow of fluid. Although each valve has a relatively simple structure, a large number of valves are fitted in a piping system and trouble with any one of them could affect the functioning of the whole system, hence their proper maintenance is very important.

The structure of a valve differs from one type to another, but the main part of any type of valve consists of the following four elements. Thus, the core or main part of the valve, through which the fluid flows is called the body; the working part, which directly controls the fluid flow, is the disc; and the contact faces of the valve and the body, are called the seats, comprising the body seat and the disc seat. A connecting rod for moving the disc is known as the stem. Therefore, in a valve, the stem moves the disc, and by varying the clearance between the seats, the fluid flow is controlled.

The contact faces of the seats can be kept tight against each other in one of two ways — by direct contact between metal faces or with a rubber or Teflon sheet. The former is more secure against external damage caused by foreign matter, among others; but it requires much higher machined precision. The latter method, though less likely to allow leakage even if machined precision is somewhat inferior or the valve is deformed, is subject to leaks once the sheet is damaged. For marine use, cast iron valves are very common; but cast steel valves are chosen for particularly important areas, such as where there is direct contact with the sea outside, as is the case with sea valves.



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7.1 Globe Valve – Basic Structure and Motions

The globe valve is so named because its body is shaped like a globe. Inside the body is a barrier plate, the centers of the inlet and outlet ports are aligned, and the fluid flows in a figure "S". The globe valve's structure is designed to stop a fluid from flowing by pressing a disc against the barrier plate seat. The disc's motion is either straight or in parallel with the direction of the fluid's flow. The disc shape is flat or conic. Since pressure loss within a globe valve can be significant, this type of valve is not used for fluids of high viscosity.

By changing the disc shape, the globe valve can be used in either "control motion" mode to control the flow or in "On/Off motion" mode to open/close the valve.

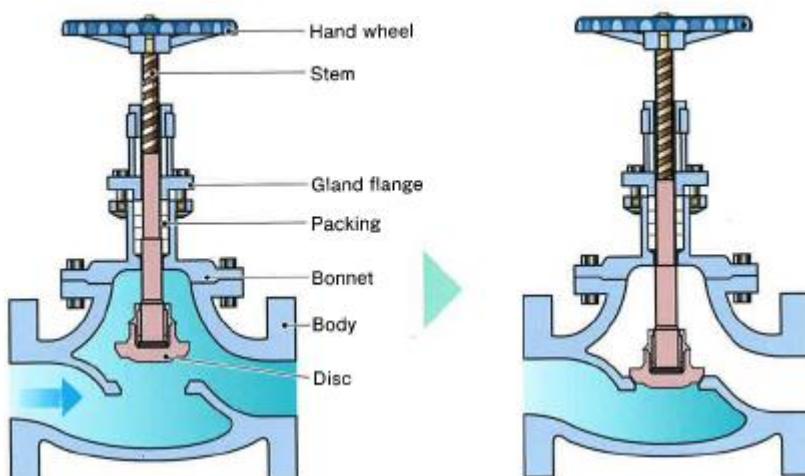
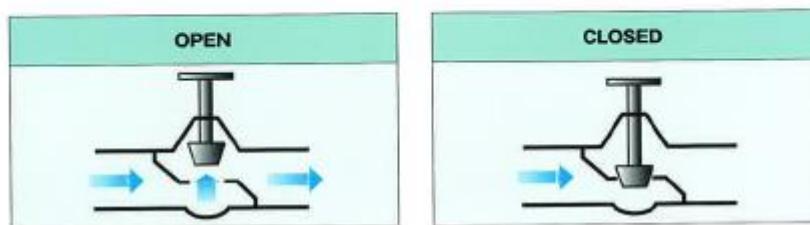


Fig.2 Globe Valve



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7.2 Gate Valve

The gate valve's structure is designed to partition the fluid flow. A turn of the handle rotates the stem and moves the disc housed in the valve body up and down at a right angle to the flow passage, opening or closing the valve. This type of valve makes use of the disc's wedging effect. The fluid advances almost in a straight line, minimizing pressure loss. Gate valves are used for conditions that require the valve to be fully opened or fully closed. If the valve is used while half-opened, the fluid flow around the disc changes abruptly and may lead to corrosion or erosion from cavitation. It is used in "On/Off motion" mode. In this mode, a counterclockwise turn of the handle to close the valve lowers the disc and causes the fluid to stop.

The disc motion is straight and at a right angle to the direction of fluid flow. The disc shape is flat.

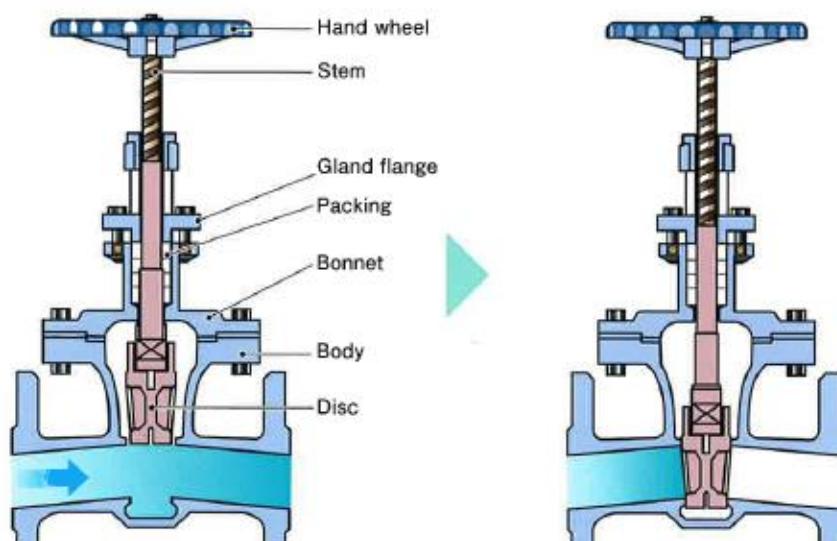
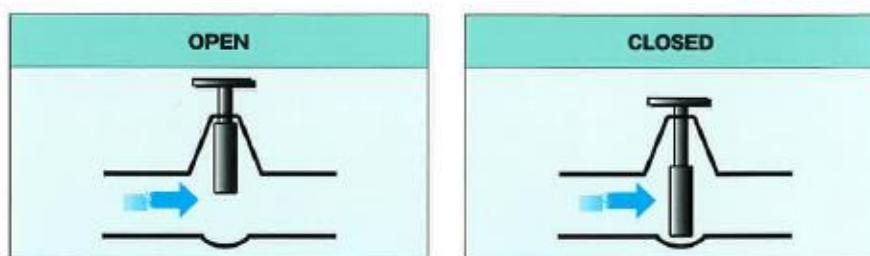


Fig.4 Gate Valve



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7.3 Butterfly Valve

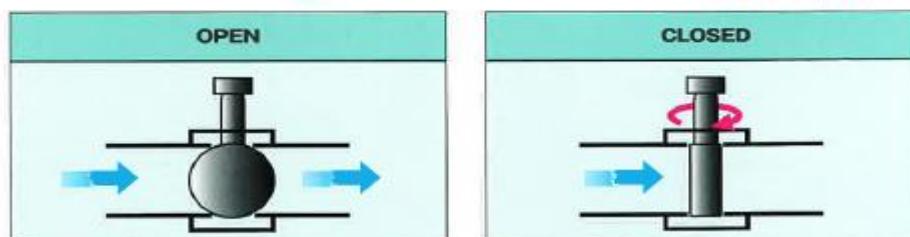
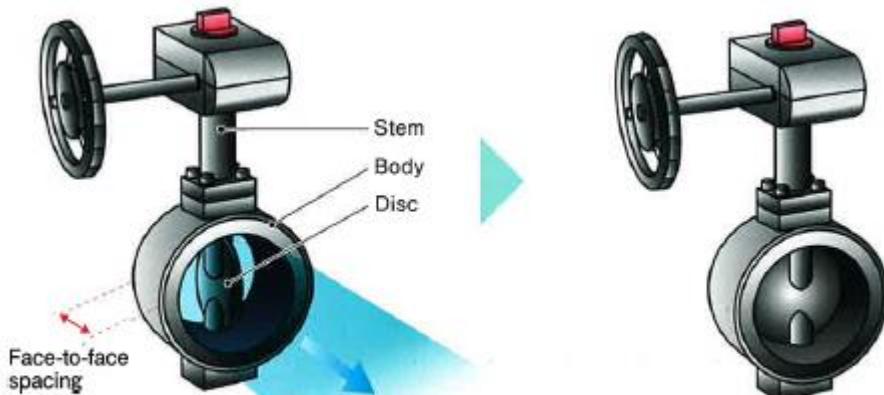
The butterfly valve has a simple structure. Inside its short cylindrical body, the disc has a seat surface around its circumference that turns 90 degrees with the stem as the axis.

The disc can move within a 90-degree range, driven by an external worm gear.

Due to its structure, shutting-off of the valve seat had been considered difficult to do. But high performance butterfly valves that resolve this concern have been developed thanks to the adoption of synthetic rubber (elastomer) and plastics and improvements to the shut-off mechanism.

Minimized face-to-face spacing makes the valve compact, lightweight and easy to attach/detach, meaning greater economy.

However, the valve requires careful operation because its flat disc can cause water hammer and unbalanced torque. This valve can be used for either "control motion" requiring flow regulation at semi-open, or for "On/Off motion" for full opening/closing. The disc motion is rotary and in parallel with the direction of fluid flow. The disc shape is cylindrical.



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7.4 Check Valve

The check valve is used to prevent fluid back flow by constantly keeping a fluid flowing in one direction. The disc is pushed open by the fluid's pressure. When the fluid flows back, back pressure presses the disc against the body seat, thereby preventing flow in the opposite direction. Check valves are used to prevent damage due to reverse rotation of the pump or compressor, or due to a fluid's back flow into a low-pressure section. There are two types of check valve: swing type and lift type.

(1) Swing check valve

With this valve, a tip of the disc is suspended from the valve body like a hinge so that it moves freely in the direction of the flowing fluid. The fluid is allowed to advance almost in a straight line as the disc swing up by approximately 60 degrees from its vertical position. When the flow comes to a halt, the disc's weight returns it to the vertical closed position. When pressure is applied from down-stream, the disc is pressed against the valve seat, creating a seal and preventing fluid back flow. The structure of the swing check valve is designed to minimize pressure loss and allow smooth flow of the fluid. This makes the valve suitable for use in horizontal piping as well as vertical piping in which the fluid flows upward from below. Swing check valves are used mainly for large-diameter pipes. Its disc shape is flat.

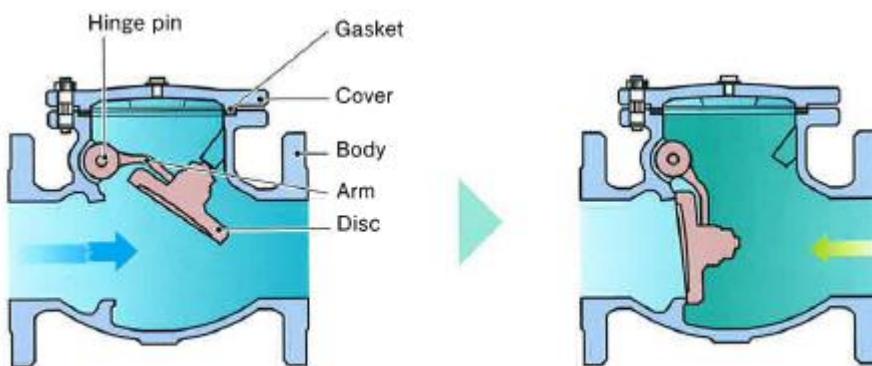
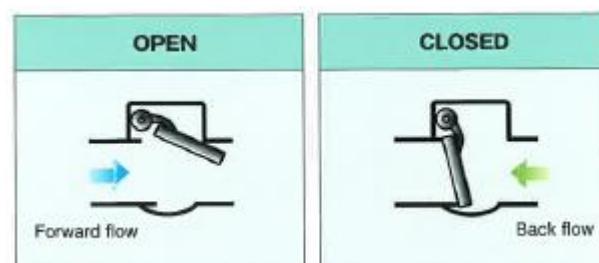


Fig.5 Swing Check Valve

When a detached valve needs to be re-attached, pay attention to the direction it is facing; if it is facing in the opposite direction the disc will malfunction.



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(2) Lift check valve

The structure of the lift check valve is that of a globe valve without a stem, handle and other parts for opening/closing operation and to which a cover has been added. The fluid flow pushes up the disc. As the flow comes to a halt and back pressure is applied, the disc is lowered and comes into contact with the disc seat, thus preventing fluid back flow.

