



A Guide To

Master Dry Dock Operations

For Deck Department

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for Deck Department

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Chapter 1

SCOPE OF DRY DOCKING

What is Dry Docking ?

Choosing a Dock

Regulations for Dry Dock

Types of Dry Dock

What is Dry Docking?

Dry docking is the process of carrying out major repairs, conversions, and modifications on a ship by taking it out of water.

As per the regulation under the supremo of maritime industry-IMO, it is mandatory for a cargo ship under SOLAS to undergo two inspections of the ship's bottom during any 5 year period.



Hull Cleaning and Survey

This 5 year tenure is the validity of the ship's "safety construction certificate" and the base on which the frequency of bottom inspections for all is carried out. Thus, dry dock of any ship will be held once every 3 years to undergo the bottom survey and other required inspections.

As dry docking is an operation where the vessel goes off hire i.e. it does not contribute to the business of the company till the time it is certified fit after sea trials, ship owners / operators want to complete each and every possible pending or upcoming survey, maintenance and checks during the docking period.

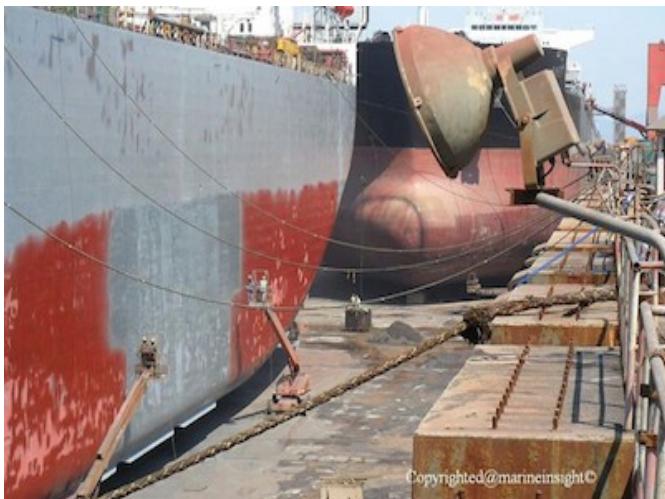
Having said that, dry docking of a ship is a tedious task which involves several aspects and parties for repair and maintenance purpose.

Right from pre-planning the dry dock to re-floating of the ship, each and every process of the dry dock needs thorough planning and preparation from both deck and engine room departments, keeping in mind the requirements of the dock master and dry dock authority.

Choosing a Dock

It is the responsibility of the ship's owner to specify the details of the dry dock to which the vessel would be taken. Apart from the pricing of the dry docking procedure, there are several other factors that are involved while choosing a dock.

Capacity of the Dock: The structure and the size of the vessel for the dry dock must be within the docking limits.



Dry Dock with Multiple Accommodation

Larger docks are therefore more successful because of their ability to simultaneously

accommodate different sizes of vessels.

Docking After Emergency: After a vessel gets involved in an accident/emergency situation, which requires docking work for the ship to sail further, recommendations are solely decided by the local maritime authorities.



Emergency Dry Dock After Hull Damage

In such cases, the first choice of the dock is thereby often sacrificed for the nearest available and capable dry docking facility in order to retain the seaworthiness of the damaged vessel.

Time, Efficiency and Reputation: Neither the ship owners nor the charterers appreciate delay during dry docks. Thereby the reputation earned

by the dock operators, laborers, managers and overall docking operations is attributed and remembered as the reliability of the dockyard to return good quality work within a documented time period.

Dock Availability: Probably the most important part for the routine docking of a vessel is the availability of a dock. The trading pattern of the vessel is also one of the important factors while choosing from the available docks.



Jam-Packed Dry Dock in Europe

Another important factor while deciding the availability of the dry dock is the the time period for vessel's "off-hire" as decided by the ship owner.

This routine dry docking of the vessels may sometimes be juxtaposed to another vessel on an emergency repair contract in the dock. It is therefore in the docks' interest to ensure no encroachment takes place between fixed docking and emergency repairs as delay can cause heavy penalty.

Dry Dock Facilities: Not only the physical capability of the dock is taken into consideration



Dry Dock Facilities- Cranes, Mobility, Workshop

while making a choice for the next available dry dock but also the facilities provided by the dock and their respective charges are considered. Provisions for workshops, contractor availability, hull maintenance facilities, administration etc. are

given due consideration while choosing a dock. The dock considered should also provide mobile dock vehicles, cranes with substantial reach etc. for transportation of heavy items to and from the workshops.

Administration: Company administration would facilitate accommodation to the officials and superintendents appointed for the dry dock. Communications and all other correspondences would be made available at the dock office.

Steel Plate Storage: Since most of the jobs carried out in the dry dock are related to steel work, the need for supplying new steel plates (especially for the damaged vessels) is a prerequisite for dry docking of ship.



Steel Plate Storage in Dry Dock

Special steel plates, if required, can be pre-

ordered, but the standard plates and steel bars are usually available in the dock. It is therefore advised to look for a dock that has proper plate storage and related facilities, including steel cutting, fabrication and similar jobs.

Workshops: They make an essential part of any dock to be considered. The dock workshops should be well equipped with necessary machinery



Yard Workshop

for various ship repair jobs. Drilling machinery, lathe machines with appropriate tools, cutting machinery etc. should be available for every task associated with the docked ship.

In order to continue providing services to the

vessel, the workshops have to employ fixed as well as contractual labour. Workshops in a dockyard include carry out jobs related to electrical system, hydraulics, steel work, paint work etc. and have special testing facility.



Specialized Repair and Testing Facility in Dock

Supply of Stores: Stores are in general accountable for meeting the immediate needs of the vessel. This is done by arranging “access-ways” and garbage/ sanitary facilities for the vessel in the dry dock.

Also, a major ship repair/maintenance job would require standard and steady supply of consumable stores, spares, electrical goods etc. Requests for such services are communicated through the vessel

in-charge to the dock manager for further actions.



Emergency Store Supply in Dry Dock

Dock Labour: Fixed or contractual, dry docks have to engage a small pool of manpower on regular employment basis.

The labour ought to be appropriately certified and surveyed prior being employed at the dock. Thus, most of the dry dock staff is either self-employed or are private contractors brought in for specific tasks.

Quick Tips

“When in dry dock, never completely rely on the dock workers especially when hot work is being carried out. Always monitor the jobs that are being performed in the ship”

Regulations for Dry Docking

Various organizations conduct a variety of surveys on a vessel during dry dock. However, some of the most important surveys carried out are conducted on behalf of the Classification Societies by means of hull, propeller, rudder and tail shaft surveys, which specifically include annual, intermediate and special surveys.

The intermediate and annual surveys are planned to monitor the general state of the vessel and to make sure that the vessel is retained in a satisfactory condition. On the other hand, the special surveys are conducted at an interval of four to five years.

These surveys satisfy the requirements and standards put down by the Classification Society and are mainly aimed at the structure of the ships. They also intend to detect long term corrosion or the start of possible damage prior to the next 'special survey'.

Every two and a half years, the stern tube and the propeller shaft are inspected, except for the

propeller shafts which run in oil or continuous liners which are required to be surveyed every five years.

On the other hand, the stress-free designed shaft, which runs under oil could be inspected every seven years since the shaft was withdrawn.



Intermediate Shaft and Stern tube

When a shaft is fixed with a keyless screw propeller or by means of a bolted flange and is running in oil, the examination can be extended to a ten year period assuming it is examined in dry dock after four and a half years and less than five and a half years since the shaft was last withdrawn.

Docking Survey - Where the vessel is ‘less than 15 years old’, survey to be carried out twice in 5 years (with maximum interval of three years).

Where the vessel is ‘more than 15 years old’, the survey to be carried out every 2 years or every 2½ years if the vessel is coated with high resistant paint coatings.

Continuous Survey - Carried out every 5 years.

Damage Survey - Carried out when the ship sustains damage.

Following are some of the important regulations pertaining to dry docking of merchant vessels:

- Two inspections of the ship's bottom are required during any 5 year period under the mandatory provisions of SOLAS I/10 where “any” 5 year period applies to all ships except oil tankers and bulk carriers subject to the enhanced survey program under resolution A.744(18) versus the 5 year “period of validity of the safety construction certificate” that resolution A.744(18) applies to determine the frequency of bottom inspections.

The 5-year “period of validity of the safety

construction certificate” is the base for measuring the frequency of bottom inspections for all ships.

Lifeboat on-load release mechanisms not complying with new International Life- Saving Appliances (LSA) Code requirements to be replaced no later than the first scheduled dry-docking of the ship after 1st July 2014 but, in any case, not later than 1st July 2019.



On-load Release Mechanism of Lifeboat

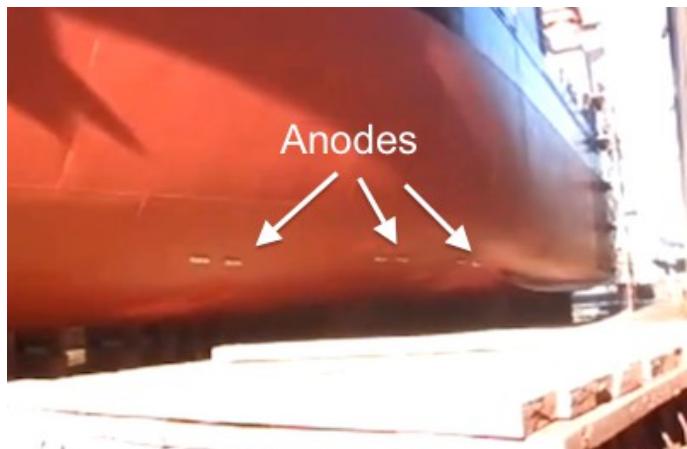
As criteria for the implementation of the “Extended Dry Dock Interval”, at the time of new building, the corrosion prevention system for the

bottom shell has to fulfill the following requirements:

- Dry film thickness of coating for 7.5 years has to be an average of 300 µm

Anodes (Alu/zinc) prepared for 7.5 years alternatively:

- Impressed current system is to be installed and maintained



Anode Fittings in Hull

As criteria for the implementation of the "Extended dry-dock interval", for ships in service, the corrosion prevention system for the bottom shell has to fulfill the following requirements:

- Dry film thickness of coating for ships in service has to be a minimum of 250 µm

- Anodes (Alu/zinc) prepared for 7.5 years

Alternatively, if installed, an impressed current system is to be maintained and documented in the planned maintenance scheme.

Quick Tips

"When doing alteration in the dry dock on any of the ship's machinery, system or structure ensure to go through all the relevant regulation for that particular job. If the surveyor points out any non compliance with the repair or renewal work, the complete job has to be redone which will not only add to the overall dry docking cost but also consumes valuable time and manpower"

"The time interval for inspection and survey of a stern tube system varies with oil lubricated and new water lubricated bearings. Check the regulations for the type of stern bearing with the makers and class certification bodies"



Types of Dry Docks

The ship's maintenance, especially the under-water maintenance cannot be handled by the vessel's crew during the normal trading times. For maintenance of the under water hull, the ship has to be taken to a dry dock.

The larger capacity vessels such as VLCCs or ULCCs require greater accommodation area as compared to the medium capacity vessels. Most of the dry docks around the world are usually restricted at providing space to larger vessels.



VLCC in Large Dry Dock

Some of the main types of dry docks found around the world are:

Graving Dock: It is a permanent purpose-built dock, made mostly out of stones or concrete. This dock is normally accessible on the seaside, from which, the vessel enters the dock for the purpose of repairs, inspections and cleaning.



Graving Dock: One Side of Dock Open to Sea

Graving docks were initially built to burn weed and other sea growth on wooden ships. With change in times, ship hulls were made out of steel thereby reducing the maintenance. Increased usage of anti-fouling paints on steel hulls and other such advancements made the graving docks less popular.

However, ships still do need to go in dry docks for completing survey work and for carrying out other

essential maintenance or repairs that cannot be done while the vessel is at sea.

Once the vessel is inside the dock, the dock is secured by locking the gates known as the “Caisson gates”. After securing the gates, the water in the dock is subsequently pumped out which lowers the vessel onto the pre-arranged keel blocks.



Caisson Gate

The advantage of putting up a vessel in a ‘Graving Dock’ is the type of facilities provided which includes administration of the dock, local workshops, local labour source, and customary supplies by the shore based services. The only difference and likewise a disadvantage is that the

‘Graving Dock’ cannot be completely controlled suiting the stability of the ship or vessel involved. This disadvantage is overcome by the ‘Floating Dock’ which can be trimmed suiting the stability of the marine vessel in question.

The ‘Graving Dock’ has provisions for the side walls to reduce the possibility of distortion stresses caused during the critical operations. Sometimes, ships and other marine vessels are secured to the walls of the dock by means of shoring wherein timber is used to size up the gap in case the vessel tilts whilst on the keel blocks.

The dock is built in such a way that it provides for the complete removal of flooding water. Such an inclining provision is better known as ‘Declivity of the Dock’.

Floating Dock: Floating docks are preferred for specific types of ships because of their flexible and mobile design. These docks have the capability to cater for smaller and medium sized trading vessels, special class vessels etc.

ULCCs / VLCCs and similar other vessels of larger size cannot be accommodated in these types of restrictive docks.



Floating Dock

Smaller coasters, research vessels, dredging vessels, fishing vessels etc. are the more usual clientele for the floating docks.

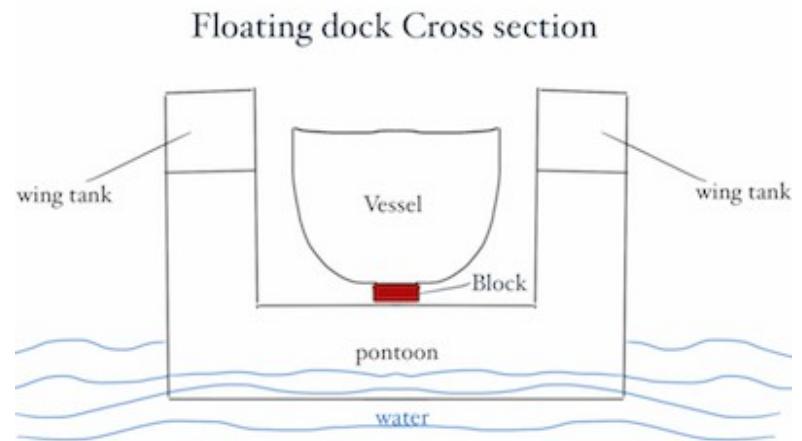
A major advantage of such dry docks is that they can be towed to any location worldwide and handle vessels in damaged and unstable conditions. They are also employed by larger shipyards to act as substitute docks for additional work.

The construction of a floating dock is based on the principle that is applied to construct 'Heavy lift vessels'. The basic construction consists of a tank system with deep tanks, double bottom and pontoon like structures, accompanied by wing

tanks located on each side and running through the length of the dock structure.

There is a height restriction up to the 'Safety Deck' for the wing tanks. Access stairways are provided at both the sides of the dock throughout the height of the wing tanks, up to the floor level. Pumps and other machinery used for filling and emptying the tanks are accommodated.

The pumping arrangement of the floating dry dock is similar to ship's ballasting and de-ballasting systems. Wing tanks are also provided with dedicated sounding systems and air vents.



Keel blocks in the 'Floating dock' are usually kept static, but there are provisions to shift them using mechanical power as per the hull requirements and

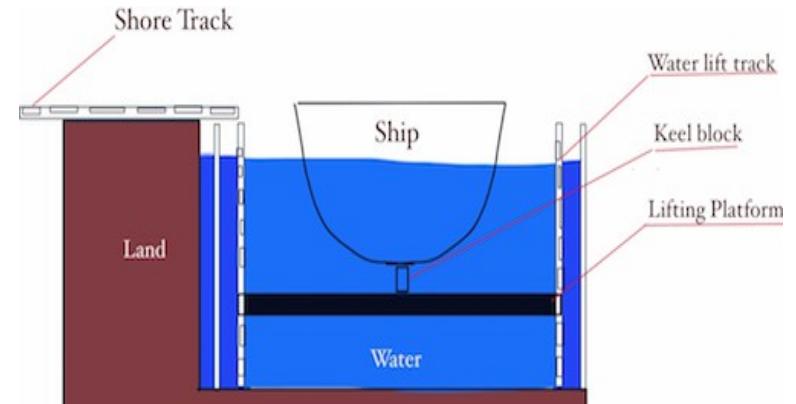
subsequent repair jobs. Power for ship's electrical system, water and other essential supplies are also provided by these mobile docks.

