MMD Questions of Last Three Years by Marine Experts

(Function-4b)

Second Edition

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I am proud to announce that with in a week we receive hundreds of orders from all over India. Class 4 exam team already started working on other functions of Class 4 Oral Booklet (Second Edition) which are soon coming to our website. So be the part of this leading company and register yourself in our website forums for Updates

INDEX

Note- Function-4 is related to MOTOR so all the Important Machinery's covered in this, & Surveyor can ask anything related to the working, overhauling, maintenance, important checks, troubleshooting, running parameters etc.

So before you go for orals make sure you have basic knowledge of all these things.

MOTOR ORAL QUESTIONS ASKED BY SURVEYORS

Each question given in this book is been asked by the surveyor

Note to User – In the end of every question some symbols are written like MA,AA,GA,SA,VI and RA, So you should know the meaning of each symbol before proceeding with this book because these symbol tell you how particular question important to you with respect to MMD Orals.

MA – Mostly Asked Question in MMD Orals

AA – Always Asked Question in MMD Orals

GA – Generally Asked Question in MMD Orals

SA – Some Time Asked Question in MMD Orals

VI –Very Important Question Asked in MMD Orals

RA – Rarely Asked Question in MMD Orals

Q – What is crankcase explosion and how it occurs **(AA)**

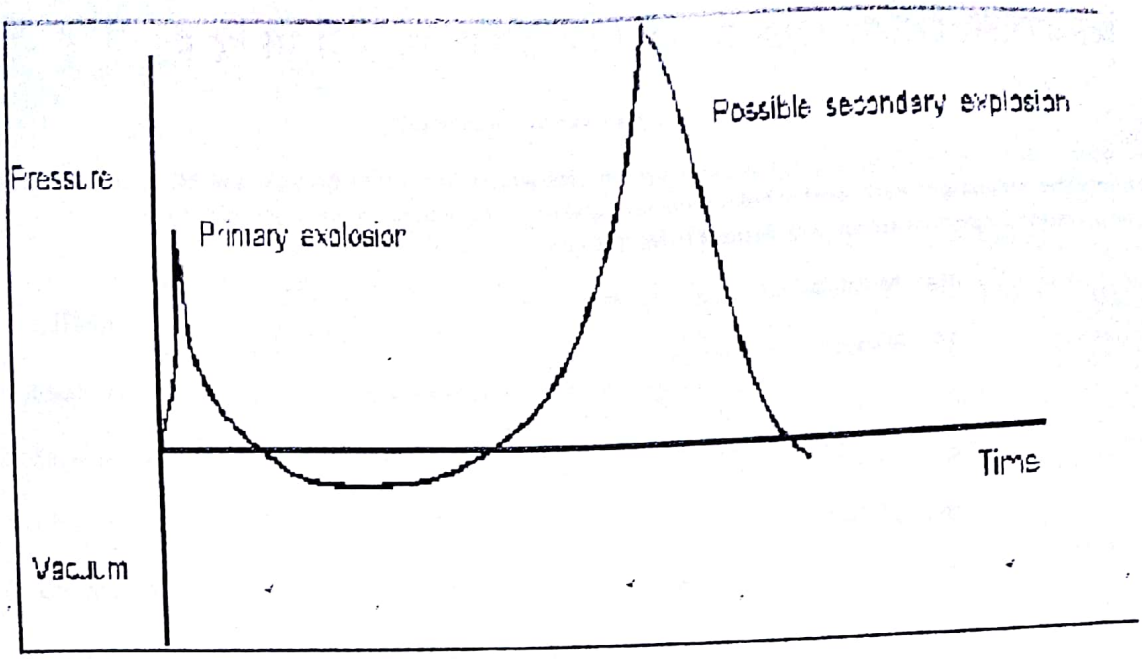
Ans – We know that large amount of oil droplets are present everywhere in the crankcase and normally the size of droplet is 200 microns which is not harmful at all

Note – Flash point of oil is normally 230 degree celsius (pure lube oil but when it mix with diesel it drops)

But when hot spot occur may be the reason given below –

1. Too much clearance between the bearing so oil film may breakdown
2. Crankshaft is not properly aligned
3. Diaphragm not sealing properly
4. If piston crown cracks then exhaust gas may leak to the crankcase
5. In man b&w if chain is too loose or too tight then chain may run hot which act as the hot spot
6. If matching gear don't have proper backlash then lubrication is not so effective and generate a hot spot
7. Circulation of lube oil is not proper

So due to all these reason which are given above create a hot spot in the crankcase and when oil comes into the contact of this hotspot it start to vaporise. Vapours are lighter so it goes up in the crankcase and form the white cloud just below the stuffing box (now the size of oil droplets becomes 10 microns because the formation of vapours) , when this vapour comes down and again come in contact with the hotspot primary explosion takes place.



After primary explosion pressure inside the crankcase increases suddenly as shown in the graph given above, so due to this crankcase relief valve activates and releases all the gases into the engine room and due to this crankcase again goes back to the vaccum. If at that time fresh air come from engine room to the crankcase then it will lead to the secondary explosion which is a big disaster in the engine room

So our main objective is to avoid primary explosion but if in case it occurs then we will have to make sure that secondary explosion should not occur

How to avoid secondary explosion –

1. All the main bearing and thrust bearing have high temperature alarm which give you the indication of increasing temperature inside the crankcase
2. In new engine we have sensor which tell you how much wear down of main bearing will take place. **Note** – If unequal wear down takes place it mean oil flow is not same in all the bearings)
3. We have NRV type relief valve whose function is to relief all the pressure which is generated during the primary explosion inside the crankcase

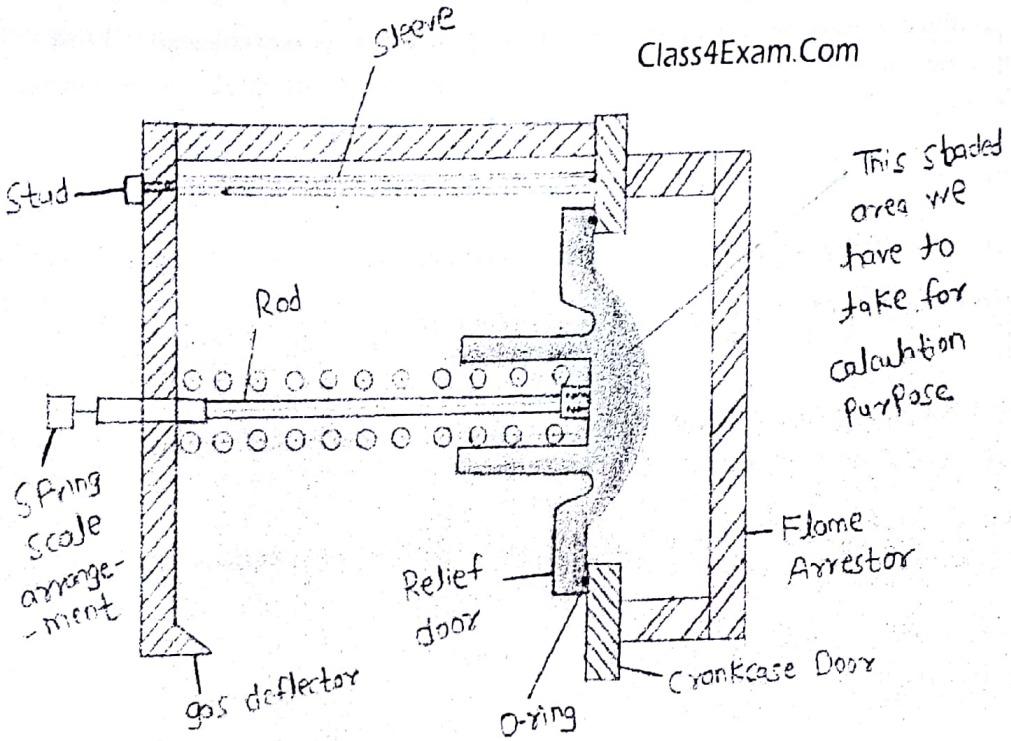
Q – What is crankcase relief valve and how to pressure test it (SA)