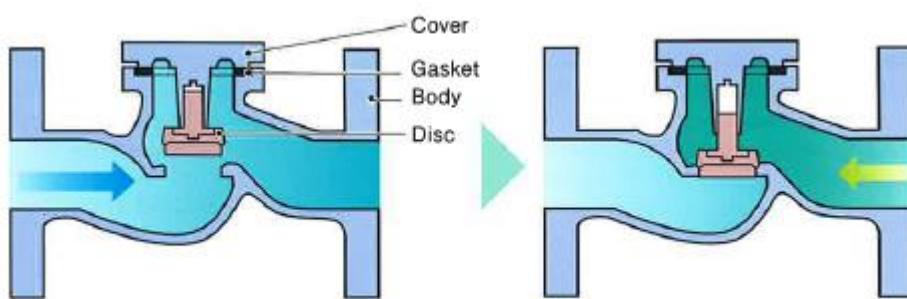
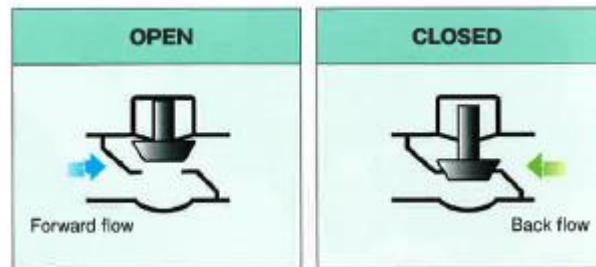


Fig.6 Lift Check Valve

The disc is either conical or cylindrical. The disc motion is straight and parallel with the direction of fluid flow. Because of its significant fluid resistance, this type of valve is used for small-diameter pipes.



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7.5 Ball Valve

The ball valve is similar in structure to a cock. Its disc is ball-shaped and a soft seat is incorporated in the body's valve seat. The lever handle type ball valve is opened/closed by turning the lever handle 90 degrees. The gear handle type valve is either an actuator type or a handle type due to the greater force required when opening/closing large-diameter pipes.

While the soft seat material used in the ball valve offers excellent air-tightness thanks to its mechanical and physical properties, it does have its limitations when it comes to high-temperature applications. The ball valve is suitable for "On/Off motion" opening/closing operations using a generally available soft seat, but it is not suitable for semi-open/-closed operations.

The disc motion is rotary and is at the right angle to the direction of fluid flow. The disc is ball-shaped.

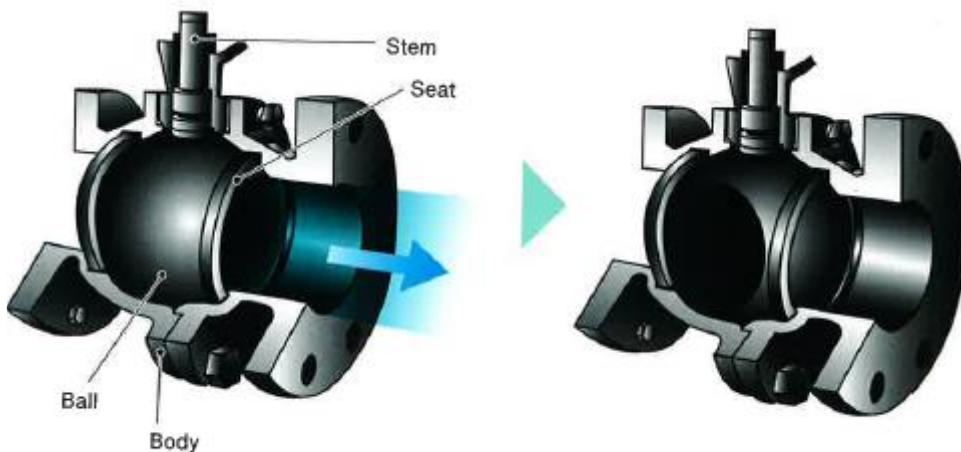
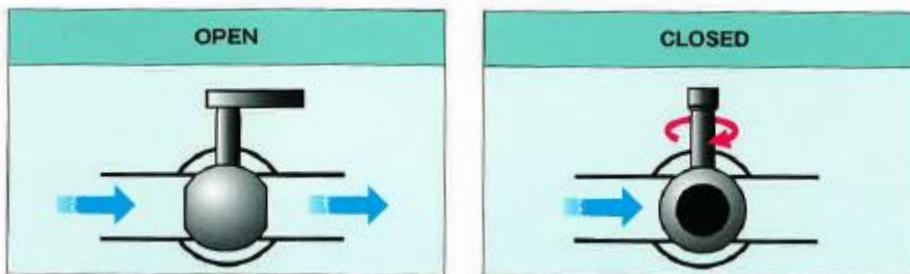


Fig.7 Ball Valve



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7.6 Needle Valve

Variations of the globe valve include the angle valve, used mainly for corners, and the needle valve, the flow-regulating function of which is made possible by a cone-shaped disc. The needle valve has a needle-shaped disc that moves in the direction of the fluid flow, making the flow easily controllable. It is used for flow control that requires fine adjustments.

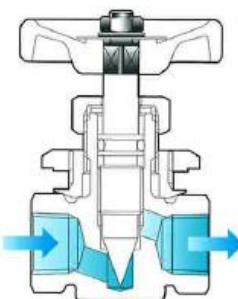


Fig.3 Needle Valve

7.7 Cock Valve (Plug Valve)

The cock valve uses a plug (reverse cone-shaped) with vertical slits in place of a disc. The cock valve's structure is that the plug is vertically positioned relative to the flow direction and turns 90 degrees to allow the fluid to move or stop. The plug and the plug seat fit well and are in close contact with each other, and the area of contact is relatively large. This enables a high degree of air-tightness and prevent damage to the contact surface. But a lubricant that agrees with the characteristics of the target fluid must be chosen.

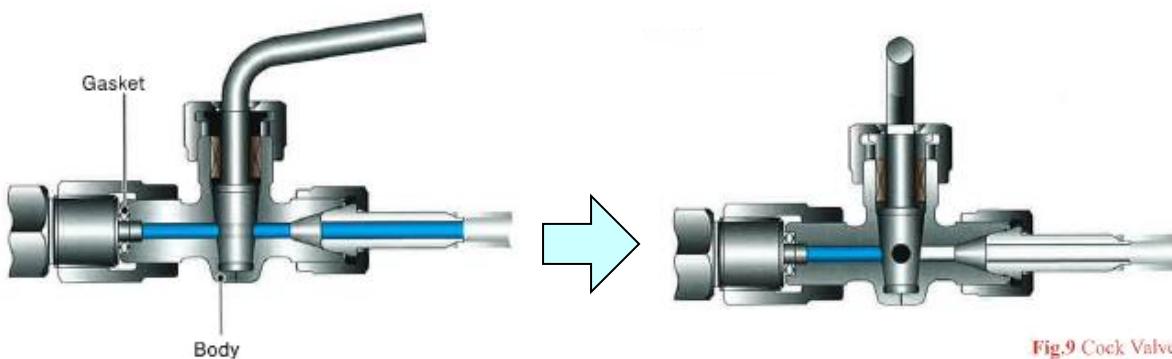
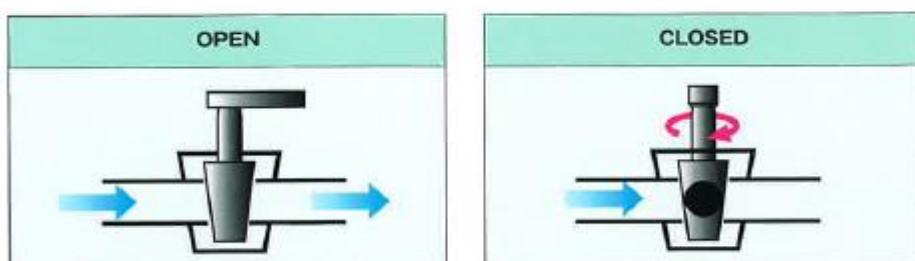


Fig.9 Cock Valve

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7.8 Diaphragm Valve

The fluid passage of the diaphragm valve consists of a diaphragm and valve body. Fluid flow is regulated by pressing the diaphragm against or separating the diaphragm from the inner surface of the valve body.

Diaphragm valves do not require packing, making them leak-free, but the material used for the diaphragm limits the valve's use to certain temperature and pressure ranges.

At the center of the valve body is a weir that is opened or closed by the diaphragm.

This valve is suitable for controlling the flow of slurry fluids, but fluid controllability in the low fluid flow range is relatively poor.

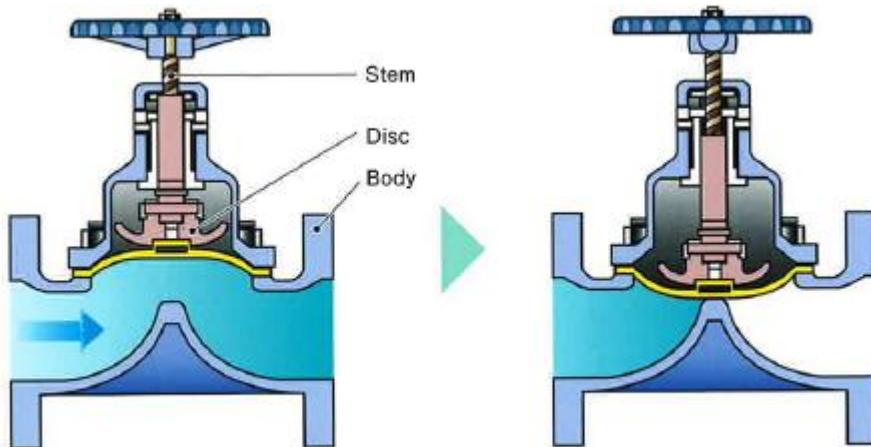


Fig.10 Diaphragm Valve

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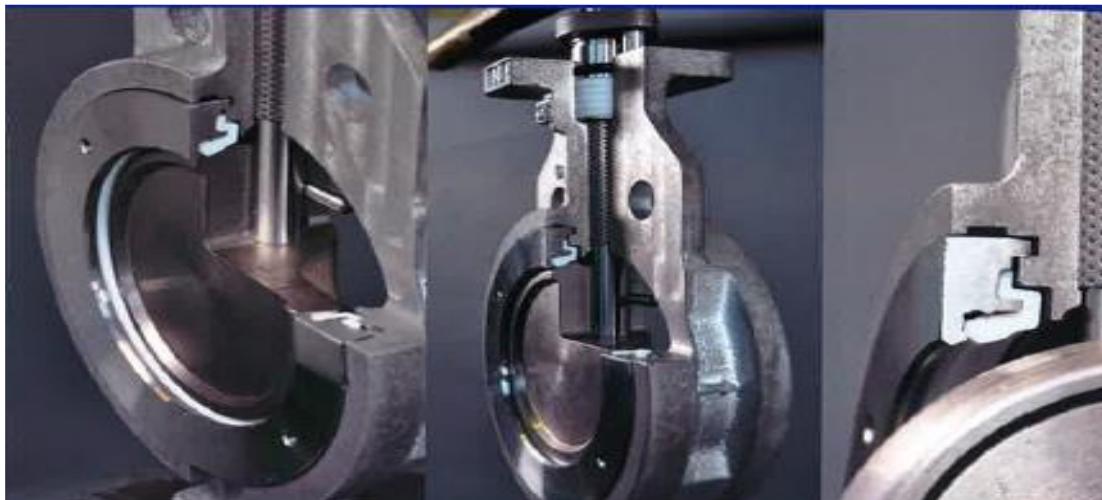
Comparing the Structures and Features of Globe, Gate, Ball and Butterfly Valves

Table 2-1

Item	Gate valve	Globe valve	Ball valve	Butterfly valve
Disc when valve is full open	Doesn't remain in passage	Remains in passage	Doesn't remain in passage	Remains in passage
Disc motion	Up and down	Up and down	Rotary	Rotary
Manual operation	Round handle	Round handle	Lever handle Round handle	Lever handle Gear operation
Automatic operation	Pneumatic/ electric actuator	Pneumatic/ electric actuator	Pneumatic/ electric actuator	Pneumatic/ electric actuator
Purpose of use	On/Off	On/off, control	Mainly On/Off, automatic valve, control possible	Mainly On/Off, automatic valve, control possible
Working temperature range	Wide	Wide	Narrow	Very narrow
Working pressure range	Wide	Wide	Slightly narrow	Narrow
Face-to-face spacing	Large	Largest	Large	Small
Weight	Heavy	Heavy	Heavy	Light

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7.9 Seals



Seals refer to parts and materials that prevent fluids (liquids and gases) from leaking out of mechanical devices, valves and other pressure vessels or structures. As such, seals perform a vital role in properly maintaining machinery performance.