Floating docks are usually constructed according to the requirements of the class. Since these docks are designed to have their structures immersed in water, they themselves would need under water maintenance after a certain period of time.

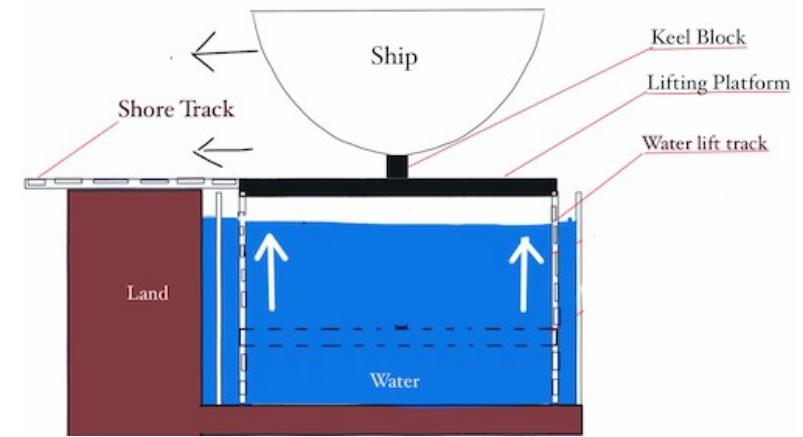
Synchro – Lift Dock: The 'Synchro-Lift' dry dock is stated to be the most recent or modern style of docking a marine vessel. As this type of dock is flexible for simultaneous docking of one or more ships without having the dock operations compromised, the dry dock facilities can be shared without causing delays.

The disadvantage of this type of dry dock is mainly the size constraint. Because of the inability for placing shores around the hull of cargo loaded vessel and the possibility of the distortion due to stresses caused as a result, heavily loaded or large sized vessels are restricted in this type of dry docks. However, workshops, dry dock facilities, dock labour etc. do not have much constraints while simultaneously attending the docked vessel. The ship's hull is also more convenient to be

worked upon and easily accessible by vehicles and cranes in this type of dock.



Synchro-Lift: Vessel Waterborne



Synchro-Lift: Vessel Out of Water

Having said that, the 'Synchro-Lift' dock has more chances of errors and also requires additional maintenance as compared to graving or floating dock. Numerous winches, platforms, lifting and

movable machinery of the dock have to undergo regular maintenance to ensure smooth operation. Any kind of breakdown or lack of proper maintenance can thus bring unexpected delay in docking operations.

Synchro-lift system has definitely brought a change in the conventional docking methods. Modern technology and advanced systems would further increase the prospective clients and ease the single site - multiple docking operations for conventional ships and other marine vessels.

Slipway Docks: Several major ports offer services through ‘floating docks’ and ‘graving docks’. Many of them also offer ‘docking slips’ which specifically cater to the smaller vessels. For choosing the slipway dock method, the critical factor is the size of the vessel which is usually based on the length of the slip.

Other criteria includes the shape of the hull and the ability of the ship to ‘sit the cradle’ on the movable platform. In most slip operations, the vessel is floated over a cradle set onto a railway bogey; this consecutively is heaved up a tracked section into a covered or open work place. After the steel wire ropes (Diameter is approx. 92 mm size for the

smaller slip) are rightly secured to the bogey, they are then used to clear the ship off the waterline using dockside winches.



Slipway Dock

However, there are limitations for the mechanical methods of dragging the ships away from the water, based on their weight factor irrespective of the tracked bogey. The dock is nevertheless restrictive in itself as to the actual size of the vessel the slip can accommodate.

Whatever be the type of dry docking used, the methods involved in each are complex and demanding for every single person involved. The vessel’s crew, along with owner and superintendents, must endeavor for safe and successful completion of the docking operations.

Chapter 2

PREPARATION FOR DRY DOCK

Deck Repair List

Superintendent Repair List

Manpower Management

Preparation for the dry dock starts by making a “repair” or “job” list by both deck and engine room department. The company office also prepares a list of all the jobs that needs to be done on the ship during the dry dock. These lists are then assembled to make a “final” dry dock file which would feature all the jobs to be carried out in the dry dock.

Deck Repair List

The repair list for the dry dock includes permanent and running defects that are observed throughout the ship's trading duration and which need to be attended in the dry dock.

Prepared by the ship's chief officer in lieu with the recommendations from the ship's Master and Superintendent, the defect list has to be a compiled in such a way so as to ensure that the work is carried out in an essential and planned manner.

The Chief Officer and the Chief Engineer's repair lists are attended in the dry dock along with the

surveys and recommendations from the ship's superintendent.

It is to ensure that the vessel completes the routine docking jobs to prevent the vessel from sailing without proper certifications and to satisfactorily complete the required ‘Surveys’. All the ‘Survey jobs’ are attended separately, as are the jobs in the list recommended by the ship management.

The purpose of the repair lists is to allocate ships' personnel with jobs that are to be performed and monitored in the dry dock following the guidelines of the ship owner.

This is done by providing the ship's officers from respective departments, with a copy of the list of jobs to be carried out. The jobs so completed are then reported to the vessel's in-charge, in most cases the Superintendent, who then tallies with his job listing and files them for future references.

Repair lists are normally accompanied by spares and stores, which are required for the dry docking, in the form of requisitions under company format. The list of stores and spares is usually arranged with mutual consent of the chief officer, chief engineer and the vessel superintendent.

Superintendent's Repair List

The superintendent repair list will be the final one to be followed by the crew of both the departments. The superintendent will make the list taking into account all the parties concerned with the dry dock. The list would generally be configured on priority and ship-to-ship basis.

The list would contain some of the jobs as stated below -

- Bottom sea valves to be overhauled and presented to the surveyor for inspections and survey purpose



The bottom valves would usually include high sea chests, low sea chests, forward sea chests etc.

- The overboard valves that need to be overhauled and the sewage flap valves that are to be cleaned and tried out
- The vessel's side plating and bottom to be visually examined by the surveyor in order to complete the 'Hull Surveys'
- The bottom plugs to be removed for draining and checking the condition of the tanks



Draining Water from Bottom Plug

- The echo sounder sensor to be protected by

covering it with thick rubber joint prior to cleaning and painting

- All sea chests gratings to be opened up and missing bolts to be ordered and replaced



Sea Chest Gratings

- Thruster gratings to be removed
- Thrusters to be opened for overhauling
- Chain locker to be cleared, de-rusted and re-painted. Bilge pumping arrangements inside the chain locker room to be checked
- Tail shafts to be surveyed and poker gauge

readings to be taken

- The anchor and anchor chains to be arranged and cleaned



Anchor and Chain

- All edged out markings to be re-painted after final touch-up
- The zinc anode and Marine Growth Preventive System (MGPS) anodes to be replaced
- The void spaces, cofferdams, cargo tanks/holds, sea water and fresh water ballast tanks, fuel oil tanks, etc. to be opened up and surveyed

- All life saving and fire fighting equipment to be inspected and shore calibrations to be carried out as per manufacturer instructions



Lifebuoy with Accessories

- Rudder and propeller to be inspected and surveys to be carried out
- Water tightness of all accommodation watertight doors, hatch covers, booby hatches, tank domes etc. to be checked and repaired as necessary
- Deck plating inspection, repair, and renewal
- Any other major repair work to be performed

Manpower Management

As per the new maritime convention, MLC 2006 (Maritime Labour Convention), “*Each member state shall fix either a maximum number of hours of work, or minimum number of hours of rest, for a given period of time for all seafarers*”.

The MLC regulation is in lieu with the previously implemented rules of the International Labour Organization and it specifies the following:

As per the legislation, the maximum hours of work should not exceed 14 hours in any 24-hour period and 72 hours in any seven-day period.



Rest Hours

“Hours of rest” means time outside hours of work and does not include short breaks. The minimum requirement for hours of rest provided should be:

10 hours in any 24-hour period, which may be divided into no more than 2 periods, one of which shall be at least 6 hours in length, and no more than 14 hours between any consecutive periods; and 77 hours in any 7 day period.

Minimum hours of work or rest can be easily breached during dry dock and it is therefore the responsibility of the Master to comply with regulations laid in the convention.

Risk Analysis: In case of an incident/accident, the procedures for risk assessment could be improved by proper investigation. Risk Analysis play an important role in giving recommendations that can be incorporated in risk assessment evaluations.

Such documentation system requires time and willingness of the management to establish a better and safer working environment. A safe working culture can thus be established on board the ship and in the dock when the management creates a safety system to be followed throughout the working period.

Maritime Risk Analysis Results

		SEVERITY			
		1 Minor	2 Major	3 Critical	4 Catastrophic
PROBABILITY	A One occurrence every 100 years	Grounding (without leak)			Unacceptable risk
	B One occurrence every 1,000 to 10,000 years	Collision at jetty (without leak) Collision (without leak)			
	C One occurrence every 100,000 years		Grounding (with leak, LPD)		
	D One occurrence every 1,000,000 years				Acceptable risk if ALARP
	E One occurrence every 10,000,000 years	Negligible risk		Grounding (with leak, MFD) Collision at jetty (with leak)	Collision (with leak)

Risk Analysis

Risk Assessment: In order to address the health and work related issues and to have a safe working culture throughout the dry dock, a formal ‘risk assessment’ has to be carried out on board ships as well as in and around the docking area.

In most cases Risk Assessments should be considered related to the following but not limited to :

- The prevailing weather conditions while the vessel is in the dock
- The expertise and competency of the personnel conducting the task

- The efficiency and the condition of all the equipment being used for a particular task
- Any other work being carried out in the vicinity of the job site
- Lighting variables - whether the job to be carried out during day time or at night
- Manpower, adequate supervision or additional hands that are required to complete the job safely
- If the surrounding environment is safe to carry out the task (No presence of flammable gases or toxic vapors)
- As per the company and the dock regulations- checklists, job hazard assessments etc. are being filled and followed accurately
- Risk of flooding is determined and steps evaluated to minimize the effects
- Risk of fire determined and steps evaluated to eliminate the same
- Medical aid and rescue facilities are readily available and in the vicinity
- Communication processes and monitoring is undertaken effectively
- Personal Protective clothes and equipment used at all times by all personnel



Winter Clothing and PPEs

- Pre-job briefing carried out, conduct and scope of work understood, potential hazards identified and subsequent actions to be taken
- Although the risk assessment would not completely eliminate the chances of accidents in the dry dock, it would surely reduce their number and severity

Chapter 3

THE DOCKING PROCESS

Things to Do Before Entering the Dock

**Things to Check While Bringing the
Ship in the Dry Dock**

Procedure for Entering the Dock

Entering the dock is one of the most critical tasks while dry docking a ship. A pre-docking strategy along with a docking plan is made to ensure safe entry of the ship in the dock considering all aspects related to ship's stability.

Things to Check Before Entering the Dock

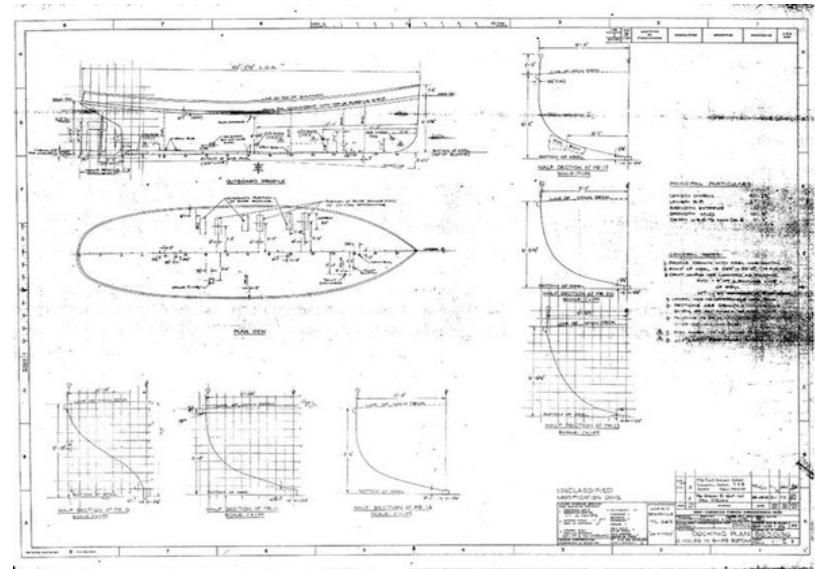
Docking Plan

The Docking Plan is an essential document that is usually furnished prior to a vessel entering the dry dock. The vessel's general particulars and docking data would be given in the plan to make the docking work easier, organized and effective.

The Docking Plan could include one or all of the following details –

- Position of the bulkheads
- Position of main structural members
- Rise of floors
- Position of bottom plugs

- Position of the bottom girders, strengtheners etc. in order to aid positioning of the keel blocks in the dock



Docking Plan

- Prior to entering the dock, proper communication between the vessel and the dock master should be carried out in order to establish the required draft and trim for safe docking
- On arrival, the docking plan is then presented to the dock master or the yard representative for providing assistance in further docking processes

Stability of the Ship – The Most Vital Aspect

The most essential and critical part during the entry and exit of the ship in the dock is its stability.



Ship Resting on Keel While Draining the Dock

It's the responsibility of the master and the chief officer to be extremely certain of the ship's behavior and stability when she takes on the blocks. Real danger to the vessel is when the ship is unstable during flooding or draining the dock. Therefore the vessel's team should reciprocate efficiently during these critical stages of docking by giving due consideration to the ship stability

assessment.

Metacentric height of the vessel is determined in order to compensate for the virtual rise in the vessel's COG (Centre of Gravity). These days, with the advent of computer programs on vessels, all calculations are done seamlessly for this purpose.

Slipping off the blocks could be highly dangerous for the dock, the vessel and the personnel onboard. Therefore it is the sole responsibility of ship's crew to ensure that the stability assessment and calculations are up to the mark.

Moreover, it is also imperative that tank soundings are taken before the vessel takes on the blocks so that the values are symmetrical while departing.

List, trim and draughts are particularly taken into consideration throughout the docking process and monitored while the ship is afloat. There is a high risk of getting the vessel's appendages such as the bilge keel dislodged, and damaging the blocks when the vessel lists in the dock.

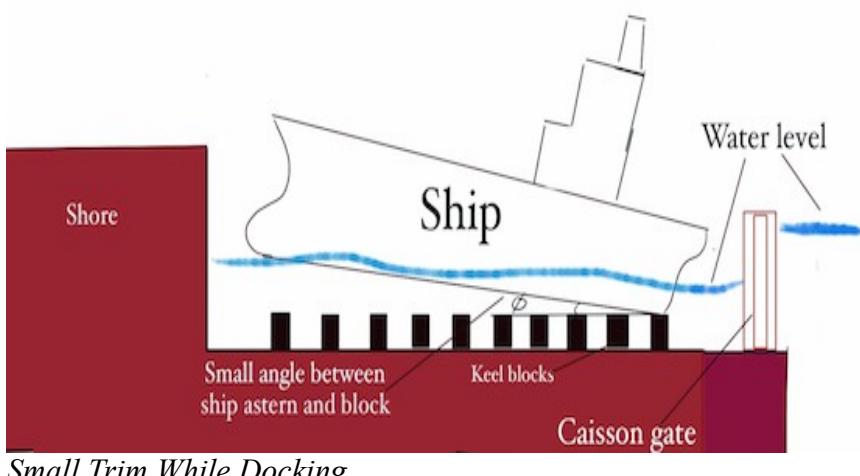
It is therefore prudent that the ship's personnel take all factors into account which can lead to

inclination of the vessel during the docking operation and also ensure that the inputs must correlate the criteria for positive stability.

The inclination of the vessel could be valid due to certain external reasons such as:

1. Force of strong winds affecting the exposed superstructure on ships with higher freeboard
2. Wave action while the vessel is in immediate vicinity of the dock

Vessels coming in the dry dock is expected to have a small trim by stern or instructed by the dock master.



This figure shall be based on the configuration of the keel blocks.

Once the vessel enters the dock, aligned as advised by the dock master and gates closed (in case of a graving dock), the water is pumped out such that the ship's keel makes a small angle with the line of the blocks.



Ship Resting on Keel Blocks

As the water recedes, the angle made by the blocks and the keel is kept constant and as the keel first touches the blocks, 'critical instant' is achieved.

Critical instant is the difference between the displacements when the vessel is fully waterborne and when she is grounded.

The change in the GM value of the vessel is the most critical phase as the vessel takes on the blocks and finally rests on them. Problems can occur when the vessel has a low GM and incurs a negative value when at the critical stages. This may result in the vessel inclining even before the blocks or the shores are placed.