Ans - As a practical safe guard against these explosions, explosion relief valves and doors are fitted. These valves serve two functions

1. To relieve excess pressure inside the crankcase thereby normalizing the pressure
2. To prevent the flames inside the crankcase from coming out and causing further damage
3. Even it wont allow the outside flame to come in because of the flame arrestor.

Note – In sulzer engine opening pressure is 0.2bar above atmospheric pressure

In man b&w opening pressure is 0.05bar above atmospheric pressure



Now the main question is how to check the opening pressure of crankcase relief door

1. For that we have the spring scale and rod which we fit on the crankcase door and pull the rod you will get the reading on the scale that at what point it will open (from scale you get reading in KG)

We know,

Pressure = Force / Area

Force = the value of force you will get from the scale in KG

Area = area of the door you will get to know out from the manual

So with this you can able to calculate the pressure setting of the crankcase relief door

Note - A deflector is fitted on the outside of the engine to safeguard personnel from the outflowing gases, and inside the engine, over the valve opening, an oil wetted gauze/flame arrestor acts as a flame trap to stop any flames leaving the crankcase. After operation the valve will close automatically under the action of the spring.

Note – Sometime surveyor ask why crankcase relief doors are there ?

Above we already told you so many reasons but sometime surveyors wants to listen about the regulation related to the relief door –

1.The internal combustion engine of a cylinder diameter of 200 mm or a crankcase volume of 0.6 m3 and above shall be provide with crankcase relief vale of a suitable type with sufficient relief area.

2.In small engine cylinder dia. does not more than 300mm, crankcase door of which are usually very strong. It may have relief valve or valves at its end

3.In large engine, cylinder dia. over 30cm, It required one relief valve to be placed on each crankcase door

4.Its free area should not smaller than 45cm2and there shall be minimum of 115cm2/m3of the gross crankcase volume

5.Spring setting for opening pressure is 0.07 bar at an internal pressure and will close when the pressure has been relieved

6.The valves open smartly and close positively and rapidly

Q – As a 4th Engineer you are on the watch and one unit OMD activates what will be your action (VI)

Ans – Every people have different opinion on this question that was the reason surveyor wont accept your answer most of the time, so below we try to give you the standard procedure that what to do in this kind of scenario –

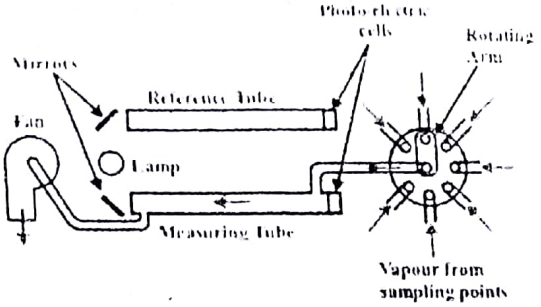
1. Inform to the wheel house
2. Press engineer's call alarm (to call all for help)
3. As soon as possible stop the engine
4. But make sure not to stop any lubricating lube oil pump
5. But fuel pump to be stopped if it was not common for both the main engine and generator
6. Open ventilation to be run which create the vaccum inside the crankcase
7. Don't stand in front of the crankcase door

8. Connect all the fire hoses and make sure to ready all the equipment near to the bottom platform
9. Leave engine room for some time
10. Come down to engine room after I hour (just to give the sufficient time so that the engine should be cool down)
11. With the help of the palm and hand check the condition of the crankcase door (if it is still hot, we recommend you not to open the door at this instant of time)
12. If crankcase door is not too hot then you can open the crankcase door but make sure everything is okay else you may lead to the secondary explosion
    Note – Just slack open the door not to be completely open, just to conform that crankcase should not be pressurise from inside
13. If everything seems to be okay then stop the lube oil pump and ventilate the crankcase fully before man entry into the crankcase
14. Enter into the crankcase by taking one torch with you
15. If any bearing temperature is high it gives you the white metal (which give you the indication of hotspot)
16. If you find any bluish tint on the surface it mean that was the hot spot and due to the lube oil quenching action it changes the colour
17. After complete inspection if you did not find any thing then check all the OMD alarms are working satisfactorily or not (sometime OMD may give you the wrong indication)
18. Start the engine and slowly increase the speed and do continuous monitoring.

Q – What is OMD, explain its construction and working. What maintenance is to be done on OMD (SA)

Ans - An overheated diesel engine can become a source of fire and extreme havoc if periodic maintenance and proper practices are not carried out. Oil Mist is created in the crankcase when the lubricating oil is splashed by moving and rotating parts of the engine. This oil mist reduces the flash point of the oil, allowing it to catch fire in presence of a hot spot. It is important that this concentration of oil is kept under control and incase its presence is detected, the engine should be stopped or the speed lowered. But how will an engine detect that the level of oil mist has increased in the crankcase?

Oil Mist detectors are used for this purpose. Crankcase of each cylinder is connected to the OMD, which continuously checks the air sample from each cylinder. If the amount of mist increases, OMD raises an alarm. Let's see how it detects the mist.



Construction

Generally only OMD is fitted in each engine. OMD doesn't reduce or prevent the formation of mist, but only give warning in case the concentration rises above the level at which an explosion can take place.

The arrangement of OMD consist of two tubes of equal sizes. Both these tubes are places parallel to each other. At one end of each tube, a photo-electric cell is fixed. Photo-electric cells generate an electric current when light falls on their surface. The amount of electric current generated is directly proportional to the intensity of light falling on it. The other ends of both the tubes are sealed by fitting lens that allow light to pass through them.

Equal intensity of light is reflected on the photo-electric cells using a lamp. Light passes through the lenses after being reflected by mirrors. One of the tube has an inlet and outlet connection for introducing oil mist.