(1) Gaskets

A valve incorporates the valve disc, which shuts off the internal pressure, and the stem, which opens or closes the disc. A gasket is sealing material inserted into the connection endpoint of the valve body and bonnet, which is then tightened and fixed with bolts and nuts.

Gaskets are used as seals at the endpoint (flange) of pipe-to-pipe or pipe-to-equipment connection and at a pressure vessel manhole, thus preventing fluid leakage out of the piping system and foreign materials from entering the system.

Soft gaskets like O-rings or rubber sheets are used for fluids with high pressures and/or high temperatures. Sealing tape, used widely on threaded parts, and liquid seals are also common.



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(2) Packing

Packing refers to the soft and lubricious sealing material applied to the stern, which penetrates the valve from the bonnet, and in between the rotation axis and its stationary counterpart. Seals are classified into contact and non-contact seals. With the former, the seal is in contact with the moving part. Contact seals vary according to purpose. Self-seal packing uses a fluid's pressure to enhance the seal; O-rings and lip packing are two examples of self-seal packing. Conditions of use will determine the performance requirements of the seal, the characteristics of which vary according to type. In general, the seals must be strong enough to resist pressure deformation caused by the fluid being sealed.



(3) Conditions for Use of Gaskets and Packing

It is essential that you choose the sealing material best suited for the conditions of intended use since gasket and packing performances always involve the direct risks of fluid leakage.

Packing and gaskets must be of sufficient strength to withstand the tightening power of bolts. Weakly tightened bolts degrade the performance of the valve and result in leakage. Conversely, excessively tightened bolts will damage the valve, again lowering its performance. In such circumstances, the bolts are also subjected to excessive stress. Therefore it is necessary to tighten the bolts to the appropriate level – no less and no more, and avoiding uneven tightening. Packing and gaskets must exhibit the following characteristics: they do not allow the fluid temperature and/or the ambient temperature changes; and, within their rated working temperature range, they do not soften or degenerate at high temperatures or solidify at low temperatures.



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(4) Soft Gaskets

Rubber O-rings

O-rings are ring-shaped rubber moldings with a round cross section. In addition to use as gaskets, they are also used as packing for reciprocating motion.

O-rings are used after being set into a groove. They are used widely as seals for hydraulic and pneumatic equipment as well as for reduced pressure and vacuum applications thanks to their excellent sealing performance and ease of setting. O-ring's withstand pressures are 10 atmospheres when used as packing, and up to 1MPa when used as a gasket.

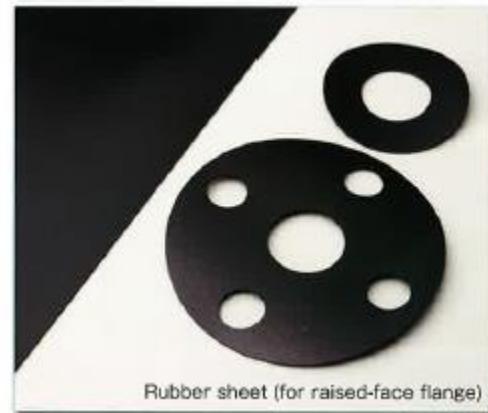
Silicone rubber O-rings cover a wide temperature range of -60~230, while those of nitrile rubber have a range of -30~120. Inserted into a groove, O-rings can withstand pressure of up to 25MPa.



Rubber Sheets

(Gaskets taking adventure of rubber's elasticity and resiliency)

Rubber sheet gaskets are die cut from sheets of rubber 1.0mm to 3.0mm in thickness. Rubber materials include natural rubber nitrile rubber, chloroprene rubber, ethylene-propylene rubber (EPR), butyl rubber, silicone rubber, fluoro rubber and perfluoro rubber – the type used for a specific application will depend on the weather ability, chemical resistance and heat resistance characteristics required. Rubber sheets offer superb sealing and are frequently used for raised-face flanges because of the larger contact surface area.



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(5) Gland Packing

Gland packing is a braid, the material of which has been impregnated with a lubricant. It is cut into appropriate lengths and stuffed into the valve's gland section, surrounding the rotating axis.

Gland packing is usually used in three to five layers, one layer placed on top of another, which are then covered with a gland and bolt-tightened to provide compression for sealing. Reasonably priced and easy to use, gland packing is quite common. After being set in position, the tightening bolt should be adjusted to the appropriate torque.

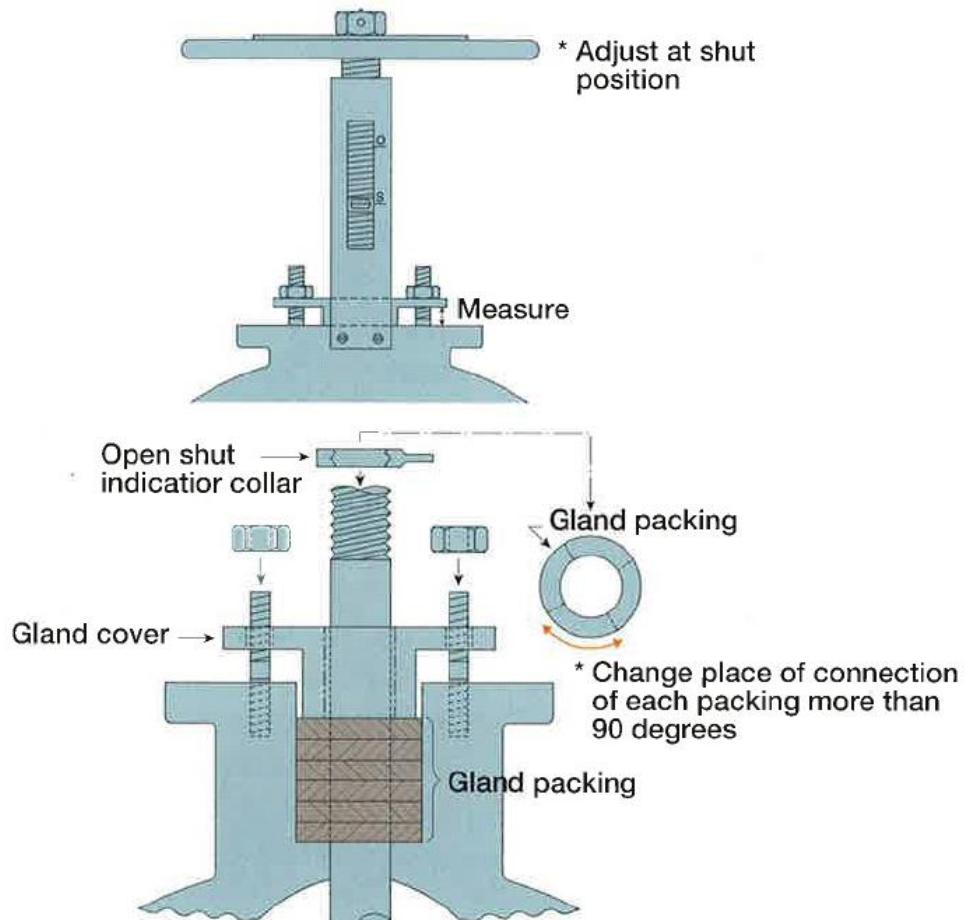


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How to replace Gland Packing to a Valve

- (1) Put valve position on "Shut".
- (2) Remove split pin, nuts, washers, name plate and handle in order to top to draw.
- (3) Remove indicator plate of "Open" and "Shut".
- (4) Remove an indicator collar.
- (5) Remove nuts of control weight.
- (6) Remove gland weight collar from the handle rod.
- (7) Remove gland packing using a special tool or a needle for canvas sawing.
- (8) Fill new packing into the trench.(usually 4 to 6 piece of packing fitted.)
- (9) Restore in order of the above reverse (5) to (1).

- Valve packing used in steam-pipe system shall be carefully installed, because the steam can not be easily stopped. It is effective to apply graphite grease or Molykote to packing. In the case of packing used in the water system, grease will be appropriate.



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8. HYDRAULIC SYSTEM

Hydraulic System is used for equipments which control heavy things such as a crane, a lift and a press machine. In addition, Hydraulic Actuation System has characteristic performance such as stable speed properties, a large force of press and ability to stop in a medial position. Its performance is the important element to the industrial equipment.

For operate and maintenance of hydraulic system, you may understand the function of power when it pressures a liquid and the characteristic of the hydraulic fluid. Also it is important to acknowledge the constructional and functional aspects of hydraulic actuators.

8.1 Characteristic of Oil pressure

Advantages

- Creation of large forces and torques, high energy density
- Ability to regulate force easily and correctly by adjustment pressure
- Easy to operate automatically and remotely
- Simple overload protection (no damage in case of overload)
- Simple monitoring of load by measuring pressure
- Ability to regulate speed of force easily by adjustment flow.
- There is little vibration and smooth movement
- Durable

Disadvantages

- Hydraulic oil is easy to burn thus the risk of the fire
- Pumping is complicated than electric wiring and air circuit. Also it is in danger of oil leak
- Temperature of hydraulic fluid influences conditions of operation of a hydraulic actuator (velocity).
- Loss of the energy is **huge** due to conversion of energy of oil pressure
- There is a limit of velocity of hydraulic cylinder and hydraulic motor due to a limit of velocity of Hydraulic fluid
- The hydraulic actuation may have a problem if the hydraulic fluid contains excessive air.

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8.2 System Components

The purpose of hydraulic system is well controlling to hydraulic actuator. The equipment, which constructs hydraulic system necessary to hydraulic actuator, can be classified into five elements. (See the table below)

Hydraulic pump	<ul style="list-style-type: none"> A pump to take up oil from an oil pressure tank, and to supply oil to an oil pressure circuit Usually it is driven with electric motor Divided into two categories, 'fix displacement pump' and 'variable displacement pump'
Oil tank	<ul style="list-style-type: none"> A tank to save oil to supply into an oil pressure circuit and receive oil returning
Hydraulic actuator	<ul style="list-style-type: none"> An actuator is a device that converts the pressure energy of oil to mechanical energy, and is used in the valve driving unit.
Hydraulic valve	<ul style="list-style-type: none"> Valves such as Pressure control valve, Flow control valve and Directional control valve
Accessory equipments	<ul style="list-style-type: none"> Equipment, as useful secondarily to oil pressure circuit, such as plumbing, coupling, filter, air breather, pressure gauge, oil temperature-meter

(1) Hydraulic pumps

Hydraulic pump is a pump to take up oil from an oil pressure tank to supply oil to an oil pressure circuit. Generically, the pumps are driven with electric motor. All pumps are divided into two categories, 'fix displacement pump' and 'variable displacement pump'. They have different character and therefore the structure of hydraulic system differ with the kinds of pumps. The pressurized oil made with a hydraulic pump is called pressure oil.

The object of hydraulic pumps is operation of the actuator by providing pressure oil to hydraulic actuator. It needs to provide high pressure and plenty of pressure oil in order to secure enough pressure and capacity for actuator. It is important to choose and design of equipment constitutes hydraulic circuit around the hydraulic pumps for safety use.



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(2) Oil tank

Oil tank is a tank to save oil to supply into an oil pressure circuit and also receive oil returning via the drain port of the oil pressure circuit. The oil tank takes the role of cooling and depositing sediment the oil which returned from all over the circuit and was warmed by the pressure.

(3) Hydraulic actuator

A hydraulic cylinder and hydraulic motor that convert hydraulic power into useful mechanical work are called hydraulic actuator. For well control of the hydraulic actuator you must consider many factors of it. Examples follow.

<Effect of setting state>

- Speed and direction of force
- Pressure differences between working and stop working
- Size and variation of the load
- Friction load and inertial load
- Gravity

<Safety>

- Limit of pressure and capacity in oil pressure circuit
- Speed and power control while working
- Safety when unexpected stop

Also you should not forget effect of the characters of elements constituting an oil pressure circuit of hydraulic valve such as flow control valve, directional control valve and pressure control valve (e.g. reducing valve, relief valve) on the speed and force of the actuator.

(4) Hydraulic valve

Controlling the actuator means controlling size, speed and direction of output. This is called Three Elements of Work which are OUTPUT (strength of force), SPEED (speed of force) and DIRECTION (direction of force).