In cases where the vessel's hull has been damaged, it may not be practical to adhere to the Stability assessment or even attempt docking the vessel conventionally.

Here, the trim or list could be reduced internally by transferring cargo or ballast to hold the vessel upright and be docked in a safe manner. Usually the damaged vessels are put up in floating docks. The end result here is to achieve safe docking and undocking operation.

Quick Tips

"Stability is the most important aspect for getting a ship safely into a dry dock"

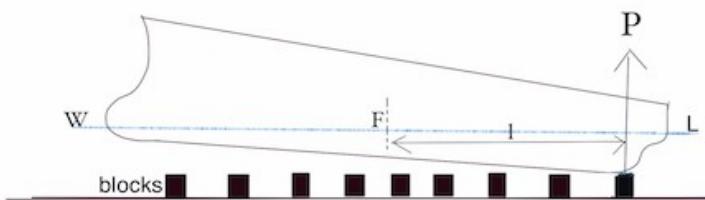
The four important factors that must be watched over before entering the dry dock are:

1) The Vessel to have adequate Initial G.M

- 2) Vessel to be upright
- 3) Small or Moderate Trim Aft
- 4) Tanks are pressed up: No Free surface effect

Critical Instant / Critical Moment

It is that moment which occurs just before the vessel takes on the blocks overall. The upthrust of bilge block is initially enacted on the stern part of the vessel section which touches the blocks first (if the vessel is trimmed by the stern).



P=the upthrust at the stern in tonnes
t= change in trim after entering dock in cm
l= the distance of the centre of flotation from aft in meters

Upthrust at Critical Instant

The upthrust is up to its maximum at that instant. Upthrust can be calculated by following formula:

$$P(\text{max}) = MCTC * t / I$$

MCTC = Moment to change trim by 1 cm.

t = Trim in cm.

I = Distance of F from P.

It is called critical instant because maximum loss of GM occurs at this instant. If the GM (metacentric height) becomes negative, the ship may capsize or slip from the blocks.

Critical Period

Defined as the period from the time when the keel first touches the blocks until the vessel takes on the blocks overall. An upthrust is caused by the blocks and is denoted by "P".

'P' at any instant can be calculated by the following formula:

$$P = TPC * \text{Change in mean draft in cm.}$$

P is maximum at the instant before vessel takes blocks overall (Critical Instant).

Due to the upthrust, the vessel reduces its GM. The G (Center of gravity) moves higher to G', and M (Transverse metacenter) moves down to M', thereby GM is reduced.

Shift of G (Center of gravity) or M (Transverse metacenter) may be calculated as:

$$GG' = (P * KG) / (W - P)$$

$$MM' = (P * KM) / W$$

KG – Distance between Keel and Center of gravity (COG)

W – Displacement of the vessel

P – Upthrust as calculated above

KM – Distance between keel and transverse metacenter

Master and Chief Officer must calculate the stability values prior entering the dock and also ensure that there is NO negative GM occurring. If the GM becomes negative, the vessel will lose its positive stability and she may capsize or slip-off from the blocks causing additional damage to the dock as well as the ship.

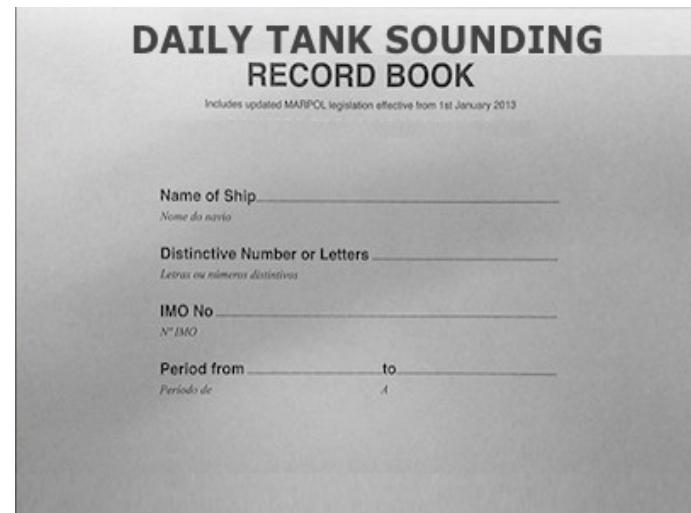
In some dry docks, the stability calculations of the ship is taken seriously by the yard as well. In fact as per the yard's regulations, the dock masters and the pilots have to send a copy of the stability calculations showing the loss of the GM and the critical moments prior to the docking.

Statutory Stability Information

Prior and during the Dry Dock, the vessel's chief Officer and dock master will require ship's stability information as reference. Such information may be in the form of plans or other documents which include the following:

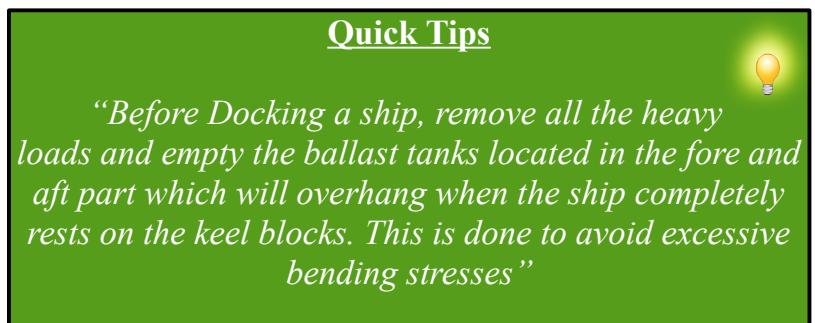
1. Ship's general particulars
2. A metric conversion table and deadweight scale
3. Capacity plan
4. General notes on stability
5. Hydrostatic particulars
6. Damage stability information
7. Centre of gravity of all tanks
8. Details on free surface movement
9. Curves of statical stability and the Cross Curves with examples

10. Condition sheets for various options
11. Tank sounding booklet which includes initial soundings of all tanks when the vessel took to the blocks.



Sounding Logbook

12. Initial dock trials information if required



Gas Freeing (Tanker Vessels)

It is a requirement to gas free the ship prior to entering the dry dock. This can be conducted by implementing one of the two methods:

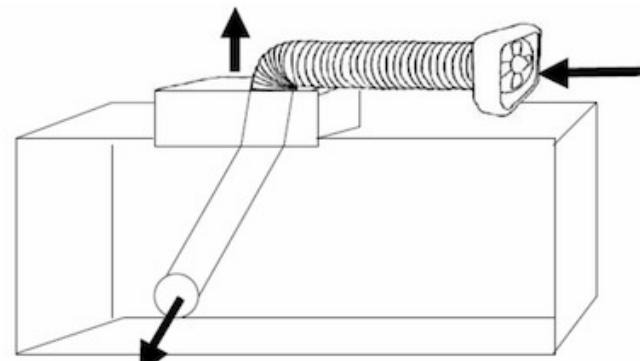
Using an educator driven by steam or air

Or

Using portable water driven fans

Alternatively, it can also be achieved by making use of the Inert Gas (I.G) fans used in combination with fresh air intake; however this method is not as fast as compared to the two stated above. Prior to 'gas freeing', the tanks should be systematically purged by the inert gas in order to get the tank atmosphere below the critical dilution line.

Over the years, the tradition of gas freeing by means of canvas 'wind sails' has been outdated. The two currently accepted methods are the dilution method and the displacement method. In the first method a pipe work located at the bottom of the tank e.g. cargo line or purge pipe is used. The success of this operation is based on the fact that petroleum vapors are heavier than air and hence have a tendency to build up at the tank's bottom.



Gas Freeing

Alternatively, the dilution method makes use of fans to blow out air at the bottom of the tank to dilute the vapors.

During the process of gas freeing, all tanks should be vented to generate an exit velocity which can clear off any gaseous vapors from the deck area. Careful attention needs to be given to restrict the toxic vapors from entering the accommodation area which should be securely closed.

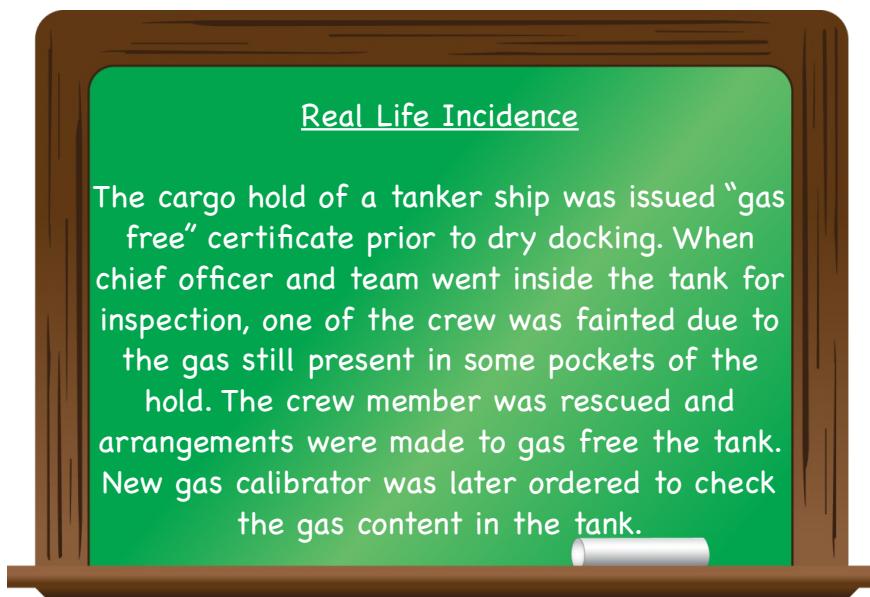
Quick Tips



"Until the tank is purged with inert gas below the critical dilution line, the gas freeing operation should not be attempted since the tank's atmosphere does not pass through the flammable zone with dilution by air. Once tested by means of gas detectors, the ship will be issued with 'gas free' certificate"

At the completion of dry dock period, all tanks should be filled completely with Inert Gas (Primary Inerting) before loading the first cargo.

There have been many cases in the past wherein accidents have taken place due to the presence of gases despite getting the tanks / holds ‘Gas Freed’. Nowadays, even the surveyors or inspectors coming onboard the vessel are compelled to bring their own ‘Calibrated’ gas meters for added safety. Sometimes it so happens that if the surveyor suspects incompetency in the working culture of the vessel he may reject the inspection or delay it altogether.



Things to Check Before Bringing in the Ship

- Make a repair and maintenance list and create or obtain a dry dock handbook from the shore personnel prior to the docking. Dry dock handbooks are provided in order to get an in depth evaluation of the docks’ aspects and provisions
- At some places, the docks are completely disorganized and the ship’s staff has to deal with the lack of correspondence which leads to confusion and disparity between the two parties
- All previous clearances and measurement data are to be noted. Clearances for critical equipment such as rudders and propellers, and measurement data for anchor chains are taken and compared to the previous data in order to record the discrepancies
- Ensure the vessel is carrying minimum ballast and bunkers (Fuel Oil and Fresh water)

- Clean the bilge wells of the cargo hold to avoid fire/accidents if any hotwork is carried out inside the hold



Cargo Hold Bilge Well

overhauled must be clearly demarcated. During surveys, most of the important valves are inspected and it is therefore imperative to clearly define them in order to avoid delays



Grey Water Overboard Valve

- Ensure that all the cargo tanks of the tanker ship are well ventilated and gas freed before entering the dry dock
- All heavy equipment and gears to be secured before entering the dry dock
- Fire fighting plans and safety measures are to be discussed prior docking. Fire plans should carry an updated crew list along with other documents
- All valves and sea chests that are to be

Real Life Incidence

During the ship docking process, there was some delay in connecting the shore electrical supply. The emergency generator of the ship was also kept unprepared and isolated which led to complete blackout for a long time. This also resulted in standstill of the ship operation causing delay.

- All spare parts, tools and stores to be checked and kept ready for use
- All the emergency lighting and the emergency generator systems to be tried and tested beforehand. Emergency Generator will be used at least once during the docking period.
- Sounding of all domestic, ballast, bunker tanks and void spaces / cofferdams must be taken and recorded
- Split the on board staff into groups so as to oversee / administer the jobs carried out by the yard gangs
- Shore connections for AC and refrigerator cooling water system as well as the connections for the fire lines are to be readied beforehand in order to avoid delays
- Ensure to paste warnings and caution signs inside accommodation stating “not to throw anything in toilet with vacuum system” in English and if possible also in the local language
- Prepare separate file for empty landing reports to be used in the dry dock
- The officers to prepare the vessel’s stability in accordance with the dock masters requirements
- Canvas or ‘Kraft’ paper is laid down throughout the accommodation flooring in order to prevent the floor on entrance deck from getting spoilt
- All the cargo securing and lashing material to be removed and kept inside stores
- The lighting of the deck and cargo hold to be checked



Ship in Dry Dock at Night

- Important machinery like hydro blaster to be taken out from stores and checked for operation
- If vessel is docked with cargo onboard, same to be properly secured and lashed
- All mooring ropes to be kept in rope locker, except the ones necessary for docking stations
- All deck machinery and their associated components are to be covered using tarpaulin or canvas that would evade the grit / sand dust from collecting up on the gears
- All practical tools such as working spanners, hammers, pliers, nuts and bolts should be stored away in locked compartments
- Paints and chemicals to be stowed away in well ventilated and secured locations
- Avoid ships from docking adjacent to dry dock walls as it can cause difficulty during cleaning and inspection especially in multi accommodation docks



Mooring Ropes in Use

- All stores, cabins and compartments inside the accommodation to be locked and the keys to be kept with the respective crew members and responsible officers



No Space to Check Bulbous Bow

In some docks, there have been cases wherein the ship's crew have reported intrusion in the deck / engine and provision stores. Sometimes the dock workers have it all set up with the dock cranes, shore party, gatemen and likewise to sneak the stores that have been lifted without the consent of the ship's crew. Chief Officers and Chief Engineers must make sure that the ship's staff are well aware of the presence of dock workers onboard and the tools given to them are taken back after the job is completed

Procedure for Entering the Dock

For the vessel to navigate through the inland waters towards the dry dock, it has to be prepared by all means. This includes the coordination between the ship's bridge team and the harbor and docking pilot/s. The bridge team should practically include the master, officer of the watch, pilot, helmsman and a lookout.



Entering Dry Dock

Real Life Incidence

During one of the docking procedures, the shore connections for AC and refrigerator cooling systems were not compatible with the ones given by the yard. As a result, time was lost due to no prior communication between the ship and the dock. This led to uncomfortable living condition in the accommodation, provisions started getting damaged and extra / unplanned work was called in for. The ship staff then had to fabricate extra adapters for the required shore connections.

Ship's engineers should be duly informed of the vessel's programs as they can then attend to the machinery as required. All communications are then carried out by the master throughout the

docking and undocking operations.

Engines are usually kept on maneuvering, ship's anchors are cleared and ready for being dropped in case of emergencies, thrusters are kept in working condition and steering motors employed for all practical purposes.

Local weather conditions such as weather forecasts are studied well in advance and the local tides are given due consideration as the vessel is brought into the dock. Safe navigation can only be a result of effective coordination among the team members, the pilot/s and the crew.

Dock clearance should be obtained from the dock master prior to the vessel entering the dock. The under keel clearance and maximum permissible dock drafts should also be obtained well in advance in order to have a safe berthing and docking operation.

All routine navigational aspects are to be followed with due diligence. Position fixing, monitoring the under keel clearances, weather synopsis and tidal features, record keeping etc. are to be adhered to within limits as required for safe passing and docking.

Duties of Chief Officer (While Entering Dry Dock)

Practically, the chief officer is the manager of the vessel, working under the guidance of the master. The master of the ship authorizes the chief officer and the crew members to move ahead with the dry dock work.



Standby on Bridge

It can be presumed that, if not all, the following duties would be performed by the Chief Officer:

- Correspond with the dry dock manager concerning the ship's draught and trim to suit the dock construction

- Soundings of all internal tanks should be taken before entering the dry dock
 - Set up all the necessary documentations essential to complete the dock operations and the expected workload inside the dock
 - Estimate that the ship has ample positive stability to endure the expected 'P' force that will affect the vessel when taking blocks
 - Once the vessel enters the critical period, it is to ensure that GM is large enough to compensate for a virtual rise in 'G' once the keel touches the blocks
 - To improve the positive stability of all the slack tanks, free surface effects they should be also 'pressed up' or pumped out if possible (Clearly it may prove impractical to change the status of similar commodity or fuel oil tanks)
 - All repair list should be completed and kept readily available for handing over to the dry dock authorities
 - All utilities required should be ordered before ample time for supplying to the ship on docking
 - All store rooms, toilets and ship compartments should be locked for security purpose and loose gears should be stowed away before entering the dock
 - Rig fenders must be provided around the vessel prior to entering the dock
 - Plug and lock all upper deck scuppers to decrease the risk of pollution
- Dry Vessels (Container, Bulk Carrier etc.):**
- To ensure continuity of the strength throughout the length of the vessel, make sure that all hatches and beams are in a stowed position
 - Prior to approaching the dock, lower all cranes or derricks
 - In case of valuable cargo on board, it should be provided with a lock up protection in place

Tanker Vessels:

- Before entry, the vessel needs to be certified as “gas free”

Role of the Master During Docking

The master of the ship is the ultimate authority onboard. The responsibility of the master is independent of other parties involved in the docking but at the same time the master has to work in lieu with the superintendents, dock masters and pilots.