Working

Out of the two tubes, one is called the reference tube and the other is called the measuring tube. Measuring tube has a connection for oil mist, which is extracted from the crankcase with the help of an electric extractor fan. The reference tube is filled with clean air and is used as a reference for measuring the level of mist in the measuring tube. Samples from each cylinder is monitored by using a rotating selector valve, which connects each cylinder in sequence to the OMD.

If the concentration of Oil mist in the measuring tube rises, the intensity of light reaching the photo-electric cell reduces. Now as both the tubes are electrically connected, reduction

in the generation of electric current will induce an electrical imbalance between the two cells, which will lead to ringing of the alarm.

When Oil mist is detected, the rotating selector valve immediately stops to indicate the cylinder with high concentration of mist.On indication of an alarm, the engine should be slowed down or stopped to prevent damage or explosion.

Maintenance

It is important to carry out routine maintenance of OMD to prevent false alarms. The sensitivity of OMD should be checked on a regular basis. As all the samples contain a small amount of mist, the lenses and mirrors tend to get dirty and thus require periodic cleaning. The extractor fan and the rotating valve should be checked to avoid chocking of a particular sampling tube. The sampling tubes that connect cylinders to the OMD should not have any loops and also shouldn't be of length more than 12.5 meters.

Q – What do you understand by the term scavenge fire and reasons for the same and what action you will take (AA)

Ans - For a scavenge fire to begin there must be present a combustible material, oxygen or air to support combustion, and a source of heat at a temperature high enough to start combustion. In the case of scavenge fires the combustible material is oil. The oil can be cylinder oil which has drained down from the cylinder spaces, or crankcase oil carried upwards on the piston rod because of a faulty stuffing box. In some cases the cylinder oil residues may also contain fuel oil. The fuel may come from defective injectors, injectors with incorrect pressure setting, fuel particles striking the cylinders and other similar causes. The oxygen necessary for combustion comes from the scavenge air which is in plentiful supply for the operation of the engines. The source of heat for ignition comes from piston blowby, slow ignition and afterburning, or excessive exhaust back pressure, which causes a blowback through the scavenge ports.

Causes of scavenge fire

There are many reasons for scavenge fire. However, the main ones are as below:

1. Blow past of combustion products caused by leaky, sticky or broken piston rings, worn out liner, faulty cylinder lubrication, or insufficient axial clearance of the piston rings.

2. Overheated piston dissipates heat to the under piston area caused by faulty atomization and injection pressure, faulty fuel pump timing, loss of compression, engine overload, failure of coolant circulation or insufficient cooling due to formation of scale.

3. Blow back of exhaust gases caused by exhaust back pressure or deposits on exhaust ports, fouling of grid before turbine inlet, fouling of turbine blades, choking of EGB or economiser gas outlet.

4. Presence of fuel oil in the scavenge spaces due to defective fuel injectors, incorrect pressure setting of injectors or fuel particles landing on the cylinder liner due to excessive penetration.

5. Excessive cylinder lubrication which is drained down to scavenge spaces.

6. Oxygen is plenty during engine operation.

Indications of scavenge fire

There are a few signs which indicates a scavenge fire. One should be extremely cautious in case any of the below mentioned conditions are observed.

1. Scavenge temperature will start increasing.

2. The turbochargers will start surging.

3. High exhaust temperature.

4. Loss of engine power and reduction in rpm. This happens because a back pressure is created under the piston space due to fire.

5. Smoke coming out of the scavenge drains.

6. The paint blisters will be formed on the scavenge doors due to high temperature but this will occur only in large fires and extreme cases.

Actions to be taken

Action taken in case of a scavenge fire depends on the type of the fire, whether small or large. In case of large fire the following signs will be easily visible – the peeling or blistering of paint, large reduction in engine rpm and surging of turbocharger.

For small fires

1. Start reducing the engine rpm and reduce it to slow or dead slow.

2. Increase the cylinder lubrication of the affected unit. Special attention to be given for this as this does not feed the fire. In case of increase of fire do not increase the lubrication.

3. The fire can be due to leaky fuel valves, so lift up the pump of the affected unit.

4. Keep scavenge drain closed.

5. Keep monitoring the scavenge and exhaust temperatures and let the fire starve and wait for it to burn itself out.

6. After confirming that the fire is out start increasing the rpm slowly.

7. Keep monitoring the scavenge temperature for any signs of re-ignition.

For large fires

1. Stop the engine immediately and engage turning gear, and keep engine rotating with turning gear.

2. Extinguish the fire with fixed fighting system for scavenge fire. This may be co2 system or a steam connection for smothering the fire.

3. In case fixed system is not available on very old ships an external cooling is provided to prevent distortion due to heat.

4.Once after confirming that the fire is extinguished. The scavenge space is allowed to cool down and later opened for inspection and cleaning of the scavenge space.

Inspection after Scavenge Fire

1.Intense fire can cause distortion and may upset piston alignment

2.Check by turning the engine and watch movement of piston in the liner, check for any occurrence of binding at part of stroke (Binding indicates misalignment of piston)

3.Check spring on scavenge space relief device, if the device was near the set of fire

4.Piston rod packing spring also should be checked, which may have become weakened by overheating

5.Check piston rings and liner for any distortion or reddish burning mark

6.Check diaphragm and frame near affected part

7.Check guides and guide shoes

8.Check tension of tie bolts

Prevention of Scavenge Fire

1.Clean scavenge space and drain at regular intervals

2.Keep scavenge space drain open at regular intervals

3.Excess cylinder lubrication must be avoided

4.In case of timed lubrication, the time has to be checked as per PMS

5.Piston rings must be properly maintained and lubricated adequately

6.Piston rod stuffing box must be maintained to prevent oil ingress in the scavenge space.