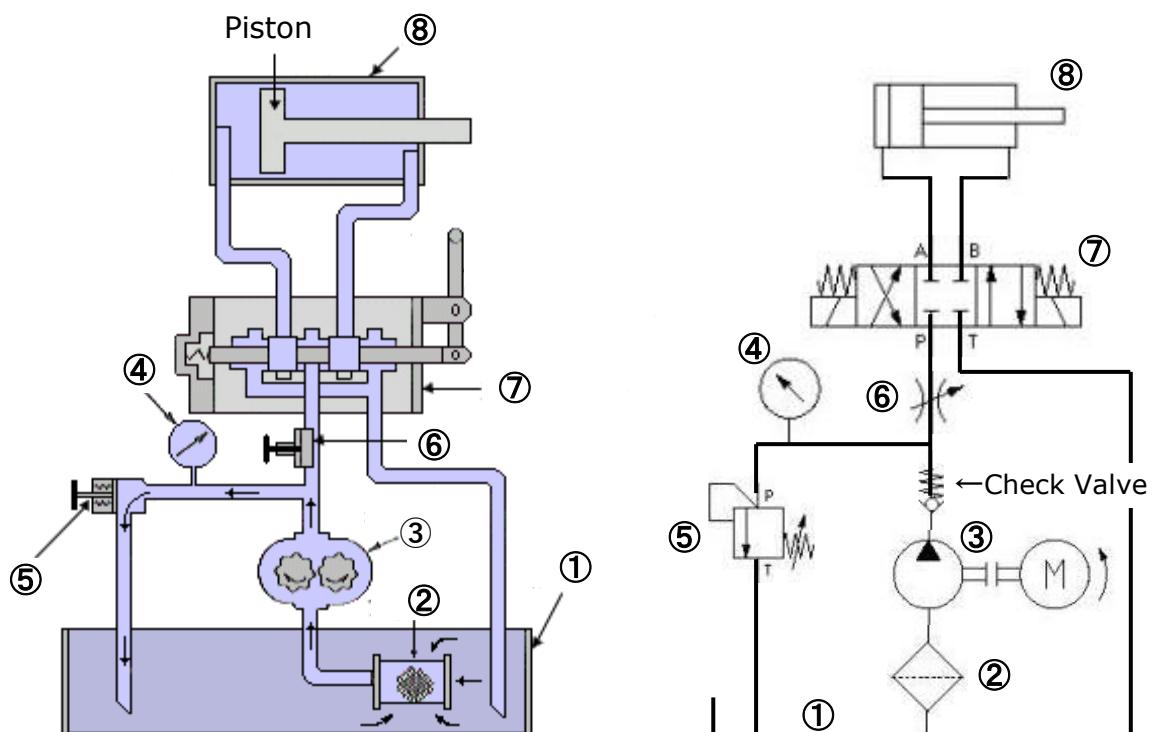
Hydraulic valves are for controlling Three Elements of Work.

- (1) Pressure control valve : Control the strength of force
- (2) Flow control valve : Control the speed of force
- (3) Directional control valve : Control the direction of force

(5) Accessory Equipment

Equipment, as useful secondarily to oil pressure circuit, such as plumbing, coupling, filter, air breather, pressure gauge, oil temperature-meter.

It is necessary to know the characteristic of each apparatus. The plumbing includes a metal pipe, a flexible hose and so on. There is different characteristic each, for example around the connector part of way of the oil in the plumbing become narrower due to one-touch coupling which uses for putting on and taking off a flexible hose.



- 1 – Oil Tank
- 2 – Filter
- 3 – Pump
- 4 – Pressure Gauge

- 5 – Pressure Relief Valve (Safety Valve)
- 6 – Flow Control Valve
- 7 – Direction Control Valve
- 8 – Hydraulic Cylinder

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8.3 Failure of the hydraulic valve and the hydraulic system

If the hydraulic valve or the hydraulic system fails, the valve should be operated using the emergency hand pump. However, the actions to be taken differs depending on the type of failure that has occurred.

(1) Measures against failure of solenoid valve

(If installed in the accommodation space (hydraulic pump unit room))

- 1) If remote operation from the CCR is not possible, press the manual operating buttons to the left and right ends of the solenoid (open/close sides) using the tip of a screw driver and close or open as required.

However, if the abnormality is in the open side of the open-shut valve, even if it is opened, it may be excited to initiate closing and the valve may be closed.

- 2) If remote operation is not possible even after performing the procedure in 1), the solenoid is likely to be defective (open or closed side of the solenoid) and it should be renewed. There is no need to shut off the power for removing the defective part and replacing it with a spare. Moreover, no tools are required for the replacement, and the replacement work can be easily performed.

3) Operating the valve using the hand pump

Hand pump can be directly connected to the valve actuator and the valve can be opened or closed. If the solenoid valve itself has failed, the power needs to be shut off. However, to avoid shutting off the power, the power unit of the solenoid valve can be removed and the hand pump can be used for opening/closing the valve. Remote operation of other valves can also be performed in this way. The connector for the hand pump is installed near the solenoid valve chamber. Fully open or fully close the valve at the selected position while observing the flowmeter on site. Follow the procedure given below for operating the valve using the hand pump.

- a) The hand pump cannot be connected easily to the self-seal coupling since it is subjected to pressure. Therefore, release the pressure by pressing against the connector strongly with a flat tool.

With this action, there is a possibility that hydraulic oil at high pressure may spray out. If it does, use cotton waste to suppress the hydraulic oil. If you use the "air bleed handle provided with the self-seal coupling," you can easily release the pressure.

- b) Fit the self-seal coupling after releasing the pressure.
- c) Set the hand pump selector lever to the "Open" or "Close" side and operate the hand pump.

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(2) Measures against failure of solenoid valve

(when solenoid is in the local box on the upper deck)

The measures below are to be adopted when the solenoid valve cannot be replaced and hydraulic pump cannot be stopped since the system is working during the cargo handling operation, and moreover, when the hydraulic stop valve of the local box cannot be closed. Under such conditions, all valves other than the valve with the abnormality can be remotely operated from the CCR.

1) Open-shut valve

- a) Remove both the closing and opening sides of the power unit of the solenoid in the open-shut valve.
- b) Since hydraulic pressure is acting on one of the connectors fitted to the self-seal coupling of the hand pump, release pressure by pressing against it strongly with a flat tool.

With this action, there is a possibility that hydraulic oil at high pressure may spew out. If it does, use cotton waste to suppress the hydraulic oil. If you use the "air bleed handle provided with the self-seal coupling," you can easily release the pressure.

- c) Fit the self-seal coupling after releasing the pressure.
- d) Set the hand pump selector lever to the "Open" or "Close" side and operate the hand pump.
- e) Fully open or fully close the valve at the selected position while observing the flowmeter on site.
- f) In the fully closed condition, the valve cannot open and remains closed due to the mechanical locking mechanism.

2) Valve whose degree of opening can be adjusted

- a) Set the valve position at the CCR to neutral for valve whose degree of opening can be adjusted.
- b) Fit the self-seal coupling.
- c) Set the hand pump selector lever to the "Open" or "Close" side and operate the hand pump.
- d) Fully open or fully close the valve at the selected position while observing the flowmeter on site.
- f) In the fully closed condition, the valve cannot open due to the mechanical locking mechanism.
- g) If the valve remains excited even if its position is set to "Neutral," remove the power supply unit.

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3) Directly operating the valve in the pump room

- a) The valve can be operated regardless of whether the hydraulic system is operating or not.
- b) The valve can be operated regardless of the position of the valve operating knob in the CCR.
- c) Close the stop valve in the hydraulic pipe connected to the actuator of the valve.
- d) Remove the self-seal coupling (hydraulic pipe) fitted to the valve.
- e) Fit the self-seal coupling of the hand pump to the relevant part.
- f) Set the hand pump selector lever to the "Open" or "Close" side and operate the hand pump.
- g) Open or close the valve fully at the selected position while observing the open/close indicator visible from outside the valve body.

(3) Measures against damage to the hydraulic piping in the tank

If the hydraulic piping in the tank is damaged, the valve cannot be operated even if the hydraulic system is operating normally. Free the gases in the tank containing the valve and repair the hydraulic piping.

If the discharging operation is in progress, the schedule needs to be changed by switching over from the tank main valve to the tank stripping valve for discharging the said tank. Depending on the oil remaining in the tank, the discharging time may be delayed, but there should not be any problem in the discharging operation itself.

1) Measures to be adopted when the damage to the hydraulic piping in the tank is minor

- a) Rotate the needle valve* of the solenoid valve in the local box counterclockwise and increase the flow rate of the hydraulic oil.

At the normal flow rate, the valve cannot be operated because of leaks in the hydraulic line in the tank. For this reason, the flow rate should be increased so as to compensate for the amount lost due to leaks.

- b) Turn the valve operating knob in the CCR to open or close the valve.
- c) If the oil leak is minor, then the valve operates.
- d) If cargo handling operation is continued with the existing condition, the hydraulic oil may flow continuously out of the tank, and the oil will have to be replenished in the hydraulic pump unit room. If no further action is taken, the hydraulic pump trips due to low sump tank oil level.

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2) Measures to be adopted when the damage to the hydraulic piping in the tank is major

- a) Rotate the needle valve* of the solenoid valve in the local box counterclockwise, increase the flow rate of the hydraulic oil, and estimate the magnitude of the damage.

If a large amount of hydraulic oil is leaking out and if you operate the valve from the CCR, the sound of a large amount of hydraulic oil flowing through the needle valve can be heard.

- b) The valve cannot be operated if a large amount of hydraulic oil is flowing through.
- c) When the main suction cannot be used, discharging has to be carried out using the stripping line.
- d) Rotate the needle valve of the said solenoid valve in the clockwise direction and fully close it. Leakage of hydraulic oil can be stopped by this action.

By this method, all valves other than the valve in the damaged hydraulic line can be operated remotely in the normal manner. If the hydraulic stop valve in the local box is closed, all valves in that local box cannot be used.

- e) This instance refers to damage to the hydraulic piping, and the valve cannot be operated even by using a hand pump.

* What is a needle valve? (See Fig.)

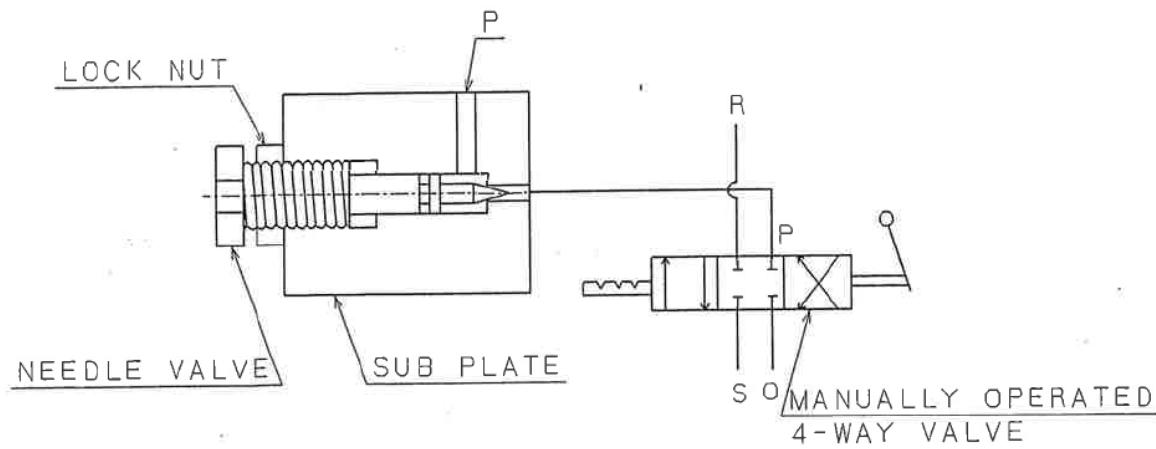
The needle valve (flow control valve) is fitted to the solenoid valve and is used for adjusting the flow rate of hydraulic oil in the valve.

If turned clockwise, the valve is throttled and the flow rate decreases; if turned counterclockwise, the flow rate increases.

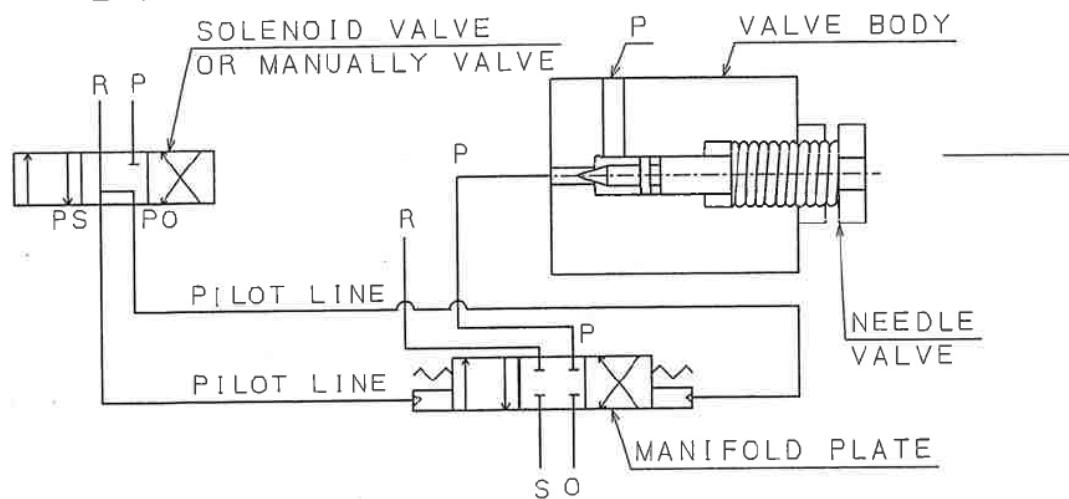
Adjustments to the speed of opening/closing the valve are performed using this needle valve. The needle valve has a lock nut, which should always be locked after performing adjustments.