All the communications, decision makings and job delegations is the responsibility of the master.



Master on Bridge with Dock Pilot

- The master also plays a very important role for the vessel’s stability and maneuvering. Sometimes on specialized vessels where the pilots are unaware of the maneuvering provisions and characteristics of the vessels, the master will be responsible not only for controlling the vessel but also for safely guiding the vessel in to the dock.

The master of the docking vessel must ensure the following:

- Transparent communications and liaising between vessel and dock personnel
- Repair lists are ready and accepted by all parties
- Onboard jobs delegated to respective competent personnel
- Safe working culture is maintained onboard
- Maneuvering and handling the vessel in lieu to the dock master and the docking pilots
- The engines and thrusters are used appropriately while approaching the dock

- Safe navigation throughout the docking period
- The propeller and thruster movements are stopped while the vessel enters the docks
- All retractable appendages such as the speed logs, stabilizer fins etc. are stowed away inside the hull prior entering the dock
- Enough hands are available onboard for making fast the tugs, attending the moorings, assisting the shore personnel (if any) for docking the vessel

If the vessel has damaged its hull plating, the dock authority can advise the following while entering the docks –

- Trim the vessel by head or maintain an even keel so as to continue steering appropriately
- Reduction of speed to be considered to relieve the pressures on the stern areas
- Continuous monitoring of the water level in the shaft or tunnel bilge sections is carried out and provision for pumping out is

provided

- All watertight doors to be kept under watchful eyes for efficient operation

Role of Deck Officers

- Deck Officers are assigned jobs by the Master or by the Chief Officer on behalf of the Master. The responsibility that lies with the officers is directly accountable to the master

The Master might delegate the deck officers to liaise with the Chief Officer for attending various functions while docking. Deck Officers might also be used to fill in the gaps as competent personnel and to take actions on behalf of higher hierarchy.

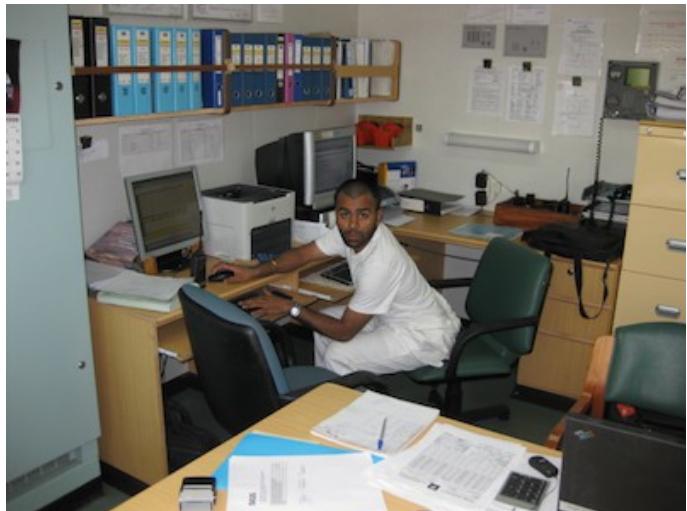
The Deck Officers will make sure of the following:

- Proper communication between the master and the crew
- Navigational watch keeping

- Event Logging. All times and events to be logged down in the ship's official logs:
 - Time of the tug being made fast
 - Entry into the docks
 - All relevant engine movements
 - Record of the shore men (if boarded the vessel for mooring/assisting in dock entry)
 - Time of caisson / lock gates opening and closing
 - Time of pilot embarking/disembarking
 - Time of first lines ashore etc.
 - The bridge equipment are adequately used and switched off as and when the ships power is isolated
 - Mooring stations are properly manned by having competent personnel for all the rope work
 - Assist the bridge / master as and when required
 - While on deck, assist the bridge by providing all clearances from the navigational obstructions in proximity

Basically the deck officer is the “eyes and ears” of the master during critical operations such as making entry into the dry dock. The master will rely on the officers for accurate reporting and advisories.
- ## Logbook Entries
- For all legal and record purposes, a distinctively routine docking operation should be included in ship's logs. A typical logbook account should cover all aspects of docking for various activities.
- The deck logbook and engine logbook should be appropriately recorded with -
- Times of operations and details of tugs involved
 - Times and details of the relevant engine movements

- Times when lines passed, taut and cleared
- Gates closing / opening in case of the ‘Graving Dock’
- Times and operations related to flooding / emptying the dock



Deck Officer Keeping Dry Dock Records

- Times when vessel rests or clears the keel blocks
- Access-way attached to the vessel after residual water is cleared from the dock
- Times of Pilot/s embarked and disembarked

the vessel during docking and un-docking

- Delays encountered if any
- All other operations and tasks undertaken during the stay of the vessel in the dock are to be recorded and provided to the company office as necessary

All the vessels initial tank soundings must be recorded in the tank sounding book. This is particularly required when the vessel re-floats, as the vessel may have undergone changes during the course of the dry dock.

Quick Tips



“All the tanks soundings must be recorded in sounding book prior docking and any changes in the tank level during the course of dry dock must also be recorded.

“Sounding book is then produced to dock master informing the changes and levels in the ships' tank for stability purposes”

“It is extremely important to record the complete docking operation in the logbook, as in case of any damage during the docking process, the insurance club will demand all records in a legal document in order to confirm the scenario before approving any claim”

Chapter 4

DUTIES OF SHIP'S STAFF

Duties of Master and Chief Officer

Duties of Other Officers

General Duties of Bosun

Papework in Dry Dock

Safety Procedures During Dry Dock

The key to an efficient dry docking operation is equal distribution of work among crew members. All personnel are assigned with specific tasks and duties according to their ranks and experience. Proper distribution work not only helps in timely completion of the dry dock but also reduces accidents and mishaps during dry dock.

Duties of Management Officers

Before dry docking a vessel, the master shall advise the dock master with regards to the quantities and distribution of fuel, ballast and clean water aboard.

In case of any proposed changes, the master shall inform the dock master in advance and get his consent, including the plans to take water in double bottom, domestic and peak tanks while the vessel is in the dry dock.

During this time, the chief engineer needs to collaborate and liaise with the chief officer. Also, the ballast and fuel shall be transferred with the

written consent and instructions of the dock master.

Safety Aspect

Master should ensure that officers onboard follow all safety procedures and precautions as practiced by the shipyard personnel. Special care must also be taken by the master to eliminate all fire hazards.

During the process of removal of deck plates, gunwales, ladders, gratings, floor plates and handrails, the repair yard must take sufficient safety measures. It is also mandatory to correctly secure and reinstall these items once the repair work is completed.



Repair Work

In case of any infringements regarding the safety regulations by the shipyard personnel, immediate reference to the superintendent is required who will then take up the issue with the shipyard management.

Repair Conferences

The attending superintendent, master, chief engineer, chief officer, second engineer and electrical officer are required to attend the repair conferences. Whenever necessary, the attending superintendent may call the shipyard management for the conference.

Unsatisfactory Work

In case an officer considers any repaired equipment unsatisfactory or the equipment is in a substandard condition, it needs to be immediately brought to the attention of the chief engineer or master, who may then take up the issue with the attending superintendent.

Ordering Utilities and Other Ship's Services

It is the duty of the chief officer, with consent of the master, to order the ship essentials as well as

the domestic services, which the ship would require during its tenure in the dry dock. These would include the following:

- Earthing wire fitting and bonding
- Electrical power via shore side generators
- Provision of sanitation facilities, supposing that the crew are living on board
- Access gangways from ship to shore



Ship Access from Dock

- Night watchman fire/safety and gangway security

- Collection of garbage and disposal facilities
- Emergency services
- Communications - land line direct
- Sea circulating connection for machinery spaces
- Additional lighting, if required
- Air-line connection if necessary for operating pneumatic tools



Air Supply from Dock

- Connection of water pressure availability on the fire-line

Quick Tips



"The sewage discharge pipe is connected to a sewage tank kept on the dock. Check the shore connection before starting the overboard discharge to avoid spill"

"Most of the vessels now use fresh water generator and do not take water from the shore during their normal voyage. In such cases, the shore water connection blank and valve are to be eased up as they have not been operated for long duration of time. Neglecting this can lead to jamming and undue delay in docking work"

Paints, Chemicals and Gas Preparation

Hot work and cutting jobs followed by cleaning and painting of the ship are the most common procedures performed on ship's deck during dry dock operation.

It is the responsibility of the ship's staff to ensure that the ship is presentable and sea worthy after the dry dock is over. For this -

- Ensure that the paint including primer is available onboard, as immediately after the dry dock, the ship staff will have to work hard to enhance the look of the ship's deck in order to avoid any trouble from the Port State

control. (They definitely take the matter of deck appearance and housekeeping very seriously)

- If needed, raise a requisition for paints to the company
- Paints and chemicals should be a part of routine ship supply. Ensure the same is done in lieu with the superintendent prior to docking
- The chemical requirement for cleaning must be informed to 2nd engineer, as he is responsible to raise the requisition for chemicals
- Check if enough oxygen / acetylene gas bottles are available onboard. If not, raise a requisition with the 2nd engineer
- All gas cylinders to be properly secured and kept outside on the deck
- Check if enough welding and brazing rods are available in deck workshop. Raise requisitions for the same if required



Hotwork in Dry Dock

- Ensure that the paints and chemicals used are tallied for when and how they get consumed, especially the paints used for the ship's exteriors
- Hull Paintings have to be overseen by a paint supervisor. The ship's chief officer should ensure that the jobs are carried out as planned

Quick Tips

“Don't forget to cross check the weather forecast from the local department to avoid wastage and undue delay because of rainfall during or after hull painting. The hull paint coatings have a 'setting time' after application which should be taken care of”



Duties of Other Deck Officers

Deck officers are normally the watch keeping officers onboard and have their watches rotated as per the ship's watch keeping schedule.

The master or the chief officer may delegate additional duties, apart from their routine ones, to the junior officers. The watch keeping duties of the deck officers are normally as listed down in company manuals.

Every deck officer is responsible for all the jobs carried out during his/her watch. Be it day or night, handing over and taking over the watches are two very critical stages of the watch keeping routines in dry dock.

The jobs to be carried out by the deck officers may be as enlisted below:

- Ensuring safety and security is intact at all times
- Overlooking the ship's staff as well as the shore staff during critical operations

- Recording all the events during their watches and logging them down in the 'Daily Progress Reports' and in relevant log books
- Ensuring that jobs are being carried out as planned for the day



Checking On-going Jobs

- Making sure the ship's crew is working safely
- Counter patrolling for fire and pollution
- Assisting chief officer for the deck work as required
- Working in lieu with the master for

completion of paperwork as required

- Assisting in preparing the vessel for class surveys
- Passage planning and chart work
- Setting up the bridge equipment and taking inventories of stationary items onboard, medicine chests etc. under master's supervision
- Maintenance of all LSA and FFA under the chief officer or the safety officer's supervision
- The deck officer is also required to land some of the critical safety equipment such as the life rafts, the fire extinguishers, rescue boat / life boat kits, SCBA cylinders etc. ashore for testing and maintenance as per the scheduled interval. Such decisions should be made after verifying the same with the chief officer or the master
- Overlooking delivery of paints, chemicals, general stores and provisions as and when they arrive



Receiving Paints in Dry Dock

- Ensuring all the equipment/ parts landed ashore for repair are noted and landing report is prepared
- Liaise with the dock personnel during emergencies and medical/ first aid requirement

Quick Tips

"When any hotwork is carried out inside the ship, it is a normal practice to switch off the fire alarm in the vicinity and carry out manual fire watch by the shore safety officer. Deck officer must ensure that the fire alarms in nearby areas are in proper operating condition and continuous fire watch is being kept by ship's crew"



General Duties of Bosun

The ship's deck crew works under the supervision of the bosun or boatswain. He is responsible for the welfare of the deck crew and acts as an intermediary between the ship's chief officer/master and the crew.

The bosun is a senior deck crew member who is responsible for maintaining the ship's integrity. The bosun supervises the other deck crew members and is not a watch keeper. The duties of the bosun can be described as below –

- The bosun plans out the day's work and assigns tasks to the deck crew. Normally the chief officer is the one delegating the Bosun for deck jobs that need attention
- The bosun checks on completed work for compliance with approved operating procedures
- As a senior crew member, bosun delegates jobs to his subordinates and juniors with respect to the ship's maintenance

- He ensure that all provisions attending to safety such as the shore fire lines, fire watchmen etc. are readily available
- He ensures that the jobs are carried out as planned during the dock meetings
- The bosun must ensure proper PPE is provided to the crew
- He has to ensure that all the ship's tanks such as the ballast tanks, cargo holds / tanks, fresh water tanks, cofferdams etc. are drained, cleaned, gas freed and ready for inspection
- He takes possession of all deck stores, paints/chemicals, housekeeping stores etc.
- He is the in-charge of safety and security of the ship's crew and property

Quick Tips

"As much as possible, the bosun must consult the chief officer before allotting jobs to the deck's crew so that the chief officer can carry out the risk analysis of the job to be performed and also ensure that all safety procedures are being followed"

Paper Work During Dry Dock

Ships/Company Documentation Required for Dry Docking

In order to hand over the correct documents to the dry dock authorities, it is mandatory for the ship to coordinate with the company officials and also arrange for the essential copies of the ship's plans prior to the arrival.

However, the following items are prepared by the ship's chief officer:

- The General Arrangement Plan
- The Dry Dock Plan
- The Shell Expansion Plan
- Gas free Certificate (Tanker Vessels)
- The Ships Stability Information
- Cargo Plan and Manifest (In case docking with cargo on board)

- Relevant Certificates
- Rigging Plan (Cargo Vessels)
- The Plug Plan (incorporated into Dry Dock Plan)
- The Fire Fighting Facility Plan of the Vessel
- The Shell Expansion Plan
- The Tanking Arrangement and Distribution of Commodities



Providing Dry Dock Plans to Dock Personnel

The relevant documentation and number of copies of important plans required will depend on the

status of the ship, i.e. if it's just a routine maintenance or an emergency repair.

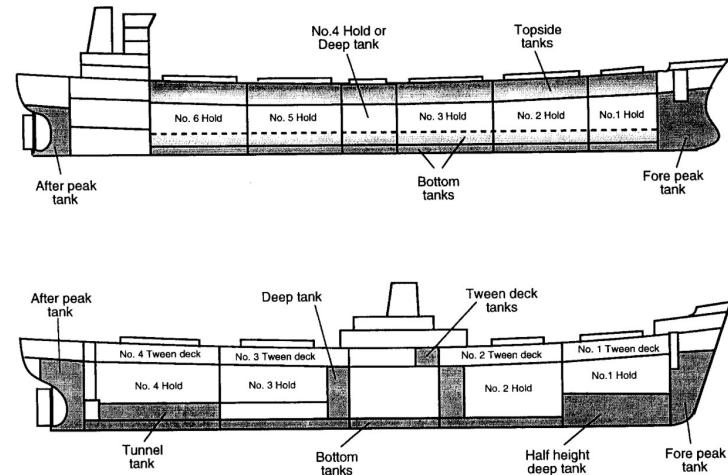
For example, if a grounded vessel with bottom damage is being docked; it will typically have the shell expansion plan copies readily available. More or less all dry docks have the facility to print blue print plans provided the original copies are supplied by either the company or the chief officer.

Dry Dock Plan (The Docking Plan): The dry dock plan contains the ship's bottom hull and any appendages extending from the bottom to ensure no damage is caused to the fittings. The main function of this plan is to show the distribution of shores and blocks which support the ship once it is inside the dock.

General Arrangement Plan: A general arrangement plan outlines the ship's profile along with the detailed description of the vessel's equipment, compartments, accommodation, cargo and machinery spaces, working space, store rooms, passages along the dimensions of the vessel etc.