7.Prolong engine or any cylinder over loading to be avoided

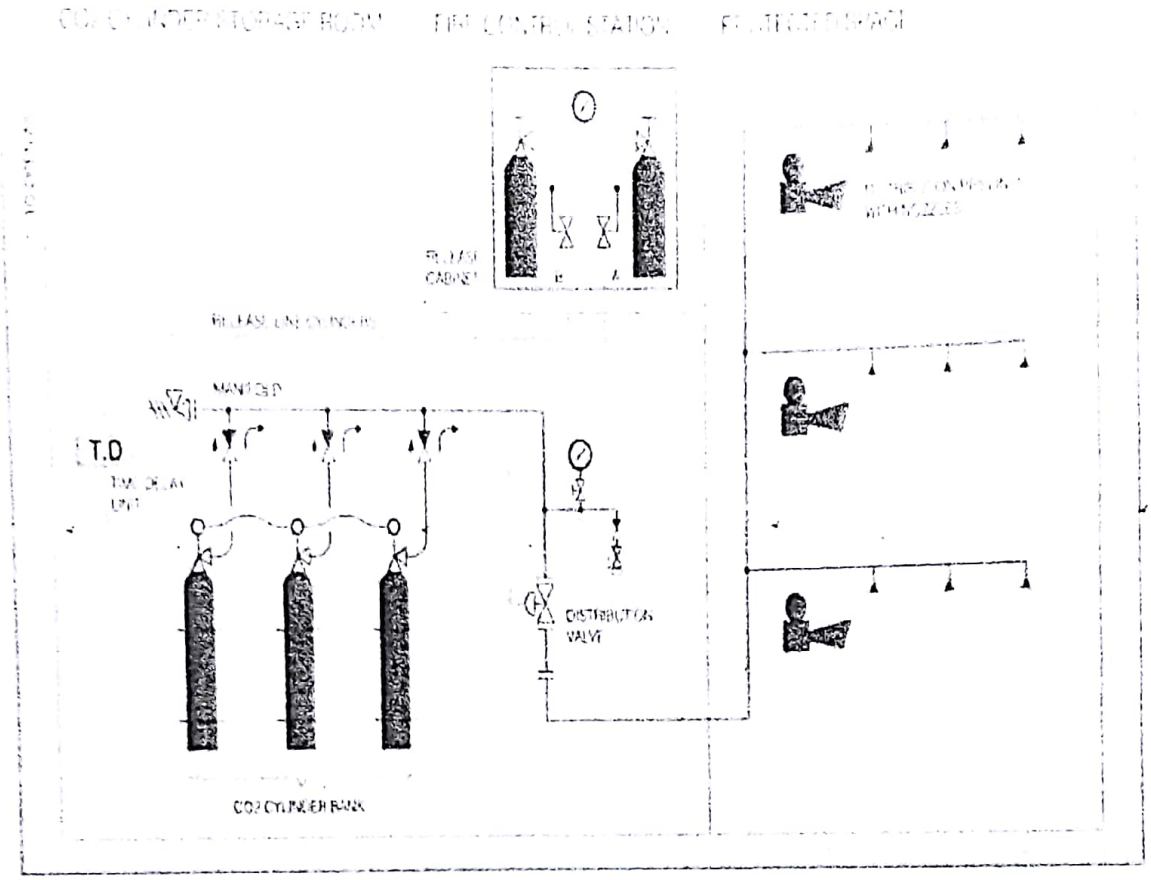
8.Cylinder liner wear must be within admissible limits

Scavenge Space Protection Devices

1.Electrical temperature sensing device fitted within the trunking, which will automatically sound an alarm in the event of excessive rise in local temperature.

2.Pressure relief valves consisting of self closing spring loaded valves are fitted and should be examined and tested periodically.

3.Fixed fire extinguishing system may be CO2, Dry Powder or Steam.



Note – Before oiler start cleaning the scavenge space, 2nd engineer always go inside the scavenge manifold to check maximum oil is collected near to which unit which help you to make out that something is not right with that unit and we normally fed the lube oil with respect to the sulphur content in the fuel oil

Q – What all things you will inspect during the scavenge space inspection (SA)

Ans – There could be number of things which need to be checked during the inspection of scavenge space –

1. Check the main blower inlet flap valves. These should be free to open and should close when released.
2. Turn the engine so that the piston is viewable through the scavenge ports. Inspect the piston skirt for signs of scuffing or abrasion. Inspect the rings for damage and the ring grooves for evidence of carbon build up. These rings are in good condition.

   Note – At the time of inspection if you ever go with the 2nd engineer in scavenge space inspection then you notice that with the brass rod he try to push the piston

ring just to check the elasticity of the piston ring if you feel hard to move it then it means either it is stuck or break

3. Turn the piston down, so that the crown can be inspected. Look for excessive deposits, burning, signs of poor injection, or cracking.

Note – If you find oil droplets on the top of the piston crown it simply give you an indication that you injector is dripping which may lead to crown failure also.

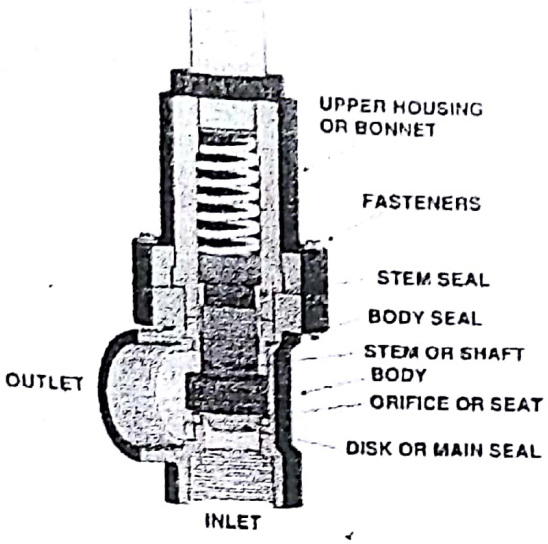
4. Then look up the liner using the mirror. Look for evidence of corrosion, scuffing or abrasion.
5. Check all the scavenge drains are cleared or not
6. Check the condition of sludge by squeezing the oil in your finger because sometime you find a very fine metal particles in that
7. Check the condition of locking wire below the piston which hold the skirt and crown together
8. Check the relief valve at the manifold of the scavenge space at the entrance (normally pressure setting is 10 percent more than the scavenge pressure)
9. If you found black spot on the piston ring it simply means blowpast from that particular unit
10. If you found any oil is dripping from the underside of the piston it means your o-ring inside the piston cooling space is leaking.

Q – What is starting air line explosion and its preventive measures (MA)

Ans – Main line contain 30 bar air but this air is not pure it also contain some traces of the oil so, we have the fuel which is oil and we also have the sufficient air so for the fire to take place we only need a heat or spark which usually come from the leaky air starting valve which is the cause of starting air line explosion.

Preventive measure

1. Air compressor to be maintained in a good condition
2. Air bottle is to be drain regularly in every watch
3. Starting air line is to be drain once the engine has been stopped
4. Make sure air starting valve on each cylinder head is properly overhauled and inspected at regular interval of time
5. **Relief Valve:** It is fitted on the common air manifold which supplies air to the cylinder head. Normally fitted at the end of the manifold and it lifts the valve in the event of excess pressure inside the manifold. The advantage of relief valve is it will sit back after removing the excess pressure and thus continuous air is available to engine in case of manoeuvring or traffic.



6. **Bursting Disc:** It is fitted in the starting air pipe and consist of a perforated disc protected by a sheet of material which will burst in case of excessive pressure caused due to air line explosion. It also consist of a protective cap such constructed that if the engine is required to run even after the disc has been ruptured, the cap will cover the holes when it is turned. This will ensure that in manoeuvring or traffic air is available for engine at all time.
7. **Non Return Valve:** Positioned in between the Air Manifold and Air Receiver, it will not allow the explosion and its mixture to reach the air bottle because of unidirectional property of N.R. valve.
8. **Flame Arrestor:** It is a small unit consisting of several tubes which will arrest any flame coming out of the cylinder through leaking start air valve. It is fitted on every cylinder before the start air valve.