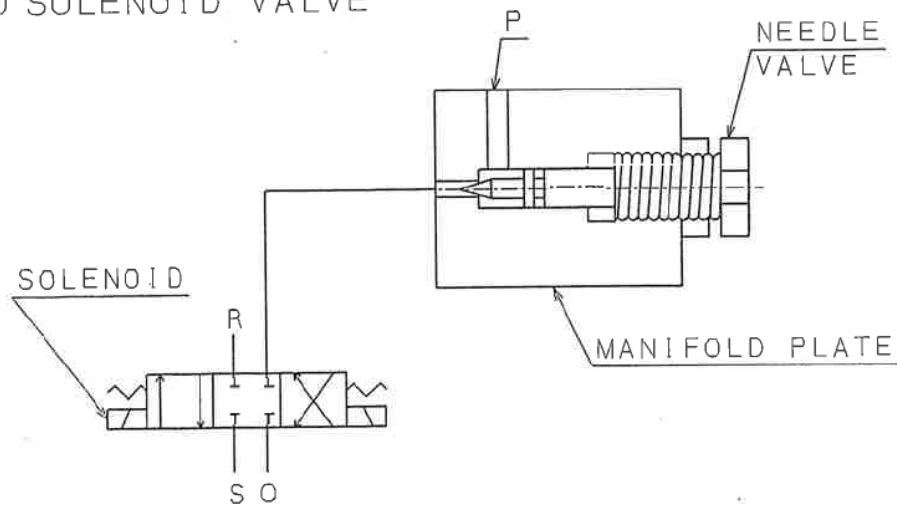
(1) MANUALLY OPERATED 4-WAY VALVE



(2) PILOT OPERATED 4-WAY VALVE



(3) SOLENOID VALVE



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(4) Measures when the hydraulic motor of the hydraulic pump unit fails

The hydraulic pump unit has two hydraulic motors of identical capacity. Normally, one motor is in operation while the other is in the standby condition. If several valve operations are performed together, the hydraulic pressure will drop but the standby motor operates automatically due to the backup mechanism and maintains the designated pressure. When no backup mechanism is provided, the standby motor should be operated manually.

Even if one of the motors has failed, the other can be used for cargo handling operation.

(5) Measures when the accumulator pressure drops

Sometimes the pressure of nitrogen gas charged in the accumulator* drops or the rubber bag in the accumulator becomes holed and the designated pressure cannot be maintained. This abnormality can be detected since the hydraulic pump repeatedly loads/unloads around the designated pressure even when the valve is not operated. The nitrogen gas should be charged or the accumulator replaced after the cargo handling operation is completed. This action is also repeated frequently when the predetermined pressure for loading/unloading is abnormal.

*** What is an accumulator?**

An accumulator is a device that maintains the operating pressure by accumulating and releasing oil using the compressibility of gas. The main reasons for installing the accumulator are:

- 1) To release the accumulated high pressure oil into the hydraulic circuit, cut down the working time and to save energy
- 2) To use the accumulator to maintain pressure
- 3) To prevent surge pressure that occurs in the piping system

8.4 Bleeding out air from the hydraulic piping

(1) Inspection

If the air in the hydraulic piping has not been bled out adequately, abnormal noise generally occurs during operation of solenoid valve. The phenomena mentioned below may occur in the flowmeter type valve position indicator and the valve position transmitter. In these cases, air bleeding work is necessary.

- 1) The pointer instantaneously swings out when the valve is operated.
- 2) The pointer does not swing smoothly when the valve is operating

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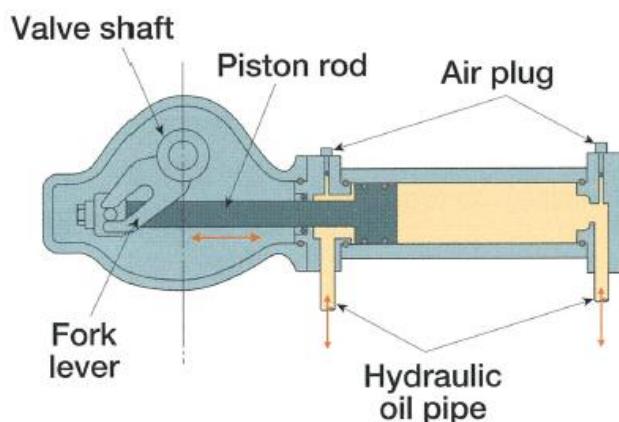
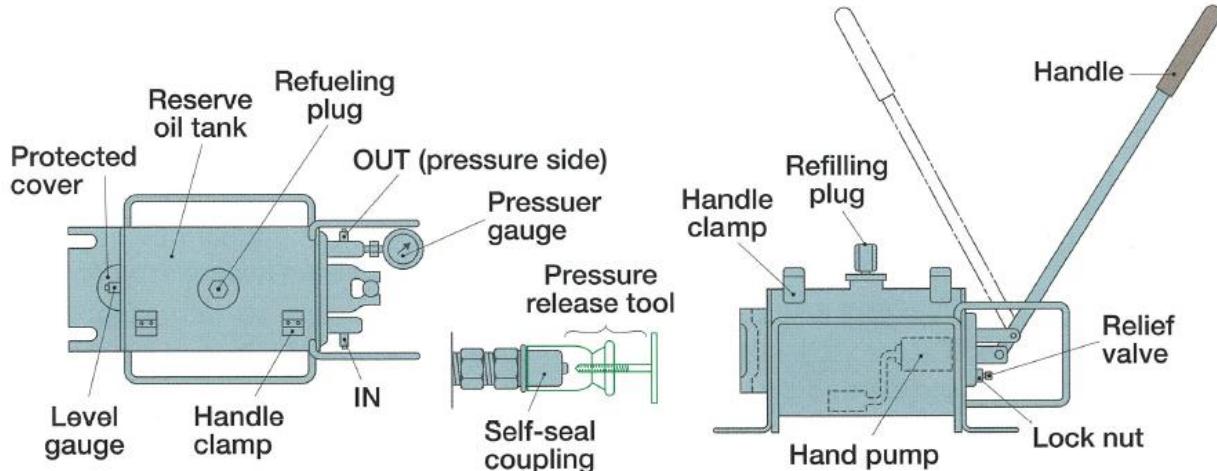
- 3) Regardless of whether the valve is fully open or fully closed, the lamp in the valve position indicator on the CCR console does not stop flickering.

(2) Air bleed procedure

Connect the hydraulic hand pump to the self-sealing coupling in the hydraulic unit (solenoid valve, etc.) from which air is to be bled. On the other hand, air purge and pressure release valve unit is to be connected to the self-sealing coupling (plug type) of the actuator on the valve side. Connect a plastic hose to the plug of the air bleed valve and keep an oil receiving can or drum ready.

Open the air bleed valve on the return side of the hydraulic actuator while repeatedly opening/closing the valve using the hydraulic air pump and bleed out the air in the hydraulic piping.

If air is included in the hydraulic piping, milky white operating oil can be observed coming out of the air bleed valve. Open and close the valve repeatedly until air is bled out completely and transparent operating oil comes out of the air bleed valve.



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8.5 Emergency Hand Pump

(1) Construction and Function

This pump is provided to be used in such emergencies as occurrence of failure in the hydraulic equipment and piping.

It can be operated through the lever provided to the hand pump up and down to produce the required hydraulic pressure to the hydraulic cylinder.

This pump is fitted with the manually operated 4-way valve which makes it possible to open and close the piping valves to change flow direction.

Two high pressure hoses are attached; their both ends are equipped with the self-seal coupling.

(2) Method of operation

To change over from the hydraulic operation by the hydraulic unit the emergency manual operation, close first of all the stop valve mounted in the piping. Upon shutting down the stop valve provided either in the pipe line or manifold plate drain the hydraulic oil through the pressure release valve and connect the self-seal coupling fitted at the end of high pressure rubber hose attached to the hand pump and the self-seal coupling of the piping.

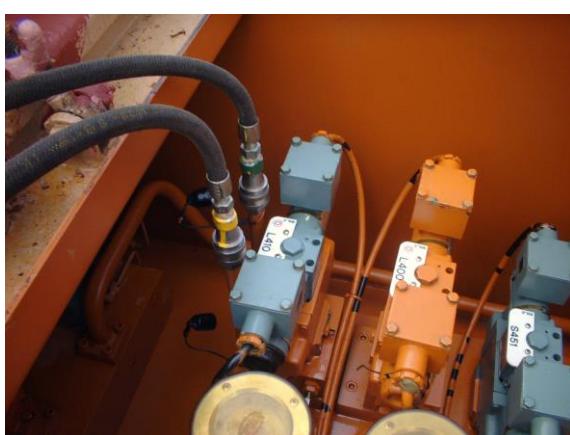
Actuate the lever of the hand pump up and down.



The opening and closing of pipeline valves should be controlled through manually operated 4-way valve.

If hydraulic oil is delivered to O, the pipeline valve is opened and if it is sent to S, the pipeline valve is closed.

To shift the operation from the manual actuation to the hydraulic operation of the hydraulic unit, disconnect the self-seal coupling to fully open the stop valve.



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(3) Cautions

When operating the hand pump, the eventual inclusion of air inside the piping will force air to shift to the hydraulic cylinder by way of the operation of hand pump. This will cause the valve to operate in an unstable manner and therefore open in the beginning the hand operated 4-way valve of the hand pump (by turning it to left) to purge air.

After making sure the oil is drawn sufficiently in this way, close the valve handle and connect the self-seal couplings.

Remove rubber cap when connection is to be executed, and replace it upon completion of connection.

(4) Inspection

This pump will seldom be involved in a trouble.

If it fails to produce pressure, check if sufficient oil is filled in the oil tank through the level gauge.

If not, supplement oil.

8.6 Self-Seal Coupling & Air-and Pressure Draw Valve Unit

(1) Self-Seal Coupling

This is an easy-to-mount push pull type coupling which allows connection and disconnection of the piping circuits without using screw joints.

"PUSH-PULL TYPE" means that the coupling is engaged by only applying push motion to allow the oil flow and is disengaged by pulling motion to interrupt the flow. This coupling is divided into socket and spigot ends; each has a built-in type valve which is pressed to the seat by the thrust force of a spring.

It is so designed that by pressing the spigot end into the socket end the valve is automatically opened to allow the oil to flow.

To disengage the coupling, the sleeve is to be pulled too.

Without this motion, it will never be disengaged.



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(2) Air Purge & Press. Draw Valve Unit

This unit is so devised as to make the drawing of air included in the oil hydraulic pipe line by use of the self-seal coupling which built-in each oil hydraulic unit.

The construction of this unit means the air draw valve is fitted at the screw part of socket type self-seal coupling as shown on below, and which is kept the spare parts box usually.

Before making of air drawing, connect the vinyl hose to the plug 3 of "Air Purge Valve", and prepare the oil can, and connect the socket type self-seal coupling to the plug type self-seal coupling built-in the oil hydraulic unit.

And, after completion of above preparation, open the air draw valve at return side, and draw out the air from the oil hydraulic actuator while repeating of valve open/close operation several times.

After completion of air drawing work, the air purge & press. draw unit should be kept in the spare parts box.



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8.7 Dehumidification and inspection of solenoid box



Photo on the right shows how a solenoid box protected from rainwater with a canvas cover.

Below photo shows how a dehumidifier (silica gel) is placed to remove humidity resulting from dew condensation due to a temperature difference between the solenoid box inside and the external atmosphere.

As the dehumidifier loses its effect after a certain amount of time, keep in mind that, the dehumidifier needs replacement at proper intervals (usually every six months).

Photos on the left upper, shows a solenoid box in which the solenoid of a remote control valve is to be housed.

When checking the inside of the solenoid box, it is important to make sure that no hydraulic oil is leaking.

As a solenoid is electrical equipment, the inside of the solenoid box should be kept dry at all times.



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8.8 Failure of Remote Control Valve and Emergency Remedy

(1) Situation

A remote control hydraulic valve has become inoperable from the ballast console.