During the dry dock, this plan is considered for the

accurate determination of the job profile so related. It comes handy particularly with the passenger vessels that have more number of compartments.



General Arrangement Plan of Bulk Carrier

Shell Expansion Plan: It's a two dimensional diagram or plan which is widely accepted for all docking operations, especially when docking due to damages caused to the hull. The plan gives an overall view in order to identify individual plate sections.

Framing of the vessel plates, the numbering and identification of the strakes are accordingly included in the plan.

Bottom Plug Plan: Normally, this plan is incorporated within the docking plan. However, if the plan is available as an added document, it would be wise to demarcate such a plan which gives details about the location of the bottom drain plugs on the exterior of the hull, their dimensions and sizes.

The responsibility of removing, stowing and securing back the bottom plug is that of the ship's officer, normally the chief officer. For all practical purposes, the plug is to aid drainage of the vessel's tanks and compartments for surveys and/or repairs.

Tank Arrangement (Capacity Plan): The Capacity plan of the ship is a separate plan, outlining the arrangement of vessel tanks and compartments in details.

The location, volumetric size, other aspects of the vessel's cargo holding tanks, bunker tanks, ballast tanks, deep tanks, lube oil tanks etc. is given in this plan. Normally, the ship's General Arrangement (GA) Plan includes such details.

The plan aims to aid in taking the vessel's various tank soundings while the ship is afloat and when she is taken to the blocks.

Fire Arrangement Plan: It is one of the most important plans to be attended during dry dock, for use by ship's personnel and most importantly the dock personnel for handling practical and emergency situations. This plan is kept in a container outside the accommodation area for easy access.



Fire Plan Outside Accommodation

This plan specifies locations of all firefighting equipment onboard, which includes fixed flooding systems, fire mains with hydrant positions etc.

The fire line is pressurized with the shore water supply (which is connected via the International Shore Coupling to the dock's fire lines) as usually all the pumping machinery would have been isolated for repairs.

Other Paperwork

With regards to the implementation of ISM code on board ships, it is very important for engineers, officers and surveyors to log down all the events and prepare reports of each and every work carried out on ship's deck.

This would require to:

- Prepare a separate file for blank landing report, which will be filled and signed by the chief officer (C/O) and the shore in-charge when any part from the ship's deck is landed ashore for repairs or checks
- Make a separate file to collect all the invoices of spares received during dry dock
- Make a separate log file to note down valve operations in deck (fire line or ballast line). Whenever anybody operates a valve (opens or closes), he/she should record it in this log file along with the date, time and current position of the valve (open/close)
- Prepare a separate “Isolation log file” to include the date, time and the machinery

isolated, so as to ensure that it is brought back to normal when the dry dock is completed

- A “work-done” file to be arranged for the dry dock, which is to be filled with the type of work and the date of completion of each job
- Keep all the manuals of important machinery and systems readily available as they will be required by the ship's staff and shore people for reference
- Make a separate set of photocopies of layouts, line diagrams, and systems as they will be required by the shore staff. This would avoid losing or misplacing of the original diagrams
- Previous dry dock reports also to be kept ready for reference
- A separate file with all kinds of work permit forms (blank) to be arranged and kept ready
- Rest hour file to be properly maintained in the dry dock

Safety Procedures in Dry Dock

- Firefighting equipment ready at all times
- Fire detectors and fire alarm must be in good working condition
- CO2 total flooding system door must be locked to prevent accidental actuation



Isolating CO₂ System

- Safety gear to be worn while working i.e.- Safety shoes, helmet, overalls, safety goggles, ear mufflers, and gloves. Ensure

that appropriate PPE is provided to the deck staff

- Proper working permits must be obtained before carrying out any work on board, e.g. hot work permit, enclosed space entry permit etc. Same to be verified and signed by the responsible personnel
- All lifting gears should be checked and the same to be in good working condition
- Escape routes should be clearly marked for easy accessibility during emergencies



Escape Route

- Safety lamps/torches are to be used for the jobs – never use a naked lamp

- Enough number of Safety harnesses to be made available and ensured that all are checked for good integrity
 - No transfer of oil should be carried out in dry dock
 - All the fire call points inside accommodation and bridge to be tested prior dry dock and any dead point is to be rectified
 - Acetylene and oxygen bottles are to be properly stored and secured
 - Fire officer must be present at the site of hot work and fire extinguishers to be readily available. The ship's "Fire plan" must be handed over to dry dock authorities
 - No unauthorized personnel be allowed on board
 - Ship to be electrically grounded to shore earth
 - Fire locker to be maintained, SCBA to be kept fully charged
 - Fire line to be kept always ready with 2 hydrants open if no hull work is carried out
 - Safety meetings along with risk assessment to be carried out every morning before starting routine jobs
- Quick Tips**



"End each working day by taking a fire safety round and a short meeting to discuss various safety hazards. Any reported matter by ship's crew or shore team must immediately be notified to the chief engineer and shore safety officer"
- Real Life Incidence**

C/E forgot to disconnect the connection to the CO₂ bottles prior to opening the high pressure air valve. Shortly after starting the test, CO₂ bottles started discharging into the E/R. Unable to stop the discharge, he activated the CO₂ alarm. About 10 minutes after the accident, rescue operations were started by shipyard rescue team. Several crew members and yard personnel were sent to the local hospital for medical treatment. Three crew member were later declared dead.

Chapter 5

MAINTENANCE WORK IN DRY DOCK

Maintenance of Deck Machinery

Maintenance of Deck and Equipment

Maintenance of Cargo Holds and Cargo Tanks

Maintenance of Hull

Maintenance of Rudder, Propeller, and Stern Tube

Maintenance of Accommodation

Maintenance of LSA and FFA Systems

Dry dock is the best time to carry out all pending, scheduled and emergency maintenance jobs on ships. Repair work is performed on the basis of the priority of the jobs mentioned in the “repair list”.

Regular and/or Routine Tasks in dry dock comprise of :

- Cleaning of the ship's bottom which could include high pressure water or grit blasting
- Hull painting and re-coating of the underwater area and boot topping
- Cleaning and painting of the chain locker
- Ranging and inspection of the anchor cables
- Inspection and re-packing of all underwater stuffing boxes
- Overhauling of all underwater valves
- Inspection of stabilizers (fins) for corrosion and operational quality
- Renewal of sacrificial anodes as and where appropriate
- Examining rudder and propeller arrangement. Also survey requirements must be met for the tail end shaft
- Cleaning of all sea water intakes and straining arrangements
- Painting draught and freeboard markings
- Cleaning, polishing and checking clearances of propeller(s) and rudder fittings
- Drawing tank plugs relevant to tank draining schedule and cleaning of various tanks
- Inspecting bow thruster units and monitoring corrosion or damage effects
- Inspecting windlass and brake linings
- Renewing pipe lagging and flange gaskets
- Conducting any general steel work repairs; for example, flame cutting, welding etc.
- Carrying out general repairs in deck and engine room

Maintenance of Deck Machinery

Anchor Winch / Windlass Inspection: An essential aspect of the ship is the operational condition of the windlass which can directly influence the safety of the vessel.

The windlass is usually inspected at the time of dry docking where special attention is paid towards replacing the ‘brake linings’.



Winch Repair

A close inspection of the floating end of the band break, along with the efficiency of the braking system, would be of high priority. Any suspecting

condition or corrosion of the cotter pins within the brake system can cause concern and thus should be replaced in the dry dock.

Other important parts of the winch to be checked are:

- Gears and internal parts
- Hydraulic pipings and valves
- Electric motors and circuit
- Clutch system
- Winch drums
- Foundation and body covering

Deck Cranes: These are the ship’s lifting mechanisms which are required for various operations such as lifting stores, spares, provisions etc.

Due to their diversity in work, the lifting machinery are subjected to constant wear and tear and therefore are required to be maintained and tested as per the international regulations.



Deck Crane

When lifting appliances such as the components associated to the crane ‘fail’, the magnitude of losses could be devastating.

Failure of ship's lifting mechanism can lead to serious injury or even death not only to ship's personnel but also to stevedores and dry dock workers.

The ships lifting appliances are tested and inspected as per the following frameworks-

- Merchant shipping regulations
- Flag state requirements

- International Labour Organization (ILO) Convention, 152

The following are the crane components that require maintenance and testing –

- Protection and limitation devices
- Loose gears and ropes
- Winches, drums, work wires and sheaves
- Hydraulic systems
- Nuts and bolts
- Joints, frames and foundation
- Safety devices and components
- Electrical components
- Load test

IG System: It is accentuated that the safety provided by an inert gas system depends on proper operation and maintenance of the entire system.



Deck Seal

It is important to safeguard the non-return valves, especially the block and bleed valves, the deck Seals, the Pressure/ Vacuum (P/V) valves and the P/V breakers so that there is no possibility of product gases or liquids passing back to the machinery spaces.

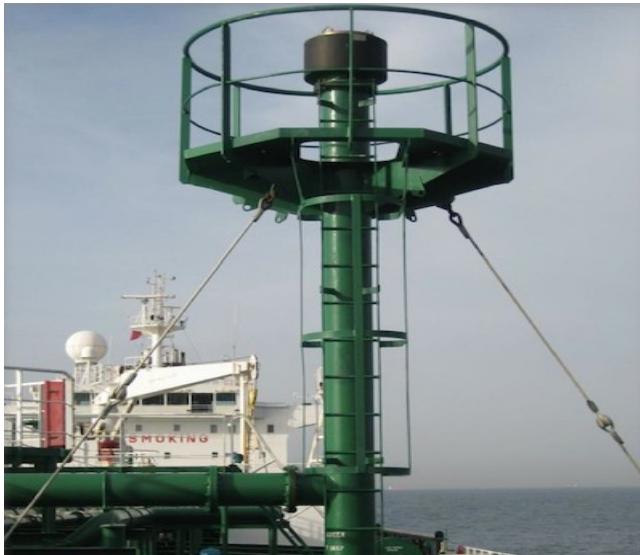
To validate the good operational capability of the inert gas plant, a record of inspection including defects and their rectification, should be maintained on board.

The dry dock period is the most ideal time for routine checks and overhauls to be carried out on the IG system and they are listed as follows:

- The deck seal (wet and dry) performs a dynamic role in the overall safety of the system and hence needs to be checked thoroughly for corrosion, damages, blockages etc.
- Checks should be made in order to find out whether the safety switches and alarms are functioning at correct parameters
- Similarly the remote valves that are supposed to open / close automatically should be certified to work appropriately as required
- Maintenance should be carried out for P/V valves and P/V breakers as they too form a part of the deck Inert Gas (IG) system
- Overhauling of P/V valves and breakers should be carried out if necessary and the body frames to be checked and inspected for damages and cracks
- All muck and oily clingage should be removed from the P/V valves so as to operate without obstructions
- Seal / anti-freeze levels should be checked

for the deck P/V breaker system

- Oxygen analyzers and related gauges used to measure the hydro-carbon levels should be checked for their precision and calibrated by a certified shore technician



Mast Riser

- Mast riser to be checked and cleaned off carbon deposit including flame mesh and screen
- The IG pipeline system on deck can be pressure tested for any leakage and required portion to be renewed

Pump Room Maintenance: A pump room on a tanker is a specific space containing a large number of cargo and ballast pipelines.

Leakage of an unstable product from any part of this enclosed system could lead to catastrophic results. The enclosed space is thereby required to be inspected and maintained in good shape to avoid accidents.



Cargo Pump in the Pump Room

There have been many cases in the past wherein crew members have lost their lives due to asphyxiation by toxic gases, explosions have occurred due to improper maintenance on the pipelines that undergo immense rise and drop in

fluid pressure, and pollution has took place due to damaged pipelines and hull.

The inspection and maintenance carried out in pump room should be as per the following –

- Ensure that strainer covers, inspection plates, drain plugs and lighting are in proper working condition
- Drain valves in the pump room cargo system, especially those on cargo oil pumps, should be checked and repaired if necessary
- Pipelines, joints and pump stacks to be properly checked and cracks to be repaired
- Pumps should be checked thoroughly and any abnormality to be rectified by competent shore personnel. This is similar to repairing and maintaining the deep well cargo and ballast pumps that are fitted in individual respective tanks
- All associated pipelines, clamps, joints, expansion valves etc. should be verified for good order and integrity

- The local pressure gauges, glands, bearings and casing of the pump should be checked for proper operation
- The bulkhead glands and packing should be inspected to ensure sufficient gas-tight seal is maintained between the pump room and the machinery space



Pump Room Bulkhead Gland With Sensor

- All intrinsically safe electrical fitting inside the pump room to be checked
- The emergency stop button functioning to be checked

Bridge Equipment: Navigational equipment are considered to be one of the most critical devices onboard ships and therefore must be maintained with the highest possible standards complying with the international regulations. Priority should be given to radars, gyros, VHFs, GMDSS equipment, ECDIS, auto-pilot and steering.



Bridge Equipment

Manufacturers provide charts clearly depicting the maintenance required and the time interval of the same.

All bridge components are to be examined and repaired by the shore personnel, who usually are manufacturer's representatives or technicians from a specialized third party company which provides such services.

Bow Thruster Units: Nowadays with the increase in safety standards, vessels are equipped with bow thrusters for efficient and safe ship handling.



Maintenance in Bow Thruster Grating

Bow thruster units are more prone to damages due to collective debris such as fishing nets, marine growth etc. With the bow section of the ship submerged throughout the trading life of the vessel, the only time bow thrusters will be accessible for maintenance, cleaning, or repair will be during the dry dock period.

It is the responsibility of the chief engineer to check the complete operation and system once the maintenance is completed by the shore party.

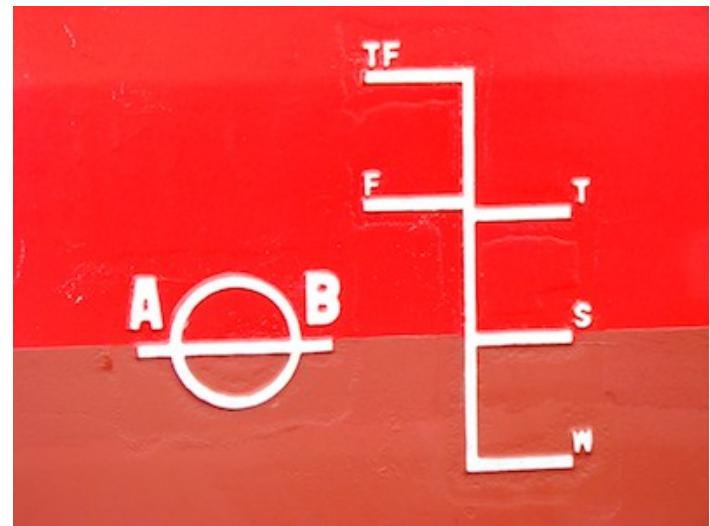
Trouble / Damage During Dry Docking

- An incomplete 'defects list' will create confusion over the work to be carried out and the work delegated
- If the ship staff is not briefed about the safety, security and routine jobs to be undertaken in the dry dock, there would clearly be a disparity among them
- Fire and explosion hazards drastically increases when hot work is done on tanks which still have volatile substances
- If spares are not checked prior to docking, delays would be inherent
- Any leakages must be pumped out to the working bilge tanks prior entering the dock
- Wrong frequency by the shore power system may cause damage to ships machinery, which would again be an additional burden
- All additional work in the dry dock, reciprocates to additional costs and time

Maintenance of Deck and Structures

Ship-Side Markings

Repainting the ship side markings such as the ship's name, draught and load line marks is not only important for survey purposes but also imperative for the running needs of the ship.



Ship Side Marking

Dry docking gives ample accessibility by means of scaffolding and staging for maintaining the exposed markings.

Painting Operations

The selection of a paint coating system for a certain vessel is based on several factors which also includes the following:

- The available budget and economics
- The life expectancy and quality of the necessary coatings
- The time availability and degree needed for surface preparation
- The trade and service conditions of the vessel
- The legislation requirements, keeping in mind the current agreements regarding Tri Butyl Tin (TBT) based paints

Incidentally, the final application of coating is determined by the budgetary restrictions which often influence the choice of application.

However, it is recommended to use high quality hull and high performance cleaning using quality products, e.g. chlorinated rubber coatings, the two

pack epoxies or the polyurethanes.



Applying Paint Coating

The decision to use high quality products would also be dictated by the anticipated level of wear and expected service conditions. Where usage of oils or chemicals can be expected (for e.g., areas such as cargo tanks, bunker tanks etc.) then either the 'two' pack polyurethane paint coatings or the much modified 'two' pack epoxy paint coatings are recommended.