Note – In sulzer we have the relief valve and in man b&w we have the bursting disc

Q – If air starting valve leaks during manoeuvring, how will you get to know out and what action you will take (VI)

Ans – If air starting valve leaks you get to know out from the following locations –

1. Air starting line becomes hot (just by hand touching you get to know out if excessive leaks it becomes red hot)
2. Relief valve lifts again and again with a high sound
3. Bursting disc burst out and relieve all the pressure
4. From the drain line smoke will come out

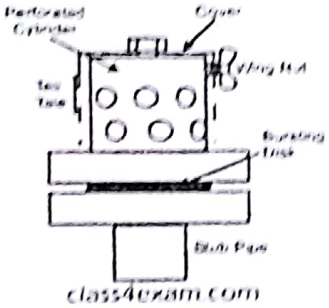
Then tell to bridge that you have the problem with engine and ask to stop the engine and change the air starting valve

But if it was not possible to stop the engine then cut off fuel oil supply to that unit so that no combustion should take place in that unit

In the mean time you should also ready the other air starting valve so that as soon as the engine stops you should replace it with in a short span of time

Note – Sometime surveyor ask you that if your bursting disc burst out then it was not possible to give a air kick because all the air should go out from the bursting disc –

If you ever overhaul the bursting disc then you can easily answer to this question otherwise it may fail you in your oral because this was the critical situation so to understand this please see the diagram below-



The safety cap consists of a bursting disk enclosed by a perforated cylinder and a perforated cover in order to protect any bystanders, in the event of a burst. The cover is fitted with a tell tale, which shows if the bursting disc has been damaged. If the bursting disc of the safety cap is damaged due to excessive pressure in the starting air line, overhaul or replace the starting valve which caused the burst, and mount a new disk

If a new disk is not available, or cannot be fitted immediately, then the cover can be turned in relation to the perforated cylinder, in order to reduce the leakage of starting air.

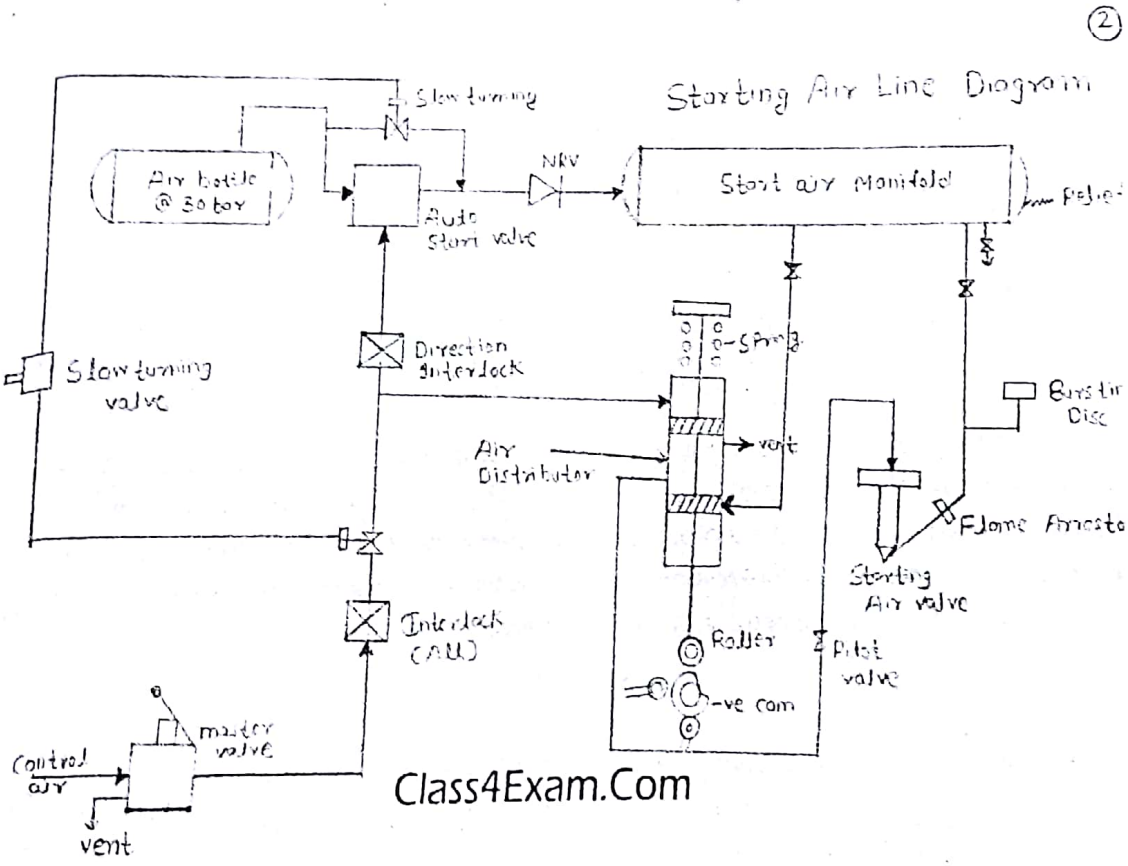
Note – Some time surveyor might ask you that your engine is stopped then how will you get to know out that your air starting valve is leaking or not ?

Most of the time surveyor check your intellectual knowledge so before giving answer to these type of questions always think for a second and then answer because your answer tell your thinking ability to the surveyor

So to check this you need to open the indicator cock if your air starting valve is leaking then air come out from the indicator cock which give you an indication that your air starting valve is leaking because air is always available at 30 bar but to allow the air to go to the unit 7 bar pilot air come from the distributor but if starting valve is leaking then 30 bar air keep going inside the unit

Q – Draw starting air line diagram and explain the same (AA,VI)

Ans – Surveyor ask so many questions in this but first you need to draw the diagram because if you unable to draw the diagram then he definitely kick you out from the room. So I try to cover all the question which can be asked from this.



The reason of providing the negative air distributor cam is –

1. Positive closing of the valve if in case it stuck
2. If some one manually open auto start valve, still it wont allow the air to go in because control air is not present and all rollers are already lift up

When engine start running all roller on distributor will lift up because of the spring action so air distributor negative cam will keep on rotating but no wear and tear because all rollers are already lift up

Running direction interlock

Interlocks are the blocking devices which ensure that the engine is started or reversed only when some conditions are fulfilled or satisfied. Running direction interlock is an essential trait that prevents the injection of fuel to the engine when the telegraph doesn't synchronise with the running direction of the engine. It is an important application in the crash manoeuvring when the starting air is used to apply brakes on the engine by reversing the operation.

Turning gear interlock

Turning gear interlock is another important thing that prevents the admission of starting air to the engine cylinders when the turning gear is engaged. If the starting air is admitted with the turning gear engaged, then the turning gear along with the motor will fly off puncturing the bulkhead. Thus the interlock is necessary to prevent such accidents.