No oil leak has occurred on the upper deck; the hydraulic operation is running with no problem, with the oil pressure maintained at an appropriate level; no liquid level change is found in the working fluid tank; nor is there any possibility of oil leaking within any ballast tank.

(2) Assessment of the Situation

Checkup of the hydraulic line revealed nothing abnormal, nor is there any stuck solenoid. In view of these results, the problem was attributed to something wrong in the electric system involved in remote control, and it was decided to apply an emergency remedy to the remote control valve.

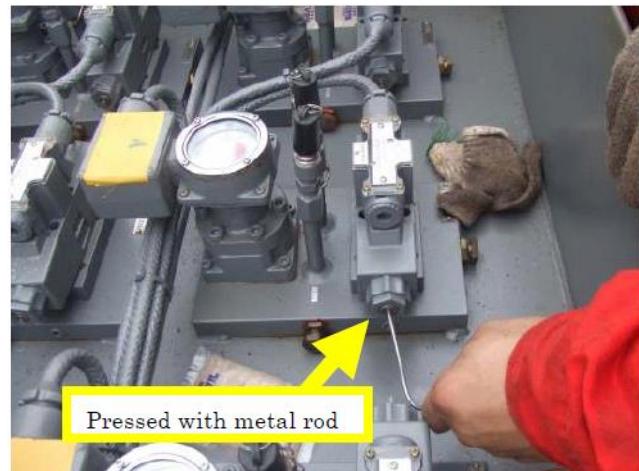
(3) Emergency Remedy

The problem with the remote control valve is attributed to something wrong in the electric system, and the valve is hydraulically opened and closed by forced excitation of the solenoids.

Solenoids for remote control valves are located in a solenoid box installed on the upper deck, or in the lower stool or the duct keel.

If any remote control valve becomes inoperable solely on account of a failure in the electric system—unless there is nothing wrong with the hydraulic system—the valve can be made operable by forced excitation of the corresponding solenoid.

Most types of solenoid are forcibly excited by pressing the forced excitation button of the solenoid with a metal rod.



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9. EMERGENCY REPAIR

9.1 DEVCON

The Devcon adhesive range has been designed to provide a high strength reliable bonding solution to suit most applications:

- Offer a wide range of working and fixture times to suit different applications
- Offer enhanced productivity
- Simplify the production process
- Provide easily applied products with minimal of training



In general, the following steps will help you properly prepare a surface prior to applying Devcon products:



Surface Preparation

- 1) Stop all leaks or seepage as follows:
 - Shut off the flow or pressure;
 - Fit a wooden peg or a sheet metal screw into the hole; or
 - Stuff wax, cork, plumber's caulk, Mortite or a cloth into the opening.
- 2) Make sure the surface is completely dry. Moisture will adversely affect the strength of the bond to the surface.
- 3) Remove all surface contamination (paint, rust and grime) by abrasive blasting, sanding or other mechanical means.
- 4) Degrease with Devcon Cleaner Blend 300.
- 5) Abrade the surface to roughen it and create a surface profile.
- 6) Use the appropriate Devcon primer.

Mixing

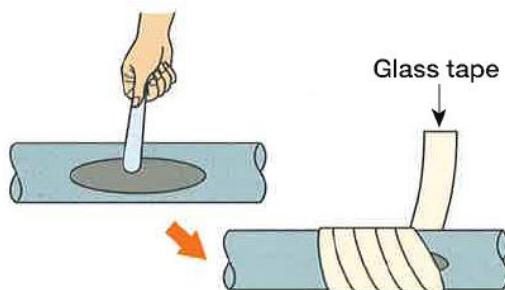
- 1) Add hardener to resin.
- 2) Mix thoroughly with screwdriver or similar tool until a uniform, streak-free consistency is obtained.

Application

Spread mixed material on repair area and work firmly into substrate to ensure maximum surface contact. DEVCON fully cures in 16 hours, at which time it can be machined, drilled, or painted.

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9.2 Multi-Metall oL (Repair for Hydraulic Pipe Line)



MM-metal ol-steelceramic is a PolymerMetal tested and certified for the repair of oily, greasy or fuel contaminated metals and alloys in case of stress due to cracks, corrosion, abrasion, impact or chemicals. The degree of soiling does not in any way affect the bonding with the structure of the soiled metal surface. High technical data and also the chemical resistance and bonding with the structure on a dirty metallic surface are remarkable features of MM-metal ol-steelceramic.

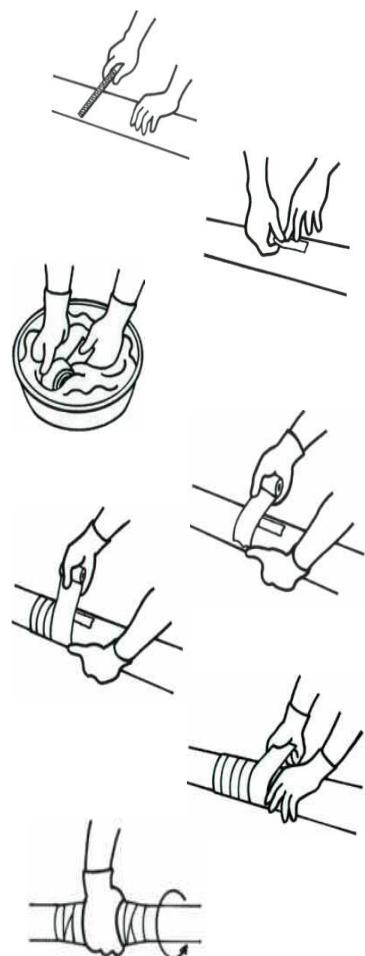
MM-metal ol-steelceramic is a two-component-product and can be either used with Hardener yellow or Hardener red. The Hardener yellow offers better technical data; the Hardener red is suitable for emergency and quick repairs or at non high-stressed repairs because of the short partial and full curing time. Possibly after the usage of Hardener red, a second overlapping coat with Hardener yellow should be done to achieve the better technical data. A metal component with two hardener components facilitates an efficient and practise-orientated use.

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9.3 Fiberglass Cloth (SYNTHOS-GLASS / MAHOTAI)

SYNTHOS-GLASS and MAHOTAI are fiberglass cloth impregnated with a water-activated urethane resin.

These are the products which are available for repairing a pipe as it is leaking and having a excellent feature not only for repairing, but for corrosion resistant, rust resistant, protection and reinforcement, UV rays, wind and rain of outside, changeable could and worm weather etc.



- 1) Clean off all loose scale, rust and other foreign objects.
- 2) Stop all leaks and wipe by thinner
- 3) Apply the rubber patch
- 4) Soak in temperate water
- 5) At the beginning wrap Syntho-Glass three laps to cover the all rubber patch.
- 6) Wrap tightly and 50% overlap is recommended
- 7) Squeeze and mold Syntho-Glass in the direction of wrap (approx. 1 min.).

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9.4 Replacement of seat ring of butterfly valve

If the valve seat ring is damaged and leakage occurs, safety measures such as gas freeing should be adopted and the seat ring should be replaced according to the procedure given below. Before starting the replacement work, always confirm that a spare seat ring is available.

- (1) Completely seal the remote controlled valve and display a warning so that it is not operated by mistake during the replacement work. Confirm that the valve is closed.
- (2) Close the hydraulic main valve and relieve pressure in the hydraulic piping. (If necessary, close the needle valve also.)
- (3) Remove the hydraulic piping connected to the actuator. Cover the removed hydraulic piping so that no dust enter it.
- (4) Remove the valve unit using hoisting equipment such as wire and chain blocks. However, if an appropriate eye plate for hoisting the valve is not available in the vicinity, be sure to assemble a adequate scaffolding (or a tripod) and then remove the valve.
- (5) If the flange fitted to the valve unit cannot be removed, fit an eye bolt to the pipe flange on one side, pull the valve in the opposite direction using a chain block or other means to create a clearance between the flanges, and then try to remove the valve. (If a hydraulic jack is available, then it can be used.)
- (6) Remove the seat ring bolts and then remove the seat ring. (After removing the seat ring bolts, strike the rear side with the hammer shank lightly ensuring that no scratches are caused. This action will displace the seat ring so that it can be easily removed.)



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(7) Clean the contact surface of the seat ring. (Clean using petrol.)

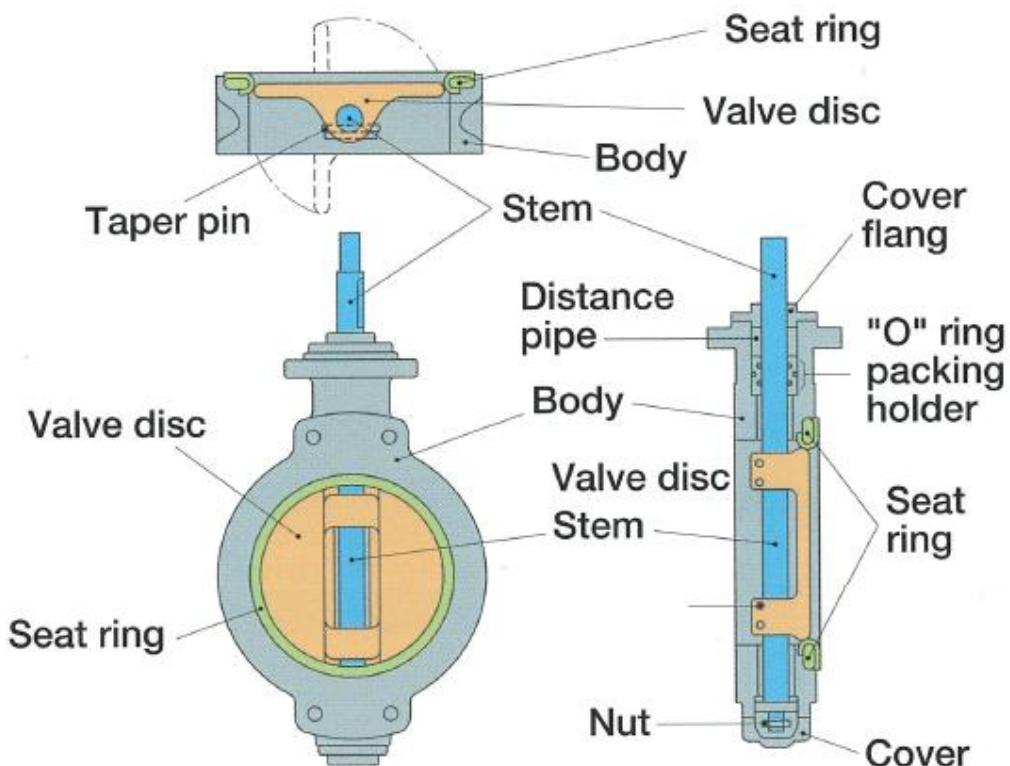
(8) Fit the new seat ring and check its seating condition.

(9) Hoist it again, place between the flanges and re-seat it.

(10) Tighten the bolts and secure the flange.

(Tighten the bolts at diagonal locations temporarily and then fully tighten them.)

(11) Fit the hydraulic piping, bleed out the air in the piping and then carry out the functional test of the valve.



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10. LIFESAVING APPARATUS

(Reference : ST/004/06)

(Reference : ZZ-S-P-10.30.01)

As a result of inspection, any defective parts should be repaired in accordance with following procedures. Any shortage of quantity should be supplemented to correct number. Defective parts other than the followings should be recorded along with their details and ordered for maintenance and repair by the manufacturers.

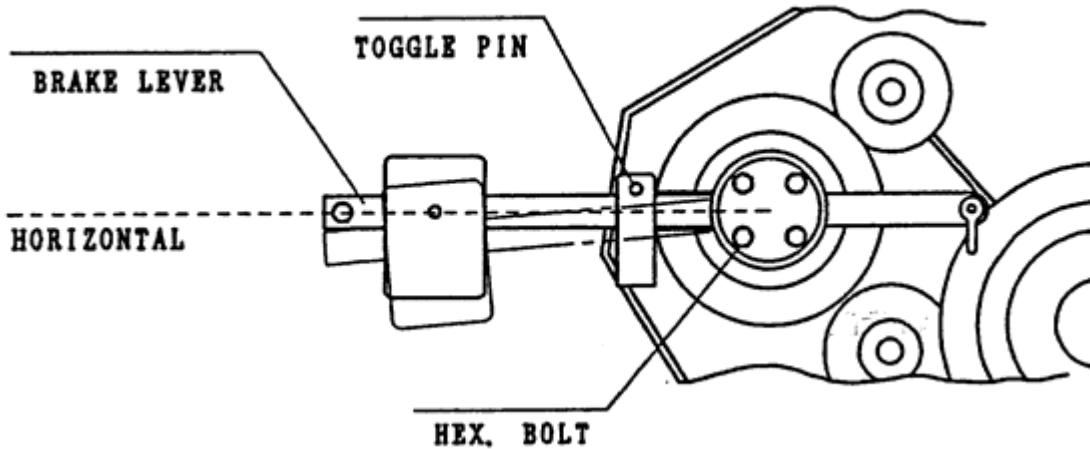
10.1 Wire rope

- Wire ropes should be changed in the following cases:
 - break of elemental wire was observed;
 - 7% reduction of nominal diameter was observed;
 - kink or looseness of ply was observed; or
 - erosion/corrosion was observed.
- Check fixing condition of wire ropes.
- Change the boat falls within an appropriate period.
- Adjust the length of boat falls as necessary so that the clearances between the davit arm and davit arm stopper at fore and aft are almost the same.
- Ensure that material and diameter of suspension links are as specified by the release gear manufacturer.