Some ship managers reckon using chlorinated rubber products to coat the exposed decks, which is practically unusual as such areas are coated with a base aluminum primer followed by high volume of finishing coats.

It is to note that for any system of painting employed, the resulting quality will be reflected by the amount of surface preparation undertaken. With majority of high quality products used on all outer areas, as a pre-requisite the steelwork also needs to be chemically cleaned.



Primer Coating

Before painting the ship, shot or grit blasting is required, along with cleaning and blast priming. Such type of cleaning requirements, undoubtedly raise the bottom line costing.

Usually the underwater hull areas are primed with a shielding metallic coating which contains an antifouling agent compatible with current legislation.

Upper superstructures and topsides of the ship would use a proper primer like a 'Navy Protective' in conjunction with a decorative hard wearing gloss coating and undercoats. Appropriate alternatives for areas above the waterline could be either vinyl paints or polyurethane.



Accommodation Area Painting

Non-exposed areas of the ship such as chain lockers or linings under machinery beds, which do not require any decorative value from coating, would usually be coated with high build Bitumastic paints. Galvanized steelwork would be primed by zinc chromate with an appropriate undercoat and protective topcoat.

Tank coatings rely on the probable nature of the tank contents. Zinc silicate coatings are resistant to an extensive range of solvents but the advanced pure epoxies are considered more versatile for fuels, oils, chemicals etc.

Chief officer must know what coating properties are required for painting various hull levels.



Different Coats at Different Levels

Ship's side and bottom paints should be resistant to alkaline conditions and have good electrical resistance to prevent corrosion. Careful use of sacrificial anodes when tactically placed on the hull would work in tandem with corrosion resistant coatings.

Terms Used for Hull Painting

Anti-fouling Paints: They are special paints, defined as a toxic composition applied to the vessel's bottom to prevent marine growth such as barnacles and weed that could affect a vessel's performance.

Boot Topping Region: It is the surface area of the outside hull plating located between the light and load waterlines of the vessel. The hull area near the water line has to be coated with paints of different compositions which can withstand regular wear.

Superstructure: It is defined as any structure which extends above the ship's main deck.

Top sides: Paintwork areas of the ship's hull that is located above the waterline.

Film Thickness: The layer of paint and thickness, usually of dry dock specification, which is used to describe the total number of coatings required to achieve the desired depth of paint coverage applied to the hull.

Leaching: It is a term which describes the

removal of substance from a solid surface. For example, removing toxics from the TBT paints

Over-painting: A term used to describe reapplying the coat on top of previous paint coats. Such practice eventually produces a rough finish and requires the hull to be stripped clean in future.

Primer (paint): The initial and subsequent coatings, applied to the steelwork as an anti-corrosive compound prior to the application of an intermediate and top coat.

Touch-Up: It is a term that is employed to describe areas of the hull that have experienced corrosive effects. As opposed to complete cleaning and re-coating of the hull, only smaller sections of the plating are cleaned, protected and re-coated.

Coating: A protective film of thickness usually about 0.2 – 0.5 mm applied to prevent corrosion of ships hull using three main mechanisms - the barrier effect, the cathodic effect and inhibition / passivation

Cradle: A staging that is suspended over the ship's side to carry out painting and repairs

Deck Plating (Crack Repair)

Damaged structural steel plates or aluminum plates are fabricated and assembled in the yard workshop so as to be replaced during the repairs.



Plate Renewal

With the advancement in technology, yards have started using computer-driven cutting torches in order to cut down the worn or damaged steel plates.

These cutting torches comprise of Oxy-acetylene, oxy-propane, oxy-butane etc. Hand cutting is used where machines are inaccessible.

In the workshop, the steel plates are custom cut and fabricated to the characteristics of the repair job and then transferred onboard where they are

welded back in place by certified welders. The steel plates are initially tack welded or spot welded onto the structure, and once in position they are welded in entirety.



Hull Section Welding

Sections of the hull that are to be repaired may be blasted using grit, sand or water and painted before assembling the new pieces. Surveys are carried out for all stages of hull renewal - the initial and final hull surveys are most critical.

Quick Tips

 “Any hull welding activity by the dock workers must be reported to the chief officer prior to the job so that chief officer will ensure that the surrounding tanks and holds are free off any oil or gas”

Funnel Areas

Maintenance on the funnel is one job that can only be carried out thoroughly when the vessel is “dead” in the yard. The surface could be blasted and repainted with satisfactory results and utmost safety



Funnel Painting

For maintenance on the funnel, make sure the supply for specialized coatings is sufficient. Normally, heat resistant or high temperature paints or those as specified in the vessel painting scheme are used in and around the areas where maintenance is to be carried out.

Previous paint and dry soot deposits are scrapped

out and the surface is buffed or wire brushed to get an even consistency for better paint adherence.

The use of high temperature paints is to prevent the coat from getting worn out due to the latent heat, which develops on the interior and exterior bulkheads during the normal running period of the vessel. Surveys and general inspections of the funnel area, including funnel flaps, are also carried out in order to check the integrity.



Funnel Flaps Inspection

with vessel operation. Initial impressions are therefore vital which can also show signs of a well-run vessel.

On the contrary, if these main embarking ladders are unsafe, it can be considered as negligence on the part of the ship's officers and crew. Thus their maintenance is of top priority.

While in a dry dock the structure of the ladder must be thoroughly inspected for cracks, bends/distortion, impairment, corrosion etc. and repairs to be carried out as necessary.



Gangway Ladder Inspection

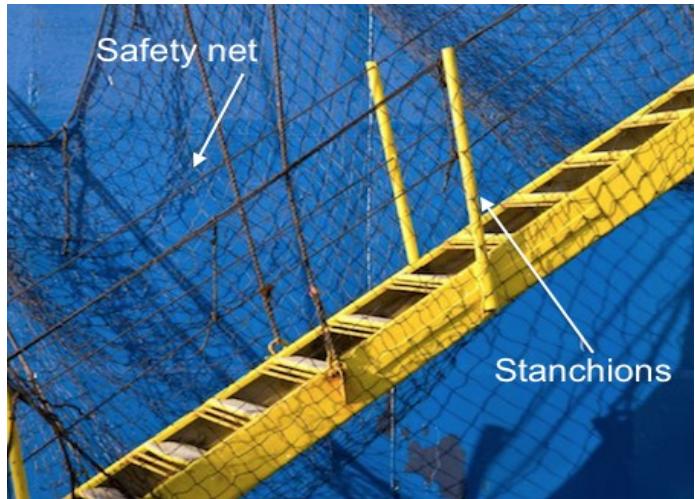
Gangway Areas

Gangway / accommodation ladder is the initial point of contact for all the parties that are involved

Corrosion is likely to occur in areas where different metals come in contact with each other.

Mild steel areas are also to be inspected closely for distortion and deterioration which can lead to a weakened structures.

Stanchions which are damaged or bent should be replaced and renewed as necessary. Regular moving parts such as sheaves, bearings, rollers etc. must move freely and greased to its appropriate standards.



Ship's Gangway

Lifting equipment of gangway must be checked thoroughly with respect to the condition of hoist wires, which must be free of kinks, particular bends near the sheaves, corrosion, and distortion.

Damaged wires must be replaced during the dry

dock and the hoist wires must be checked for valid test certificate. Safety net to be inspected for damage and renew if required.

Chain Locker and Anchor Operation: Ranging Cables for Inspection

It is important to carry out the inspection of ship's anchor cables in the dry dock by removing the complete chain from the chain locker. This action will not only clear the locker but also allow maintenance inside the locker.



Anchor Chain

The ranging of the cables can be achieved by the means of a power-driven vehicle, which would tow the chain in flakes alongside the floor of the

dock by walking back the windlass under controlled conditions. Proper arrangement of the chain promotes easy inspection of all the joining shackles.

In case the cable is worn out excessively (usually on the shackle length next to the anchor), then three or four shackles are moved from the front end position to the bitter end for rectifying the issue. If this operation is carried out, the Chief Officer is advised to do re-marking of the anchor cable throughout its length.



Anchor Chain Paint Marking

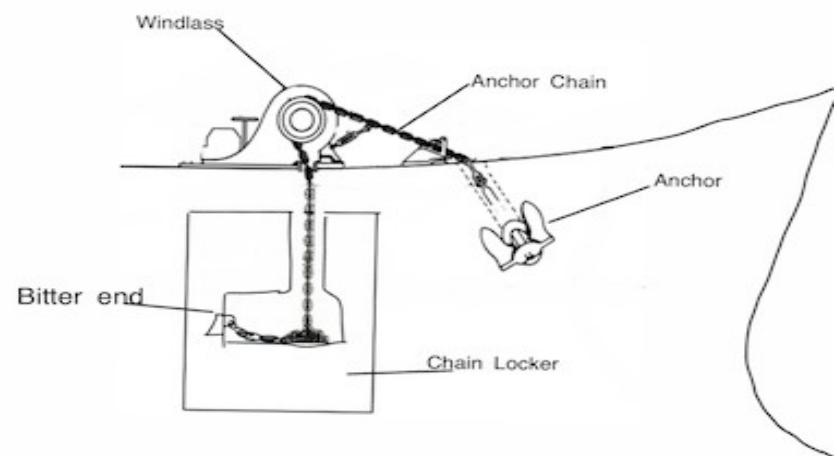
The anchor chain is then cleaned and painted with red, white, blue and yellow colors for fathom length.

Slipping the Bitter End

The slipping arrangement is usually carried out in the presence of a surveyor. It is conducted by lowering the end of the anchor cable completely using wire rope arrangement or a dock crane

Chain Locker Cleaning

Dry dock is an appropriate time to examine the condition of the chain locker.



Chain Locker

The 'mud box' and the chain locker are cleaned and re-painted using a protective paint such as 'Bitumastic'.

Attention should be given to the state of the gratings which cover up the 'mud box', particularly if they are of the wooden range, as these are extremely vulnerable and can damage in cable operations and damp surroundings.

Cable Accessories

During the dry dock period, inspection of cable accessories such as the devils claw, securing arrangements, bow stopper and similar cable holding devices is also carried out



Chain Stopper

Any mooring shackles which are retained on board such as the swivel pieces and spare joining

shackles or link adaptors will also need inspection.

Joining shackles in the cable length should be split for inspection on the floor of the dock and reassembled if found in good condition.

Quick Tips

"Ensure that the right equipment is used for the lifting any kind of load. Both the type and load capacity of the equipment and must be reviewed to keep a safety margin. The lifting cables and locking hook are also to be inspected"



Real Life Incidence

A 29 ton anchor chain was being lifted in ten 90-foot coils for moving it from a dry dock to a barge for shipping. The load was moved over the barge and the operator was about to lay it down when one of the cables snapped, causing a coil of the chain to fall. The falling coil of anchor chain struck the worker standing nearby on the back and the running chain knocked him into the water. He died as a result of being struck by the falling anchor chain.



Maintenance of Cargo Hold and Hatch Cover

The water tight and the weather tight integrity of the ship has to be ensured by close inspections of the hatch covers, manhole covers, booby hatch covers, trunking, side shell plating, tank tops, bulkheads etc. Complete inspection of inside the cargo hold is also an important task performed during the dry dock.



Cargo Hold

Doublers and inserts are welded onto the ship's damaged part in order to regain the designed strength of the section. Inspection and repairs (if required) should be planned well in advance.

Critical areas such as the hatch covers, sounding pipes, vent pipes, cleats, wedges, panels, pontoons, seals, channels, compression bars etc. should be inspected thoroughly for fractures, corrosion, and welding failures.

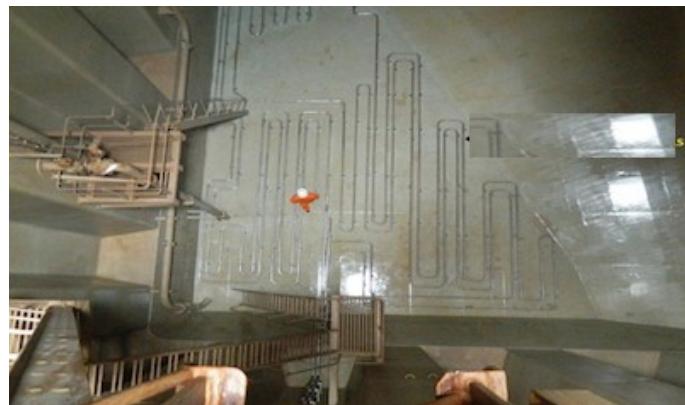


Maintenance of Hatch Cover in Dry Dock

Chances of hydraulic system failure are high due to excessive wear. Checks should be carried out on the couplings, valves, pipings etc. for any leakages. All leaks, misalignments and structural defects are to be attended by the manufacturer's representatives apart from the yard men who carry out the structural repairs.

Tankers on the other hand, have watertight compartments or tanks which are protected from

corrosive atmosphere in the tanks. However, the heating coils, cargo pipelines, cargo pumps (eg. fram system, electro-hydraulic deep well pumps) and associated components are all susceptible to damages caused by fluctuations in fluid pressures and temperatures.



Inside Cargo Tank of Tanker

Ship personnel are not competent to repair such damages; therefore specialized and competent personnel are called onboard ship during the dry dock period. The tanks and holds are also cleaned and gas freed before arrival in the dry dock for inspection and survey.

Bulk Carriers and Oil Tankers follow the Enhanced Survey Program which provides the ship owner/manager with guidelines to prepare the vessel for the special surveys.

Maintenance of Hull

Underwater Repairs and Inspection

A thorough inspection of the vessel and it's under water body is carried out by the master, chief engineer and chief officer in coordination with the attending superintendent. Careful attention needs to be given to the condition of:

- Corrosion inhibiting devices
- Paint
- Propeller and propeller shaft
- Shell plating, especially with regards to the corrosion, indentations or damages
- Sea valve strainers
- Echo sounder transducers
- Stern tube and bearing

- Speed log equipment
- Rudder and bushes
- Bow thruster tunnels
- External stabilizing arrangements
- Impressed Current Cathodic Protection

Tank Plugs: Removal of the tank plugs is carried out by the shore personal as listed in the initial job list. Proper storage, replacement and removal of all tank drain plugs are to be accounted by the chief officer.



Tank Plug Drain Protected by Wood

While refitting the plugs the area is to be cleaned off grit and other particles that can damage the threads of the plug. Lead is used as a packing material that is to be applied before ‘screwing-in’ the plug. Make sure the plug is secured tightly in place using the appropriate tool. Cement is finally applied onto the plugs in order to make sure the area is leak proof.

Hull Cleaning: Weed, barnacles and other marine growth are found on the underwater hull portion of every marine vessel in service. One of the main reasons for a ship to enter a dry dock is ‘Hull’ maintenance, especially the underwater hull exposed to sea growth.



Hull Cleaning

Such marine growth is also found near or on the

rudder and propeller areas. This affects the performance of the vessel such as reduction in ship's speeds, higher fuel oil consumption etc. due to unwanted resistance and added weight that is attached to the hull.

To remove such growth, sand/grit blasting is considered as the most common method. But due to environmental issues this method is not used in certain areas of the world. Vacuum dry blasting or hydro-blasting (High pressure water blasting) are other popular techniques which are easily available, cost effective, and eco-friendly.



Hydro-Blasting

In hydro blasting, it also becomes easier to dispose-off the residual water after the operation.

The Water-Jet System uses approximately 1000-3000 p.s.i pressure to clean the hull. Fresh water and dry blasting ensure clearing off the additional salts and dust.

The cleaned hull surface is then subsequently coated with anti-fouling paints to prevent further sea growth.

Hull Painting: The underwater body painting is carried out by the shore staff under the guidance of chief officer and master. Refer Painting operation.

Hull Maintenance and Protection: The steel hull requires appropriate care and attention even during the normal operational period of the ship. Sometimes, the condition of the hull does not allow for a complete maintenance.

In such conditions, a touch up operation is required to locate the steel areas which have been badly corroded. The touch up is followed by application of top coatings with suitable material, which is allowed to dry completely before commencing the undocking process.

Blasting Operations: Dry docks offer hull maintenance facilities such as high pressure water

washing and various blasting methods.

Grit blasting, one of the most commonly used blasting methods, is efficient but expensive as it requires additional cleaning up. Dust formed during this method is then hosed down using fresh water followed by application of top coat



Grit Blasting of Hull

Grit blasting is a method wherein shots of steel or copper particles are jetted or blasted onto the ship's steel hull in order to remove paint and rust, leaving a smooth and clean surface.

Grit penetrates deeper on the steel surface thereby providing a much cleaner area which is vital for better adherence of paint coatings.