Other interlocks are – 1. Lube oil low pressure interlock

2. Control air interlock

3. Camshaft lube oil low pressure interlock

4. Spring air low pressure interlock (for exhaust valve)

5. Aux blower interlock (at the time of starting aux blower is to be put on auto mode because of no scavenge air else it is difficult to start the engine without air that was also the reason why we get black smoke at the time of starting the engine because of less quantity of air)

6. Safety air interlock

7. Reversing completed (it was the direction safety valve if engine some how starts in opposite direction, so it will cut off the fuel supply)

8. Camshaft Interlock - It is a device, which prevents the engine from starting if the camshaft has not shifted or changed its end position in compliance with engine order telegraph.

9. Starting Air Distributor In End Position Interlock - This device prevents starting from taking place if the shifting of the distributor has not been completed.

10. Fuel Pumps Interlock - It prevents reversing of engine if the fuel rack is not in its zero injection position.

Note – In sulzer if engine start in opposite direction fuel supply will be cut off but in man b&w engine wont start because of the direction interlock. So that was the reason why this interlock is given after the telegraph as shown in the diagram

For slow turning a small line is provided as shown in the diagram which give you a very small kick of 2-3 turns (slow turning automatically takes place and at the time of slow turning your indicator cock is closed) , but if you didn't get the kick may be because of water accumulated over the piston crown so in that case you will get the alarm

Note – Sometime surveyor might ask you why to turn the engine on turning gear – 1. the reason for this is if in case excess water is accumulated over the piston crown then at the time of blow through that much quantity of water unable to come out from the small indicator cock

2.Second reason is at the time of turning the engine on turning gear if your motor ampere is increasing it simply give you an indication that excess water is accumulated over the piston crown. So never ever try to blow through in that case because you may break the engine parts.

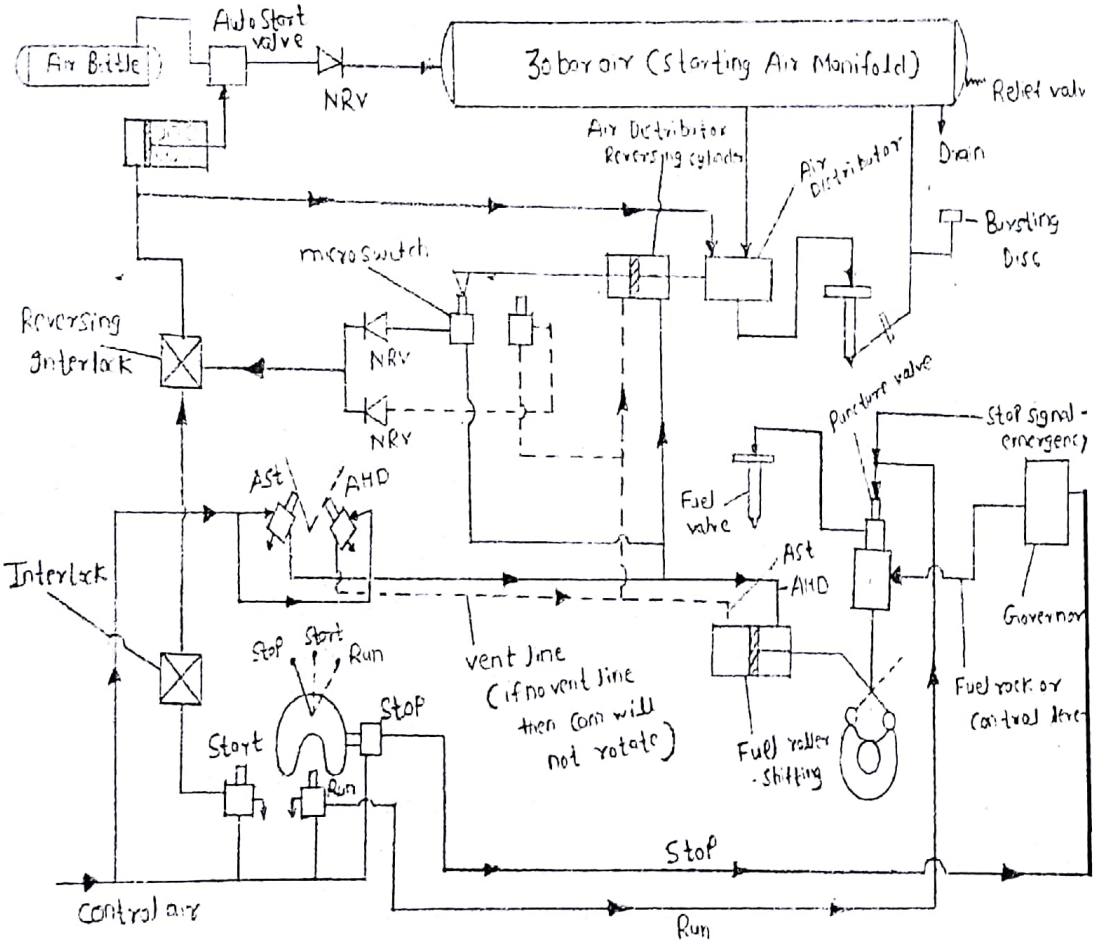
Some time surveyor might ask you that you give the kick but **engine fails to come on air –**

1. Start air distributor has not activated its end stop valve
2. No air pressure at engine manifold. The valves from the air receiver would be checked, and opened if found shut.
3. Low air pressure at engine manifold. This could indicate that the air compressors are either not working or excess air is being used. All air compressors would be started, and air usage restricted to engine manoeuvring only.
4. Turning gear engaged. The turning gear position and the interlock switch would be visually checked. The gear would be removed if found engaged.
5. Control air valves faulty or less control air pressure
6. Bursting disc burst out on starting air line
7. Auxillary blower is not running or not to be put on auto mode
8. Spring air pressure is low so exhaust valve is unable to close and the air kick goes out from the exhaust valve
9. Fuel lever on manoeuvring stand not on remote positon.

Q – Draw the Manoeuvring diagram and explain the same (GA)

Ans – I try to explain the basic working of the manoeuvring diagram so while reading this keep checking the manoeuvring diagram which has been given below because at your level

surveyor wont expect much from your side but still I try to cover all important points where surveyor can pin point you –



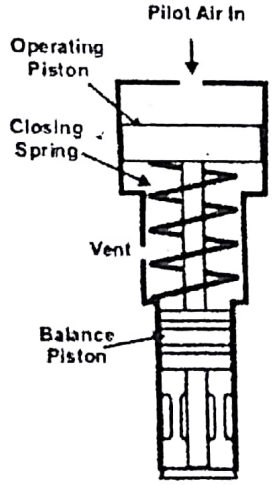
1.Normally at the time of run we have to give the fuel to the engine but we don't give in the starting unless he wont attain the minimum start rpm, once engine attain the start rpm so for 2-3 seconds both the micro switches has been pressed up(start and run) so that the engine should attain minimum momentum and keep running on fuel, but before this control air goes to the telegraph and according to the command receive from the micro switch it reverse the position of fuel pump roller through its control cylinder.