10.2 Boat winch

- Prior to commencement of the maintenance work for the winch, the boat should be secured to prevent movement.
- Oil should be checked and changed if discoloured. In case that oil level is low, oil should be added until its surface comes to the designated level in the oil gauge.
- Surfaces of each gear inside the gear box should be checked. In case that a defect is found on a surface of gear, the gear box should be replaced or repaired.
- In case that the angle of brake lever has dropped due to abrasion of the brake lining, the angle of the brake lever should be adjusted by loosening the bolts, adjusting the angle and tightening the bolts again.

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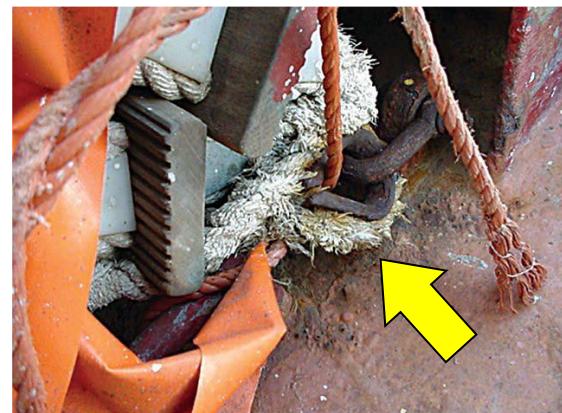


10.3 Greasing

- Lubrication is essential for the function of the davit and winch and regular checking is necessary. Greasing also should be regularly conducted. For appropriate greasing, the detailed structure of the davit and winch and the functions of their parts should be understood.
- All grease nipples of the davit should be greased at least once a month.
- Gear oil inside the boat winch should regularly be checked regarding amount, change of colour and mixture of moisture.
- Wire rope oil/grease should be regularly checked to prevent loss of oil/grease. Wire rope should be oiled or greased every two months in general.

10.4 Others

- Check the ropes (damage, twist, corrosion)
- Check the reel and supplement of grease into each lubrication part
- Confirm that the pulley block, shackle and hook are not damaged
- Check the condition of the eye ring for Jacob's ladder
- Check the condition of clutch and brake of boat winch
- Confirm that the ropes of boat winch are not rolling disorderly
- Check the emergency light



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10.5 Aspect of Lifeboat

Outside

- The surface of lifeboat should be marked with serial number, number of persons it is permitted to accommodate over and so on.
- The top of lifeboat should be marked with the name of vessel and serial number.
- It should be marked with (RESCURE) if it is used both as a lifeboat and a rescue boat.



Hand Brake Lever

Paint the end of Hand brake lever in red.



Wire handle for remote control brake release

Paint the wire handle for remote control brake release in red.



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Boat Slack Lever

- Paint the boat slack lever in red
- Display the IMO symbol



Release Grips

- Paint the end of Release grips handle in red
- IMO symbol of Release grips should be displayed



Limit Switch

Paint the Limit switch of lifeboat in red.



Ladder

- EMBARKATION LADDER mark should be displayed on the deck near the lifeboat ladder
- Put a tiger rope for prevention of falling at the time of work

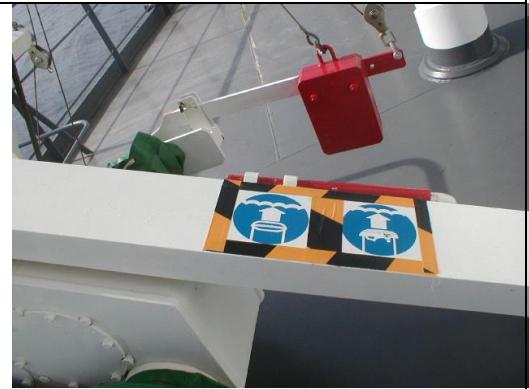


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Embarkation Light/Emergency Light
 Paint the Embarkation Light in red.



IMO Symbols
 IMO symbols of lifeboat and rescue boat should be displayed.



Launching lifeboat procedure
 Procedure of launching lifeboat should be displayed near operation area



Hand rail
 Paint the gate handrail in yellow



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Maintenance of wire and brake lining inspection date

The inspection date of wire and brake lining should be displayed.



Release Handle

- Paint the Release Handle in red
- IMO symbol of Release Falls should be displayed



Inside

- IMO symbol should be displayed on Water Spray Pump
- IMO symbol of Secure Hatch should be displayed on the hatch
- Paint the F.O. Valve in red
- IMO symbol of Seat belt should be displayed



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Lower Lifeboat

- IMO symbol of Lower Lifeboat should be displayed near Winch Remote Control Wire.
- IMO symbol of Lower Rescue Boat should be displayed if it is used both in rescue boat



Launching lifeboat/Rescue boat procedure

Launching lifeboat/Rescue boat procedure should be displayed in the boat.



First Aid kit, Hook, Oar

- Storage of First Aid kit should be marked with the Green Cross
- Put the vessel's name on boat hook and oars



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Immersion Suit

The number of Immersion suit should be displayed.



Assemble station

IMO symbol of Assembly station should be displayed around stairs in accommodation areas.



Boat Spray Line

'BOAT SPRAY LINE' should be painted with stencil and IMO symbol should be displayed



Release Handle

- Paint Manual release handle of life raft and stopper pin in red
- IMO symbol of Life raft should be displayed



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Instruction display

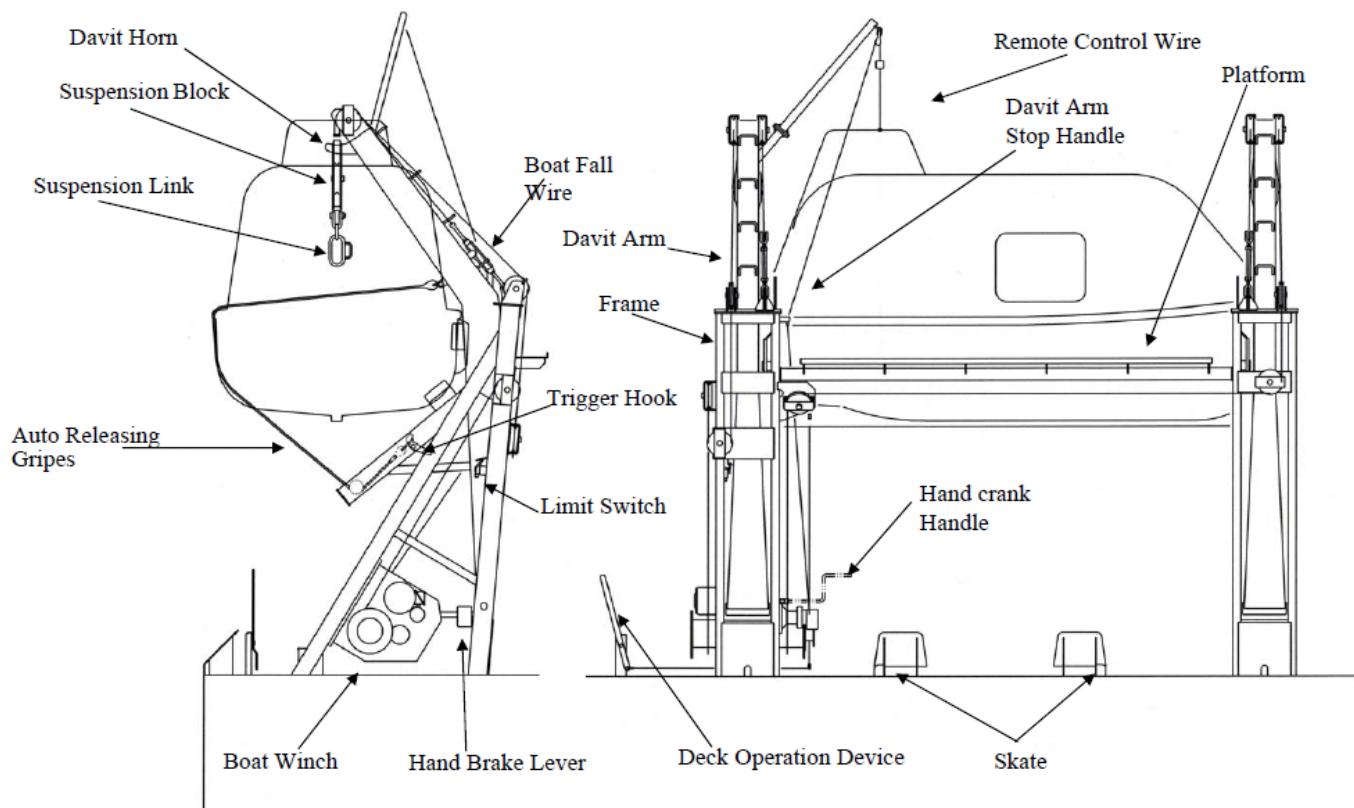
Display the instruction of life raft launching around life raft



D28

IMO symbol

IMO symbol should be displayed on storage of Life buoy.



Lifeboat davit arrangement

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10.6 Life Raft

(Reference : Safety Bulletin GEN 2011 010)

Life-rafts are secured to the cradle by means of a Lashing Strap. In addition some life-rafts have straps or bands fitted around their body. These can be 'Bursting Bands' which are part of the life raft design. Others may be 'Transportation Straps', which are for temporary use and should be removed when life-raft is installed.

(1) TRANSPORTATION STRAPS

The transportation straps are not a part of the life raft. The service agents typically put them on the life-rafts on completion of servicing for the purpose of additional safety incase of accidental inflation when transporting life-rafts back to the vessel.

These transportation straps are usually marked with a scissor symbol which indicates that these must be cut.

Scissor Symbol:



However, in some instances, the servicing company puts plain straps and leaves instructions with ship staff to cut them when the life raft is installed.

During a recent third party inspection on one of our managed vessels it was observed that transportation straps were still present even though the life-raft had been serviced some time prior to the inspection. The transportation straps in this case were plain and the ship staff had neglected to remove them.

An example of what can go wrong is given here under. An improperly inflated life-raft is obviously of no use in saving lives:-

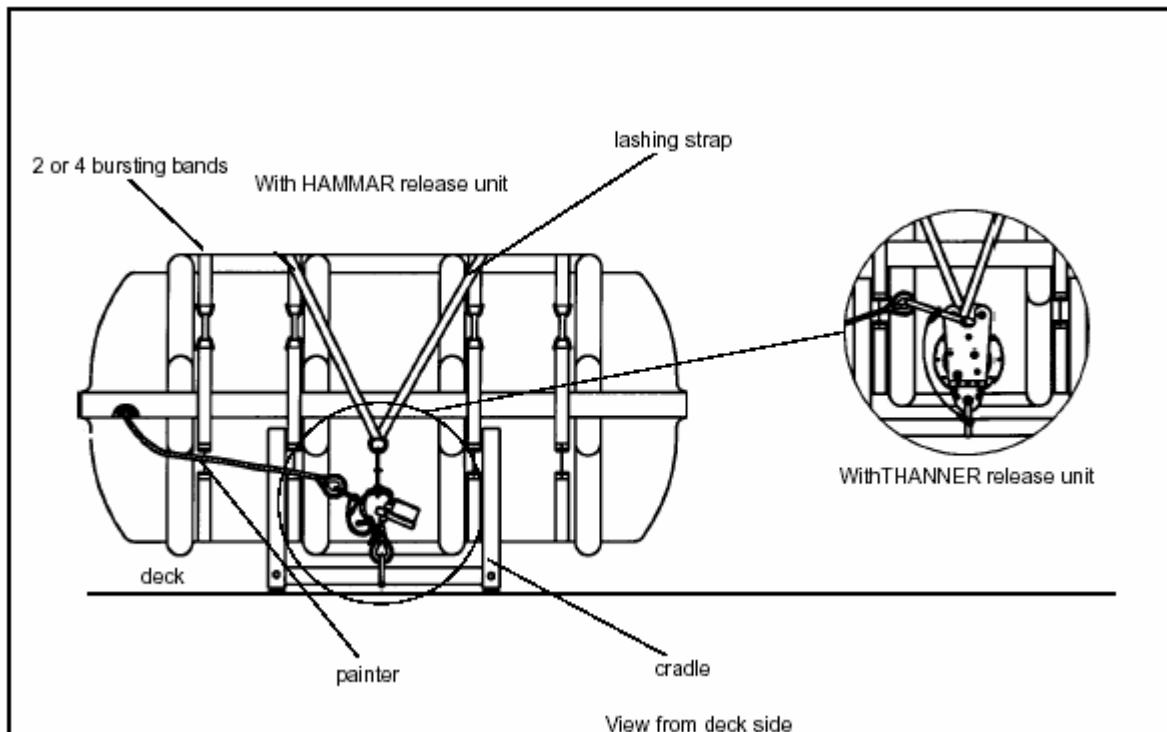


Leaving the 'Transportation Straps' in place may prevent the inflation process from being successfully completed.