Sand used for blasting is relatively softer than the grits. Moreover, they can also cause 'Silicosis' to the workers. The residue from blasting methods pollute the environment, creating health issues, and also jam the machinery systems located on the deck.

Due to the hazards related to steel shots and sand blasting, a newer method known as "High Pressure Hydro-blasting" has been developed. This method improves the blasting operations by increasing the efficiency, reducing health hazards and allowing better work ergonomics.

Quick Tips

"Prior to grit or sand blasting, it is advisable to cover all the deck machinery, especially mooring winches and windlass with a plastic or canvas to ensure no abrasive grit/sand dust goes inside the gears and other moving parts having fine clearances. The Suction Blowers for engine room and accommodation are to be switched off during blasting operation is being performed to avoid dust intake"



Corrosion Control: The structure of the ship suffers excessive corrosion under the effects of both moisture related atmosphere as well as sea water.



Hull Corrosion

Sailing of the ship requires the lower part of the hull to be immersed in sea water for 95-98% of its life. The lower region of the ship from the boot topping to the keel are almost always in danger from electrochemical corrosion, especially the aft area containing the propeller.

If the propeller is efficiently bonded to the ship's hull by means of the shaft, then the propeller becomes the 'cathode' and the steelwork of the rudder and the stern frame areas becomes the anode of a large corrosive cell, the salt water being the electrolyte solution establishing the completion of the galvanic corrosion cell.

This stern area of the hull is mainly prone to

corrosion because of the mechanical actions which produce turbulence, vibrations and the erosion of paint coverings.



Ship's Stern

Shielding the stern area and supplementary hull features, which are prone to excessive corrosion and galvanic attack, is achieved by using of 'Sacrificial Anodes'. These anodes are made with noble metals such as aluminum, zinc or magnesium.

The anodes are positioned around the stern frame areas including the rudder structure in sufficient number so as to offer adequate cathodic protection. The number of anodes depends on size of the ship, hull paint coating and material of the propeller.



Anode on Ship's Stern

The anode is sleeve welded to the hull to make a successful electrical contact. The anodes slowly waste away and are therefore required to be replaced in every dry dock.

Anodes made from zinc alloys have better capability for corrosion protection. However, the choice of the metals used as anodes is based on cost as well as practical considerations.

Magnesium anodes should not be used inside cargo/ballast tanks of oil tankers because of the possibility that it can generate a spark if the anode falls to the bottom of the tank. Also, overprotection by anodes should not be allowed to take place as this would be dangerous to paint

coatings, causing them to blister and paint failure due to the alkali generated at the cathodic areas.

Other prominent areas protected by sacrificial anodes are:

- Along the length of the bilge strake to decrease corrosive effects on the keel
- Internal tank systems
- All non-ferrous fittings, e.g. Sea water system fittings etc.
- Rudder surfaces and connecting couplings



Rudder Anode

➤ Bow/stern thruster units

Impressed Current System: This system works by supplying a controlled amount of DC current to submerged surfaces using highly reliable mixed metal oxide anodes and zinc reference electrodes. This electrical current is constantly monitored and regulated by the system itself to prevent the electrochemical action of galvanic corrosion.

The corrosion resistant anodes are insulated from the hull and kept completely immersed in seawater, thus completing the electrical circuit. The hull then becomes cathodic (electron receiver) in an electrolytic cell, efficiently preventing the ferrous ions from passing into the solution by subsequently protecting the hull.

A direct current (D.C) supply of up to 10 volts (30 volts maximum for extreme cases) is usually required along with an adaptable device incorporated in order to differ the voltage for altering conditions, e.g. Higher voltage is necessary in warm waters, where paintwork has deteriorated, when the vessel is making way or when the ship is in fresh water or dock water.

The voltage for the system needs to be maintained

within fine limits. If set on high, alkali generation would occur which would leave the paintwork of the hull open to attack. If lesser voltage is applied, the protection provided turns to be ineffective.

A more developed system employs relatively noble metals and anodes are likely to last through the duration of the ship's life.

Quick Tips

"The 'underwater' hull cleaning should only be done after prior approval from the classification society and when the applied hull paint is of hard coating, which will not peel out during the process"

Real Life Incidence

In one scenario, the dock worker who was a certified welder had to perform a complex weld on the hull. The class surveyor refused saying his certificate wasn't appropriate to the type of steel that was to be welded upon. The ship suffered delays as there weren't any welders certified to do complex steel welding.

Maintenance of Rudder, Propeller and Stern Tube

Propeller: The propeller of the ship also undergoes thorough maintenance in the dry dock. The condition of the propeller blades, hub connections, corroded area, and possibility of cracks or fractures affects the performance of the ship. These parts are thus included in the surveys carried out in the dry dock.

Due to physical defects and poor performance, the propeller is usually listed higher in the maintenance list or docking specifications.



Propeller Repair in Dry Dock

Maintenance on propeller in the dry dock includes:

- Cleaning and polishing of propeller



Crack Test of Propeller Blade

- Crack detection and repair
- Repair of bent tips
- Any other major repair

Stern Tube/ Tail Shaft: These are equipment parts of major concern to both shipboard and dock personnel. Due to usage over a period of time, tail end shafts are inspected at every possible opportunity. The exposed stern tube reveals the effects of damages, irregularities of the

components due to corrosion and factors affecting the propulsion performance.



Removal of Stern Tube

Surveyors would have the stern areas thoroughly inspected, along with the overall condition of all the associated components. This means checking the measurements of the stern glands, removing the rope guards and re-packing the area.

Rudder: Maintenance of rudder is a difficult task. As the construction of the components such as rudder bearings, joints, attachments, transmission systems etc. vary from rudder to rudder, the maintenance job become even more tedious.

Nowadays, many ships are fitted with modern

'Schilling Rudders' or the popular hanging 'Becker Rudders'.



Rudder Welding

Common maintenance jobs carried out on such rudders are:

- Leak test for rudder
- Crack detection
- Checking the inside coating of rudder
- Anode renewal
- Cleaning and Painting

Maintenance of LSA and FFA Systems

As per the SOLAS requirements, the ship owners and operators are now required to ensure that the Life Saving and the Firefighting appliances are periodically maintained, serviced and tested.

During a dry dock which is normally scheduled twice in every 5 years the following maintenance jobs should be carried out for onboard life saving and fire fighting equipment:

Fire Fighting Appliances

Breathing Apparatus: Self Contained Breathing Apparatus (SCBA) and Emergency Escape Breathing Device (EEBD) should be sent ashore for testing and maintenance. Testing must include hydrostatic testing of all the air cylinders in accordance with the regulations.

All the associated hoses, pressure gauges, whistle and valves are also checked for leakages and proper functioning. A breathing air purity test is also to be carried out and the certificates for the

same to be kept onboard.

Fixed Fire Extinguishing Systems: These systems are the integral part of firefighting system and should therefore be tested by simulation every 5 years. High pressure lines must be blown through and the sprinklers should be checked for integrity. Internal tests of all the control valves must also be carried out.

For Carbon Dioxide system, the bottle pressures must be checked and shore maintenance should be carried out as per the manufacturer's instructions.



CO₂ System Maintenance

Similarly, for foam system foam samples must be drawn for quality checks that are carried out in

shore labs. Fresh water flushing of all piping associated with high expansion foam system is also carried out. Draining and air purging is then finally done.

Water Mist, Water Spray and Sprinkler Systems:

In accordance with the administration, internal inspection of all the control valves to be carried out. Flushing and draining the system with fresh water and purging the system with air is to be conducted by competent personnel. Dry powder systems are also to be checked for moisture content and caking.

Fire Extinguishers: There have been casualties in the past when the fire extinguishers have exploded while being tested. Conclusion drawn was



Fire Extinguisher for Shore Testing

attributed to corrosion and infrequent usage. As per the requirements, the periodic maintenance of fire extinguisher is to be carried out by competent personnel on shore where pressure tests and other integrity tests are carried out.

Ensure that the test certificates are provided on board ships once the shore tests are conducted.

Life Saving Appliances

A variety of tests are carried out on the ship's lifesaving appliances in accordance with the SOLAS convention. This includes lifeboat, life raft, lifebuoy, immersion suit, life jacket and other instruments of safety.



Lifeboat in Dry Dock

The 5 yearly tests on lifeboat include:

- Lifeboat davit is to be inspected with respect to corrosion, deformations, or misalignments
- Fall wires to be replaced every 5 years
- All moving parts such as sheaves, bearings etc. to be well lubricated
- Limit switches to be examined and tested up to the designed limits
- Main / Emergency power systems and hydraulic systems to be tested and checked for integrity
- Overhauling of lifeboat engine to be carried out



Lifeboat Davit

Lifeboat davit tests such as the Dynamic Winch brake tests, Operational tests for lifeboat hooks, etc. are to be conducted in the presence of a surveyor who will assess the integrity of the davit and its components accordingly.

The Operational test is carried out by lowering the lifeboat with its full complement or weight equal to the proof load. Brake testing is done by suddenly applying the brakes when the boat reaches its maximum lowering speed.

In lieu with 5 yearly inspections, tests for life rafts are carried out ashore in closed environments. Inspection and test certificates are provided to the vessel by the shore authorities after concluding the tests.



Life Raft Servicing in Shore Workshop

While securing the rafts back to their cradle position, ensure the following:

- Markings on the raft are unchanged
- ID tags have proper information regarding valid dates
- They are tested in accordance to SOLAS Pack A / B, as applicable
- While securing, the rafts are stowed as per the ship's LSA plan
- Rafts to be secured taut with proper positioning of the Hydrostatic release unit

EPIRB and SART: The maintenance of the EPIRB and the SART is to be carried out by competent shore technician. The inspection should be detailed in every aspect related to mounting, self-test, signal decoding, batteries, hydrostatic release gear and shore based maintenance.

Quick Tips

"Every Beacon comes with a battery expiry label pasted on the body. Ensure to check the date and if required, renew the battery as per the specifications"

Maintenance of Accommodation

Maintenance of the accommodation area means having a healthy and hygienic lifestyle onboard. It is only during the dry docking period that the accommodation area gets a makeover.



Recreation Room

Chief Officer should ensure that the repairs and renewals in the accommodation area, if any, be listed in the initially approved repair file. The jobs that are to be included depends on the age and the overall condition of the vessel.

Chief Officers should ensure the following :

- Fire doors throughout the accommodation are unobstructed and are operating as designed
- Rooms are intact, insulation is in good order, flooring is undamaged and bathrooms/toilets are functioning properly
- Ventilation is unobstructed and dampers are in good working condition
- Fabrication or renewal of damaged or old furniture of the ship's lounging areas, provision stores, galley, mess rooms etc. to be done



Removing Old Furniture

- Safe access is maintained throughout the accommodation area. Rubber strips on stairways, anti-slip flooring, rails etc. must be adequate and permanently fixed
- Accommodation doors are not subjected to violent movements. Doors to have functional door stoppers or safer hydraulic door closers installed
- Drainage system to be flushed out thoroughly. If required, drain cleaning agents are to be added and flushed
- Overhead Panels to be in place, no loose wires to be hanging around
- All electrical components to be shock proof and repairs carried out as and when required
- Accommodation area to be adequately lit
- Refer chambers and cold storages are to be appropriately maintained
- Lift routine maintenance and inspection to be performed by certified shore technician

Chapter 6

CHECKS / TESTS / SURVEYS IN DRY DOCK

Dry Dock Surveys

Tests and Inspection on Mooring Winch

Rudder/Propeller Inspection

Dry Dock Surveys

Dry Dock surveys are a part of the ships periodic surveys. The classification society on behalf of the Flag States conduct such surveys and are responsible for ensuring that the ships are complying with the international regulations.

Depending on the trade of a ship, the 'In-Water Surveys' may be able to replace the 'Docking Surveys', with or without the vessel being docked in actual, only if the aspects of the surveys are covered.



Surveyor in Dry Dock

Hull surveys are carried out to inspect the state of underwater coatings and to note any level of indentation. Important hull areas are particularly noted as the coatings in these areas are further exposed to corrosion or damage.

The 'docking survey' deals with the inspection of the lower and external areas of the hull, including the rudder, sea connection fastenings, overboard discharges and other similar side fittings. The examination must be carried out in a dry dock, six months before or after the anniversary date.

Docking Surveys: The Surveyor is responsible to carry out the 'Docking Surveys' and 'In water surveys' (IWS) to observe the universal condition of the ship and its machinery, ensuring proper maintenance and suitable operational condition.

A docking survey is undertaken when the ship is placed on a slipway or is dry docked. The vessel needs to be positioned on the blocks of adequate height and properly staged with the hull to permit assessment of the shell plating.

Added inspection of particular areas such as the stern frame, keel, and rudder is also carried out. If considered essential by the surveyor, the rudder is

to be lifted to allow examination of the 'pintles'. It has to be noted that any necessary clearances in the rudder bearings are measured.



Bulbous Bow

Careful attention needs to be given to the bulbous bow, stern-bush, propeller, the sea connection fastenings (stuffing boxes), and the gratings at the sea inlets. Clearances on the stern-bush and the competence of oil glands should also be ascertained.

At the time of the survey, checks are to be made for any deterioration or corrosion of the structural areas or any undue fairness of the bottom plating.

Assessment of the overboard discharges or sea connections with their hull fittings is also to be

conducted. Hull roughness is measured by using Hull Roughness Analyzer (HRA).

A thorough examination of cables and anchors is conducted by the surveyor to check for any related connections and excessive wear on links.



In Water Surveys (IWS): Ships undergo an 'In water survey' with the intermediate docking, usually scheduled among the 'special surveys' in place of normal dry dock.

Request for an IWS should be made to the class giving sufficient time for preparations and arrangement. This includes rectifying any defects which can be covered by the survey, while engaging the vessel in her normal trading pattern.

'In water surveys' are carried out at pre-approved

geographical locations in sheltered and clear water for good visibility of the hull condition at a suitable draught. The Surveyor and the divers would conduct the hull inspection in coordination where the graphic presentation from the underwater cameras are considered satisfactory. The company will make the necessary arrangements so that the surveyor can do the inspection of above water hull structure as required.



In Water Survey

Following parts are video filmed and color photographed by the diver during in-water survey:

- Underwater shell openings including those for sea valve inlets and discharges

- Underwater shell openings of thruster units
- Rudder and shaft closing plates in the way of wear down gauge plugs
- Additional items as may be considered necessary by the Marine Surveyor

If any major defect is revealed in the 'In-water survey', the surveyor can order the ship to go to dry dock for performing repairs.

Special Survey: A 'special survey' is carried out every four years. This could be extended by an additional twelve months provided the vessel undergoes a 'general examination' to review the overall state for the duration of the extension.

The condition of the 'Special Survey' requires the vessel to be dry docked which includes all the requirements for the 'docking survey' and the 'annual survey'. Each successive 'Special Survey' would be more rigorous and in-depth than the previous one and is to be based on the Surveyor's evaluation of the overall condition of the ship.

For e.g. The surveyor may request the rudder to be lifted to expose the 'bearing pintle' for inspection.



Opening Rudder Pintle

All tanks, cargo holds, peaks, tween deck spaces and bilges should be cleaned for inspection. When necessary, pipe casings, spar ceiling and liners should be detached to allow access for inspection. Double bottom tanks, peaks and any other tanks are tested by a positive pressure head enough to provide maximum force when the vessel is in service.

Some tanks also require internal inspection whereas tanks such as bunker, fresh water or lubricating oil tanks are usually exempt from in-house inspection of the early 'special surveys'. Precise attention is to be paid to the state of the hull shell plating and shell door arrangements or any bow/stern openings. The surveyor will also

evaluate the thickness of the plating by various test methods.

It is likely that a certification process is conducted to handle TBT inspections which can become the main part of the dry docking program.

Quick Tips



"When requesting for In water Survey, keep ready all the previous docking reports pertaining to ship's underwater area and equipment"

"IMO is currently taking into account a certification serving a warrant, which states that the owner has to cover or remove all TBT paints which were coated on the ship's hull"

Additionally, special attention is to be given to the 'Special Surveys' which includes the cable and anchor arrangements, cable locker and windlass.

The cable locker should be cleaned internally and arranged for inspection towards the second and subsequent "Special Surveys". The ship's standing rigging, jointly with any mast structures would be inspected during a 'Special Survey' to find corrosion or defects for corrective action.

Continuous Survey: This survey is a substitute to the 'Special Survey,' where every survey item on board the vessel is tested in rotation over a five year period between each assessments.