2.Two micro switch will be there in the air distributor if air distributor is properly reversed with respect to the telegraph so from non-return valve air goes to reversing interlock and

then from reversing interlock control air goes to cylinder of auto start valve and operate it. This control air first check all the other interlock and wait for the reversing interlock command to operate so that it goes forward to the auto start valve

3.So due to this air @ 30 bar pressure from air bottle goes to starting air manifold through the auto start valve and NRV.

4.Now distributor and fuel pump roller is set for the operation so pilot air @ 30 bar come from the distributor and operate the air starting valve so that 30 bar air should go inside the unit and give the sufficient air to the engine so that it will over come the inertia



Note – Some time surveyor might ask you that below the balance piston 30 bar air is present and above operating piston 30 bar air is there so how it will operate the valve downward so this thing will happen because of the area difference.

5.Dotted lines in the diagram represents the venting line because if air goes to the cylinder to rotate the piston so the air to the other side must be vented out unless it is difficult to operate the piston inside the cylinder

6. Now sometime surveyor might ask you how to increase the speed of the engine so in this case again micro switches play a very important role when you keep on pressing the micro switch they keep on giving the signal to the governor and governor keep on increasing the fuel quantity.

7.Surveyor mostly ask this question that at the time of starting we don't have any scavenge pressure so governor never release the fuel because of the interlock so tell to surveyor that at the time of starting false signal is to be fed to the governor so that it will release the fuel in excess quantity (just for 3-4 seconds) so now engine started properly and from now onwards it keep getting the signal from turbocharger only.

8.In case of emergency if you want to stop the engine then stop signal for emergency operate the puncture valve of the fuel pump and stops the engine

Q – What do you understand by the term crash manoeuvring & how to perform it (RA)

Ans - Crash manoeuvring is turning the engine in opposite direction to reduce the heading speed of the ship. After certain time, the ship stops and starts streaming in astern direction. This is done by supplying starting air at about 30 bars from the air receiver to the engine. The stopping air is known as the brake air.

The brake air when sudden injected inside the engine cylinder, will try to resist the motion of the piston and the rotation of the crankshaft and propeller.

Note – When you give the brake air in the cylinder it try to resist the piston to come upward but when piston about to reach to TDC so this air will compressed and again you get the kick because of this compressed air so due to this you will unable to stop the engine so for that reason relief valve is provided on the cylinder head or in some new engine there was the switch for crash manoeuvring which operate the exhaust piston to open when the piston is about to reach to TDC.

Procedure

Following Procedure is to be followed when a navigational officer calls engine room and says that we have to stop immediately to avoid collision

When there is an emergency like collision, grounding etc. the controls are transferred immediately in to the Engine room controls

The bridge will give astern direction in the telegraph, acknowledge the same

When the telegraph is acknowledged only the starting air cam will reverse its direction but the fuel cam will remain in its running position due to running direction interlock since engine is still running in the ahead direction

The fuel lever in the engine control room is brought to '0'

As soon as the RPM of the engine drops below 40 % of the Maximum Continuous Rating or MCR rpm of the engine, give break air few times in short time frame

The break air will inject with astern timing setting inside the ahead moving piston which will resist the piston motion

Since fuel will not inject until running direction interlock opens, as soon as the rpm drops near to Zero, give fuel and air kick by bringing fuel lever to minimum start setting

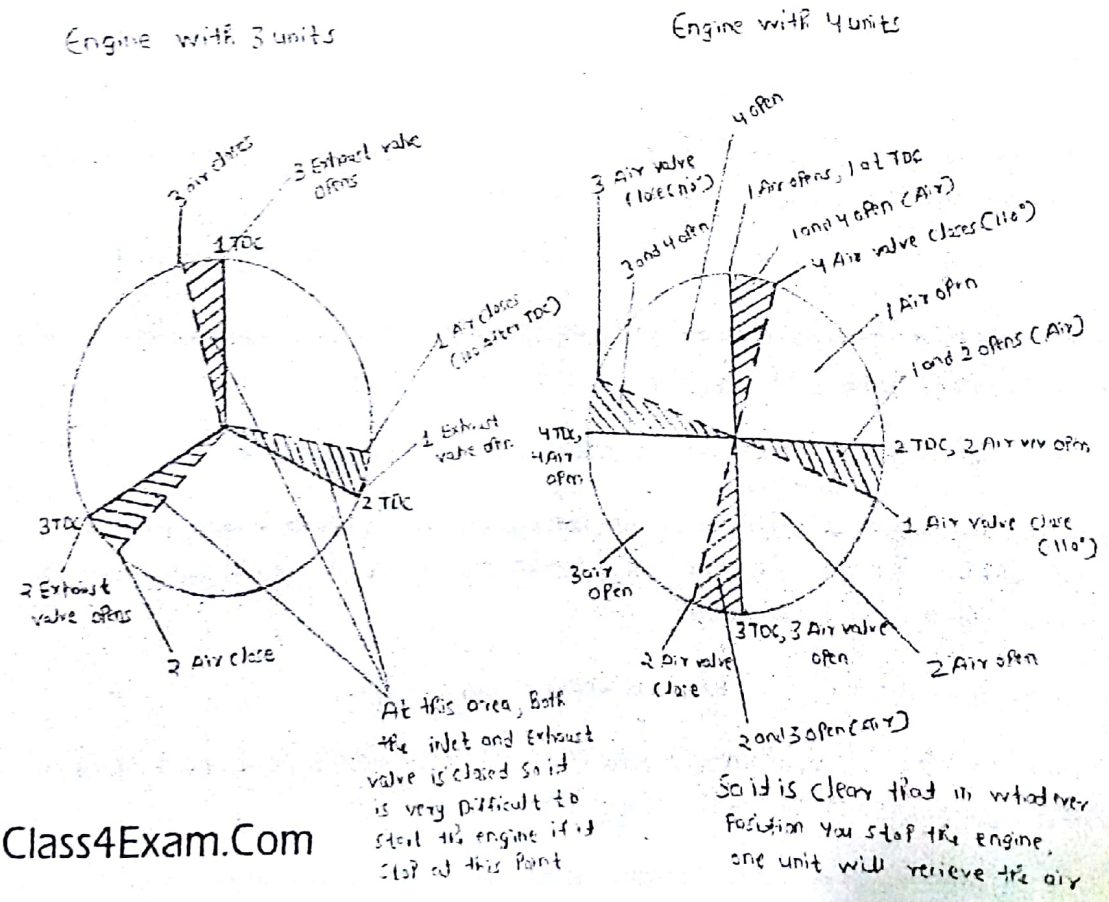
When carrying out Crash Manoeuvring, some safeties need to be bypassed to avoid tripping of engine in mid of emergency

When the ship stops and situation is under control, a detailed Main engine inspection is to be carried out when there is a chance.