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(2) BURSTING BANDS

However, please note certain types of life-rafts (e.g. some models of Viking and Zodiac) are fitted with 'Bursting Bands'. These are designed to break automatically when the life-raft is inflated.



The 'Bursting Bands' are a part of the life-raft design and should not to be removed.

CONCLUSION

It is essential that 'Transportation Straps' and 'Bursting Bands' are not confused. The best way to ensure that the correct procedure is followed is to - refer to the life-raft makers manual.

To clarify any further doubt the life raft service agent can be consulted.

The existing arrangement must be carefully checked. Any 'Bursting Bands' must be left in place. However, 'Transportation Straps' should be removed.

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11. Management

11.1 Store Management

(1) Control of ship's stores

Any articles for the ship should be used with care, bearing in mind that they are her important assets. The ship's stores should be maintained in an orderly fashion at all times.

1) The legally required equipment and fittings are inspected in respect of the following points:

- Periodic examination of the inventory in accordance with a check list.
- Check of the valid period (the service life) of each article.
- Condition of the quality of each article.

2) Spares

- When a spare part is used, its name, type and quantity used should be recorded and reported to the person in charge.
- When a spare part is requisitioned, its name, type, size, manufacturer's name, etc. must be entered, and a sample be provided, depending upon the type of such article.
- The inventories of spares are shown on the spare list.

(2) Consumable articles

- 1) With a view to cutting down expenses, efforts should be made to accomplish efficient utilization of consumable goods so as to avoid carrying a dead stock.
- 2) As to the use of consumable stores, endeavor to use them with strict economy at all times.
- 3) Get hold of the quantity of each article in stock at all times.
- 4) Entry, in an exclusive notebook, of name and quantity of each article, whenever it is taken out from the store, will help reduce an extra amount of efforts for taking an inventory of articles.
- 5) When planning maintenance work, check necessary tools and consumable stores in advance so that the work may progress smoothly.



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(3) Receiving of paints

- 1) Confirm the names, colors, quantities and lot numbers of paints upon receipt from suppliers.
- 2) Mark the date of receipt on the can with a felt-tipped marker and prepare a list of paints received for recording purpose.
- 3) When stowing paint in the paint store, the older cans should be placed on the door side and the new ones on the far side so that the older ones may be used first.
- 4) In regard to paints, endeavor to make a requisition according to plan by estimating the stock on hand on the next supply.
- 5) Paint deteriorate in quality, with the lapse of time, producing bad effects on colors, etc. and "the first in, first out" rule should be observed in their use and an excessive stock should not be held.
- 6) Store paint cans on plywood or gratings as they tend to corrode when put directly on steel plates owing to moisture.

11.2 Anticorrosion Tape Management (for NYKSM vessel)

(1) NYKSM policy on the use of anti-corrosion tapes:

After evaluating advantages and disadvantages, NYKSM has decided that anti-corrosion tapes shall not be used on hydraulic pipelines, except in the following cases: (HSEQ/ALL/062/14)

- (a) The tapes may be used at locations where it is difficult to carry out inspection & maintenance of the hydraulic pipes. (such as on the pipes located externally under / around the Stern / Side Ramps on PCC vessels)
- (b) The tapes may be used if requested by the Owners / Charterers.
- (c) LNG vessels shall comply with the LNG Fleet circular guidelines.

(2) Maintenance of hydraulic pipelines:

- (a) Anti-corrosion tapes shall not be used on hydraulic pipes. In case anti-corrosion tapes have been applied at the time of delivery, they shall be removed after 3 years
- (b) Hydraulic pipelines shall be maintained by the use of paint coating.
- (c) A Teflon piece shall be put between the U clamp / support and the pipe to prevent rubbing. A rubber piece is not

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recommended because the rubber will deteriorate within a few years.

(3) Maintenance of hydraulic hoses

- (a) Anti-corrosion tapes shall not be used on any part of the hydraulic hoses or couplings, except on hoses which are located in areas which are inaccessible (such as those located externally under / around the Stern / Side Ramps on PCC vessels)
- (b) Hydraulic hoses shall be replaced every 5 years and records shall be maintained.
- (c) External hoses on PCC vessels shall be renewed every 2.5 years
- (d) The hoses shall be replaced if external condition is found to be bad even though the age of the hose has not reached 5 years.
- (e) No tape or paint shall be applied to the rubber surface.
- (f) Please confirm "HSEQ/ALL/062/14" for more details.

※ Consult your Management Company, if your vessel is managed other than NYKSM.

11.3 Cautions against Cold Climate

General Precautions to be taken when sailing in Cold Areas

The essential point of anti-icing measures to be planned for the ship expected to sail cold waters is to base the planning on the principle that "water increases in volume when it freezes."

In short, if water freezes within piping or a valve, its volume expansion will damage the piping or the valve from inside, and therefore the cause for such a potential problem should be eliminated. More specifically, if no water is allowed in the piping or the valve, no freezing will occur, and there is no risk of damage.

Incidentally, the usual freezing temperature of seawater on a



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calm water surface is -1.9°C.

- 1) Before starting a voyage across a cold passage, water in piping or valves should be completely removed by opening the drain cock after closing the intermediate valves of pipes leading outside.
- 2) When sailing cold passages, all the hydrants arranged on the upper deck should be kept open at all times — as long as circumstances allow — and the drain cock on the aftmost side should also be kept open at all times.
- 3) The drain cocks of piping for cleaning the front window panes of the bridge and the level gauge of the fresh water tank in the steering engine room, among others, should also be kept open at all times for the purpose of completely removing the water therein.
- 4) Drain cocks of other pipes or valves, too, should be kept open at all times — as long as circumstances allow — with a view on preventing the water within from freezing.
- 5) The sounding pipes of ballast tanks also involve the risk that ballast inside their above-upper deck parts freezes. Although seawater in any ballast tank is in a free state while at sea, ballast may be blown up into the sounding pipe and freeze. Therefore, as long as circumstances allow, ballast tanks should not be fully filled, or a wire should be hung within each sounding pipe so that, even if ballast in the pipe freezes, the ice can be removed by pulling the wire.
- 6) If the engine of the lifeboat is of a type whose cooling seawater is discharged outboard through the exhaust pipe of the main engine, the water inside may freeze, making it impossible to start the engine in an emergency. Taking note of this risk, remove drain from the lifeboat engine before entering cold waters and, before entering the port, keep the engine ready to immediately start by using a line heater or the like.
- 7) The air compressor of the emergency generator also would become impossible to start in an extreme chill. Therefore, before entering cold waters, never forget to warm the space within the emergency generator room.
- 8) Before entering cold waters, make sure by inspection that no moisture has invaded into the upper deck piping for electrical equipment wiring.

Other aspects to be taken into account in planning protective measures for sailing in a cold area include the slippery ice surface and the ropes which become more difficult to handle if they freeze and harden.

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- 9) When sailing in a cold area, always keep the brakes of mooring winches tightened. If the brake of any mooring winch is loose, water may permeate into the gap between the rim and the brake lining, and the freezing of the latter might deprive the mooring winch of braking power when the ship enters the port.
- 10) Swinging out of hawsers in preparation for port entrance should not be done too early in cold waters. If hawsers swung out onto the upper deck in preparation for port entrance freeze and firmly stick to the deck surface, they will prove extremely difficult to handle. Also, hardened hawsers would obstruct smooth rope handling and expose personnel to risks both on board and on shore.
- 11) Before entering after sailing cold waters, if the bridge wing is frozen, an anti-freezing agent should be applied with a view on preventing the pilot and the master from slipping and falling so that they can concentrate on their duties.
- 12) If the ship has to be waiting offshore in a cold area, seawater in the topside ballast tank may freeze, and therefore it should be discharged whenever is practicable. Or freezing within ballast tanks should be prevented by circulating ballast from one tank to another or otherwise.

12. Deficiencies pointed out by PSC inspection

In case vessel is detained during PSC inspection, it will directly affect the voyage schedule. Please be reminded that even if numerous minor deficiencies are observed, an inspector may interpret it as "Ineffective implementation of SMS" and issue a "Detention Order". To avoid PSC Detention, you are requested to maintain good condition of your ship. Following items are past data of deficiencies pointed out by PSC inspection for your references. At least, following items should be taken care by you.

Related Lifeboat

- Lifeboat painter release is not operable.
- Lifeboat limit switches is not working.
- Retro-Reflective tape on Lifeboats defective
- Lifeboat Steering is extremely tight.



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- Lifeboat Davits - remote brake operating wire guide sheave(s) seized.
- Lifeboats remote release wire to release davit brake incorrectly adjusted & cannot release davit brake from inside lifeboat.



- On-load release system defective (Ship Detained)
- Lifeboat on-load release gear defective (Ship Detained)



- Lifeboat Sheave Rusted seriously.
- Looking out windows on both lifeboats - glass broken seriously.
- Foundation of stanchion for embarkation ladder rusted Port
- Release Device for lifeboat not in correct position



- Part of Lifeboat Retro Reflective Tape to renew
- Limit Switch for Davit of starboard life boat broken.



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- Marks of ship's name and register port of port side lifeboat port side illegible.
- Retro-reflective tapes on top of both side Lifeboat partly painted.
- Painter not attached to the life boat
- Rudder of Lifeboat - Inoperable.
- Lifeboat embarkation ladder rope broken/shackles rusted and not connected.



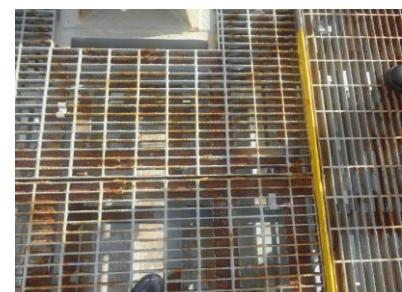
Related ON DECK

- Broken Hand rail
- Gangway- corrosion and cracking of Aluminum side girder at connection to steel turntable.
- Mooring winches - clutch lever safety pins missing.
- Pilot ladder defective
- Fresh water pipe for service accommodation holed and leakage
- Some steps on stairway from deck to bridge port side corroded and holed.
- Embarkation ladder last step is cracked



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- Stern navigation lights fastening corroded, damaged.
- Mooring ropes some of poor.
- Lighting some covers damage, fast corroded.
- Hatch covers rubber gasket channels in deteriorating condition.
- Railing and platform on forward mast found heavy corroded and unsafe to use.
- Valves between for heeling tank were rusted, stacked and not operable.
- Pilot ladder found insufficient condition with very old and worn
- The grating in front of the winch damaged.
- Fire main isolating valves were seized.



- Engine Room supply fan fire dampers wasted / holed. (Ship Detained)
- Air-conditioning supply fan fire damper wasted / holed. (Ship Detained)
- Galley door to common mess room does not close correctly.
- Fire door cannot close fully. (All Fire doors must be able to close properly)



Stairway, platform plates or gratings corroded



Wastage/holes of fire

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- Fire hose aged
- Accommodation fire door several self closing device working abnormal, fire door not closed tightly.
- One fire damper could not open
- Fire hose box between NO.4 & 5 hold broken.
- Some fire doors kept open by extra wire.
- Several fire nozzle are defective.
- Galley exhaust hood - screens in greasy condition
- Ventilator head edge on compass deck rusted and holed.
- Purifier room ventilation fan casing on poop deck corroded.
- Edge of ventilator cover rusted and holed.



holes of air pipe head



Holes of the casing of ventilator



Deteriorated rubber packing

- Tank air pipe closing arrangements defective
- Ballast Tank Air vents defective. (Floats holed, broken or seized in position).



No marking of "Close-Open"

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- Air pipes of F.O and M.E L.O Settling Tank - pipes above deck level in deteriorating condition.
- Slew on port stores crane Limit switch broken



- Safety clips/flaps for crane hooks missing.
- Stores crane limit switch broken.