CMS by Chief Engineer and Surveyor

The class surveyor normally conducts such surveys, but it is likely that a chief engineer may be permitted to survey certain machinery elements when a surveyor is unavailable provided photo proof and complete survey report is produced to the surveyor at a later stage.

If the surveyor is not satisfied with the survey report, he can re-do the survey by him/herself.

Test and Inspection of Mooring Winches

Records of regular inspections and testing of mooring winches is to be provided to the surveyor if deemed necessary.



Winch Inspection

Although the brake holding test is seldom undertaken during a dry dock, the surveyors might want to see the condition of the brake liners, proper application of the countersunk or rivets, marks or ID tags (Winch type, its serial number, manufacturing number, hydraulic motor type and motor number) along the mooring winch.

As the brakes are primary safety devices of the mooring winches/windlass system and therefore the most worn out components, they have to be properly maintained during the dry dock. Brake liners are to be changed regularly and the brake tightening mechanism must be intact and well lubricated.

The brake holding inspection is to be carried out along the lines of the international mooring guidelines, i.e. the brakes should be tested at 80% of the MBL or Maximum Breaking Load of the rope.

The work and inspections carried out on the winches during the dry dock includes:

- Draining and replacing of the hydraulic oil
- Draining and replacing the gear oil
- Inspection of the winches foundations
- Inspection of the Storage drum, tension drum (for split drum winches) and warping drum
- Inspection of gears (open the inspection plate normally situated on the main body of the

winch). Clutch – In and Clutch – Out must be functioning properly



Winch Drum and Brake

- Inspection of the ID tags on the winches and on the ropes
- Inspection of the rendering and heaving load limits (Surveyors check the markings on the winch and compare them with those in the certificate).
- Checking and comparing with previous test records
- Inspection of the Electric motor

Common Problems Faced During the Maintenance of Winches:

- High pressure oil has to be drained gradually. If the cock is open randomly, the pressure could cause injury to the personnel in the vicinity
- Grit can easily get accumulated on the gear components that have been exposed for inspections or other maintenance
- Accidental operation of the winch while performing an inspection or while carrying out maintenance of the components

Real Life Incidence

In dry dock, the operation of electro-hydraulic mooring winch was tested after completion of repairs. The junior engineer entered the hydraulic machinery room and started the main pump motor. Without warning, the return line gate valve before the filter disintegrated and its bonnet flew in the air, hitting the junior engineer on the face, fracturing his skull and nose. It was later found that one valve in the line was not opened, leading to pressure build up and causing the accident.

Rudder/ Propeller Inspection

Any distortion in the rudder plating or the rudder stock or even the propeller support brackets are detected by observation of the required clearances. If clearances are disproportionate then the deformities can be aggravated

Clearances between the sleeve and the bush of the rudder should be checked so as to prevent corrosion in the area in case of water ingress.



Rudder Inspection

Access plates for the bearing pintle and the recess to be removed for inspection.

Following Inspections to be carried out on the rudder and propeller of the ship:

- ‘Fractures’ or deterioration in the welds or rudder plating
- The rudder stock should be free of distortions or any pitting signs. As per the requirements of the surveyor, heat or cold treatment could be carried out for rectification purposes
- Sacrificial anodes in the areas around the rudder and propeller should be renewed and inspected as required
- Supporting crosspieces, especially in areas of hull contact astern, would permit close inspection for any fractures that might have caused due to floating logs, ice or other similar obstructions
- The blades of the propeller and associated components are checked for corrosion, damages, fractures etc.
- Inspection of the guard rings and water lubricated seals should be carried out

visually

- Fouling of fishing nets is a common factor causing damage to the components of the propeller. Remove or rectify as required
- Clearances should be checked using the special gauges, for example, Poker Gauge

A water seal test is carried out before securing the rudder. Surveyors require the rudder to be vertically upright while the test is being carried out. Water is then filled up through the mechanism and its levels are noted over a period of time. Reduction in the water level indicates leakage due to fracture or crack.

Quick Tips

“By cleaning/ painting of the hull and rudder with high quality paint coating and by polishing the propeller, the fuel saving potentials for a cargo ship may exceed the margin of 20%”

Chapter 7

CHECKS BEFORE FLOODING DRY DOCK

Precaution When Flooding

Duties of Chief Officer – During Departure

Precaution When Flooding

The chief officer and chief engineer are jointly responsible for checking the underwater hull openings, prior to the flooding of the dry dock.

This includes:

- Sewer storm valves
- Tank drain plugs
- All sea valves and sea chests



Tank Drain Plug

Throughout re-floating, the engineering staff shall

be stationed at the engine room to ensure that there are no leakages. Similarly, the chief officer will ensure the condition of all the deck tanks.

Following are the points to be carefully examined before flooding the dry dock:

- All departments in-charge should confirm that the repairs assigned under their departments are completed successfully followed by tests and surveys
- Check rudder plug and vent. Also check if the anodes are fitted back on the rudder
- Check Impressed Current Cathodic Protection System (ICCP) anodes are fitted in position and the cover is removed
- Check anodes are fitted properly on the hull and the cover is removed (If ICCP is not installed)
- Check if all sea inlets and sea chest gratings are fitted
- Check echo sounder and logs are fitted and their covers removed

- Check if all the plugs of double bottom tanks are secured
- Check all external connections for shore water supply, sewage disposal pipe etc. are removed



External Water Connection

- Check if the propeller and rudder are clear from any obstruction
- Check inside the ship if all repaired overboard valves are in place
- Check the area near stern tube propeller shaft for any kind of leakages

- The cables for ICCP anode fixed in the hull are carried into the engine room via water tight ducts. Ensure no water leakage is there and the duct manhole door opening in the engine room is shut
- Secure any moving item inside the engine room and deck
- Check soundings of all tanks and match them with the value that is obtained prior entering the dry dock
- Ensure emergency generator is in ready condition to start manually
- If there is any load shifting that can lead to change in ship's stability, inform about it to the dock master
- Go through the checklist again and the satisfactory checklist is to be finally signed by the master
- Master must sign the authority for flooding certificate
- Once dry dock flooding is in process, a

responsible engineer/officer should go to the bow thruster and steering gear room to check the water tightness if any repair is performed on these machinery system

- When dock flooding reaches the overboard valve level, stop the process and check the valves and the stern tube for leakages
- Shore power cables will be removed once the cooling water is available for suction in the generator system
- If required, use emergency generator power before starting the main generator to avoid long black out period
- Instructions must be given to all crew members to stay vigilant while undocking. They must continuously keep checking the water tightness of the ship throughout the process
- If crew member finds any kind of water leakage, same must be informed immediately to the chief officer or department in-charge as he/she will ask the dock master to stop flooding immediately

Duties of Chief Officer- During Departure

While approaching the completion of dock specification, the dry dock team and the ship's crew should carry out their individual checks around the docking area and the vessel.

The Chief officer should ensure the completion of the following activities:-

To exit the dry dock, the chief officer needs to carry out the external inspection of the hull. A final check is required during this time to see if any tank plugs are to be replaced. Chief officer to carry out this task by himself and not assign it to any juniors to avoid any major problem.

The chief officer must ensure that all 'survey work' is completed prior to leaving the dock, followed by a full inspection of the vessel.

He also needs to inform the expected departure time to the ships master and other crew members so as to make the vessel ready for sailing. This would include tasks such as:

- Ordering a navigator to prepare the ship movement from the dock
- Canceling shore leave and posting the sailing board
- Placing engine room and respective personnel on stand-by
- Conducting checks on all navigation equipment



Departure Checks of all Navigation Equipment

- Making significant entries into the deck and official log books

- Ensuring all hatch covers are closed and watertight integrity of the uppermost deck maintained



- Ensuring the anchors and cables are correctly stored onboard the vessel

The ship's officer, accompanied by the dock manager, will ensure that none of the materials, vehicles or personnel are left behind in the dock before commencing the flooding/re-floating operation.

Relevant manpower is provided for safely disconnecting all power and pipelines at the

correct time.

The chief officer must take a full set of tank sounding and ensure that sufficient supply of fresh water, lubricating oil and fuel is taken on board before departing.

A complete stability check of the ship is to be carried out to ensure that acceptable 'GM' is achieved once the ship is clear off the blocks.

This stability check is the sole responsibility of the ship personnel and a comparison should be made between the entry soundings when the vessel was last afloat and the first 'on the block soundings' taken when the ship became 'sewn on the blocks'.

Linesmen and marine pilot need to be present as stand-by during the time of departure. The ship's crew thereafter would be placed as stand-by at fore and aft to tend to the moorings.

Tugs, pilots and wharf labour are mostly ordered well in advance of the day of departure. Ultimately the shore gangway must be landed ashore, once the dock personnel have cleared the ship.

Once the vessel floats and is clear off the blocks, the dock manager should note the ship's draughts and forward it to the chief officer.

Finally, the master would need to sign the 'Authority to Flood' certificate once he is satisfied with the completion of the docking specifications provided by the Dry Dock Authority.



Flooding of Dry Dock

Following the completion of this certificate, the flooding of the dock shall commence. Proper communication must be maintained between the ship and the dock so that immediate actions are taken to stop flooding if any leakage is detected.

Chapter 8

Sea Trials

What is Sea Trial?

Checks in Sea Trial

Tests in Sea Trial

Paperwork

What is Sea Trial?

Sea trials of a ship is carried out when either the ship is newly constructed and delivered to its owner or when major repairs are carried out like in a dry dock. This is to ensure that the work carried out onboard ship is up to the mark and all the machinery and systems are functioning properly. Another main reason for conducting sea trials is to confirm that the water tight integrity of the ship is properly maintained after the repair work.



Sea Trial of Ship

The principle reason behind sea trials/ tests is to

ensure that the documentation of the vessel is kept up-to-date and respective company officials are aware of the ship's capabilities.

Before commencing sea trials, the chief officer should conduct a meeting with all deck officers and crew to assign them duties for checking the water tight integrity and functioning of bridge and deck equipment while sea trials are being conducted. The chief officer should also check for arrangement of tugs and confirmation of pilots with the dock authorities.



Departing from Dry Dock with Tugs

The principle reason behind sea trials/ tests is to ensure that the documentation of the vessel is kept up-to-date and respective company officials are

aware of the ship's capabilities.

Similarly, the chief engineer will also ensure correct operation of the ship's machinery during the sea trials. For testing purpose, all machinery systems are started and closely observed for certain period of time.

In case of any malfunctioning or defects on the deck, the Chief Officer needs to be informed immediately. Once the sea trials are completed, all the troubles and defects will be noted and send to the dock and workshop supervisors who were responsible for carrying out the maintenance.

At the completion of the sea trials, it is necessary that both the department heads, ships aster, shore representative and the superintendent discuss and assess the performance of the vessel and its machinery.

Quick Tips

"If any problem is detected during sea trials, no matter how small the problem is, never ever neglect it or leave it for next repair schedule. Sometimes even the minutest of the problem can lead to major accidents and detention of ships as has happened with many ships in the past"

Checks in Sea Trial

During sea trials, following things are to be checked by the deck officers:

- Check the navigation lights, connections, and switches that were repaired in the dry dock
- Check all navigational equipment which were serviced or repaired in the dry dock
- Check the steering room for any leakage if repair work was performed on rudder carrier
- Check watertightness of all sea board valves and inlets for any leakages
- Check the movement of rudder from both remote and local positions
- Check the bow thruster room for any water leakage from the seal
- Check Bow thruster operation from local and remote positions



BT Seal Area

- Sounding of all tanks to be taken once ship is in water
- If any repair work is performed on the hull of the bottom tank/cofferdam/duct keel, sounding should be taken at regular intervals of time for any increase in the level
- If repair work is performed on the pilot door, water tightness of the same is to be checked
- If the Hydraulic ramp door of Ro Ro vessel is repaired, same should be monitored for leakages

Tests in Sea Trial

The following tests are usually performed during sea trials are:

Anchor trials – Whenever a new windlass has been installed or major repairs carried out, the trials would be held in shallow waters. Here both the anchors are dropped clear and the extent of the cables paid out is determined by heaving the anchor back and the time taken to achieve this would be noted. Inspections for the lead of cables, and chafing of the chain while it is over the gypsy or the spurling pipe and the hawse pipe would also be carried out.

Speed trials over a known distance with a series of timed runs are conducted. (Such activity is usually planned clear of other traffic and obstructions)

Stopping distances under regular operating conditions are noted and checked

Turning circles of the vessel are also be checked

at various speeds

Stopping distance under emergency maneuvering to be noted

Helm indicators and rudder movements are compared against the actual required values

Fuel consumption figures are normally held over a known distance.

Emergency shutdown systems are tested in open water setting

Emergency steering is checked from the steering gear room

The detailed information obtained from the above-analyzed trials is then used to assess the ship's performance once it is functional. This information is usually stored on the bridge in an operator's guide.

Quick Tips

"If any machinery or part is repaired in the dry dock but not tested, it should be included in the list of sea trial checks to ensure that nothing is missed before the ship commences its journey"

Paper Work in Sea Trial

A joint inspection is carried out on all repaired items by the department heads and yard engineer at the end of the scheduled repair period. Details of the inspection or other relevant information that is recorded includes:

- All readings such as the parameters of sea trials, clearances taken and other relevant data discussed by the ship staff with the attending superintendent
- Sign statement by department heads attesting a satisfactory completion of each repaired item
- Details of any item that has not been satisfactorily completed, countersigned by the Yard Engineer

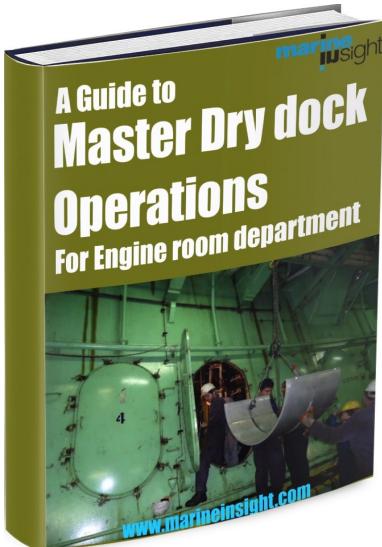
All the drawings handed over to the Yard are collected back subsequently. Once the shipyard repair is completed all the debris is removed from the ship and a thorough inspection is carried out.

Efficient dry docking operation of ships is a product of systematic planning and quality teamwork. Proper coordination and communication between all the departments involved results in a smooth and accident-free dry docking operation.

If you have questions regarding any topics mentioned in this ebook, please feel free to contact us at info@marineinsight.com

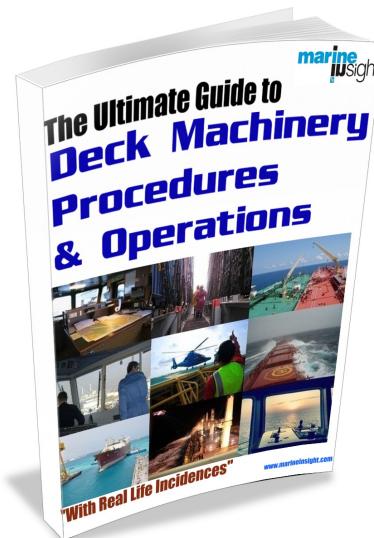
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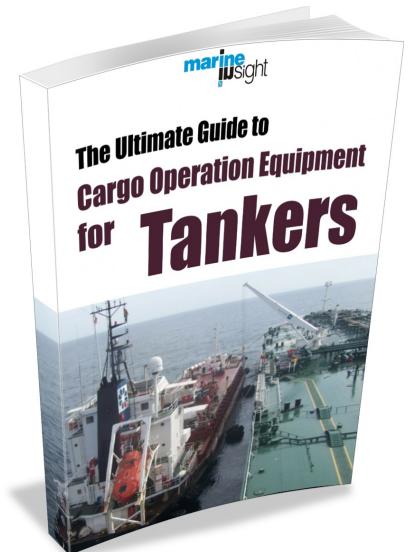


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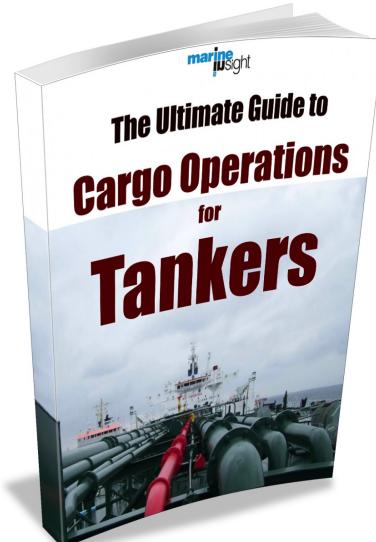
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