Q – Why it is impossible to start the engine (2-stroke & 4-stroke) with 3 units at certain position and what is the importance of overlap period (SA)

Ans – In 4-stroke engine we normally put the bigger flywheel because out of 4stroke only one stroke was the power stroke as we increase the number of unit flywheel size keep on reducing and vice-versa

Now consider a engine (2 stroke or 4 stroke) with 3 units and see how it wont able to start at some position



So from the diagram it is very much clear that at the shaded region area both the inlet and exhaust valve is closed so if your engine stop in this position then it is very difficult to start a engine unless you turn it with a flywheel and change the position, so it is proved that the engine with the 3 unit only unable to start at some positions

Normally in 4-stroke air is injected near TDC because in 4-stroke engine torque produce at two point is approximately zero which is near to TDC and BDC and maximum at 90 degree

Air is to be given just slightly after TDC so that maximum pressure utilization of the air takes place because if you give the air kick just before TDC so it does not make any sense because unless and until piston must come to TDC so ultimately you are trying to stop it which is seems to be the loss of power

Note – In sulzer we give air kick just 4 degree before the TDC

In man b&w we always give the air kick just after 11 degree TDC

Now lets talk about the 4 unit engine

so from the diagram it is clear that in what ever the condition you will stop the engine atleast one unit can receive the air

So overlap period is also clear from the diagram but the main thing is that how to calculate that overlap period

Overlap Period = Positive starting angle - 360 / No of units

Where,

Positive starting angle means = angle at which air valve opens after TDC

Like in this case,

110 – 360 / 4 = 20 degree which is the overlap period

Note – If air valve opens 4 degree before TDC and close 110 degree after TDC so positive starting angle is 110 degree not the 114 degree a important point to understand

Conclusion – So more the number of units easier to start the engine because more number of unit will get the starting torque together

Note – In 2-stroke engine minimum number of unit require to start the engine is four

IN 4-stroke engine minimum number of unit require to start the engine is six

Q – Explain TCA and TCR type of turbocharger (SA)

Ans – Before starting with TCA & TCR, first I will tell you what is turbocharger and what is the importance of it

Earlier we use supercharger which supply the air at high pressure so due to high pressure density of air increase and more fuel we can efficiently burn inside the engine, size of engine becomes compact and we can produce more power because of the power to weight ratio of the engine has been increased.

But if supercharger have that much of benefit then why we will use the turbocharger instead of supercharger because the biggest disadvantage of superchargers is that they suck engine power simply to produce engine power. They're run off an engine drive connected to the crankshaft, so you're essentially powering an air pump with another air pump. Because of this, superchargers are significantly less efficient than turbochargers.

So supercharger take energy from the engine itself so due to this loses will be there at the same time turbocharger has been driven from the exhaust gases which is one of the biggest advantage of it.

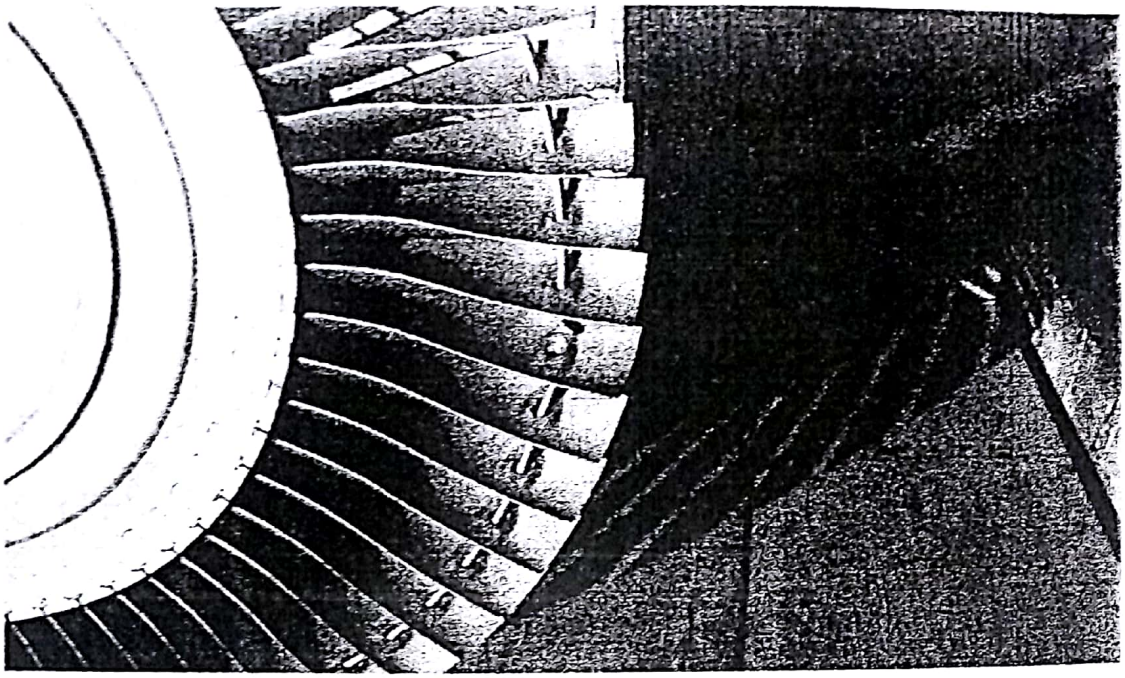
Note – Some time surveyor might ask that why we cool the air which came from the turbocharger compressor side the reason for this is that the temperature of the air is 120 degree Celsius so due to this high temperature the air expansion will take place and due to this density of air becomes low and we unable to send large quantity of air inside the engine during combustion due to which effective combustion will not take place that's why we use cooler to reduce its temperature and increase its density

Turbocharger is the heat conversion device which convert heat energy to K.E

TCA Turbocharger

We try to cover all the points in TCA turbocharger but to understand the working of TCA turbocharger please check the diagram side by side –

1. Rotor of the turbine side is forged to the shaft
2. Turbine blade is fitted to the rotor by the arrangement which is called fir tree arrangement
3. One wire is pass through all the blades and welded at the ends just to reduce the vibrations which is called the dampen wire



4. Shroud Ring – the work of shroud ring is same as just like the work of wear ring in the centrifugal pump. Shroud ring is stationary and very small clearance is there and it wont allow the exhaust gas to pass
5. Nozzle Ring – Exhaust gas from engine first pass through the nozzle ring then to the turbine blade, so some of the energy of exhaust (heat) converted to K.E in nozzle ring and remaining conversion will take place in blade of the turbocharger
6. When exhaust come out from the engine it will hit the blade due to which its direction keep on changing and it will give thrust and due to this shaft starts rotating
7. Blower we make of aluminium alloy because that side was not exposed to high heat
8. Air side we have the inducer and the blower, inducer is hydraulically press fit and it guide the air towards the blower.
9. As blower is rotating with the high RPM so due to this rotation air come out from the periphery of the blower with high kinectic energy but in the end we only want the pressure energy so that's why we fit diffuser in the end to get the pressure energy form the kinectic energy

Note – 1. Both end we have the bearing to take the thrust

Blower side = deep groove ball bearing – which takes the axial thrust

Turbine side = roller bearing – in which expansion is allowed

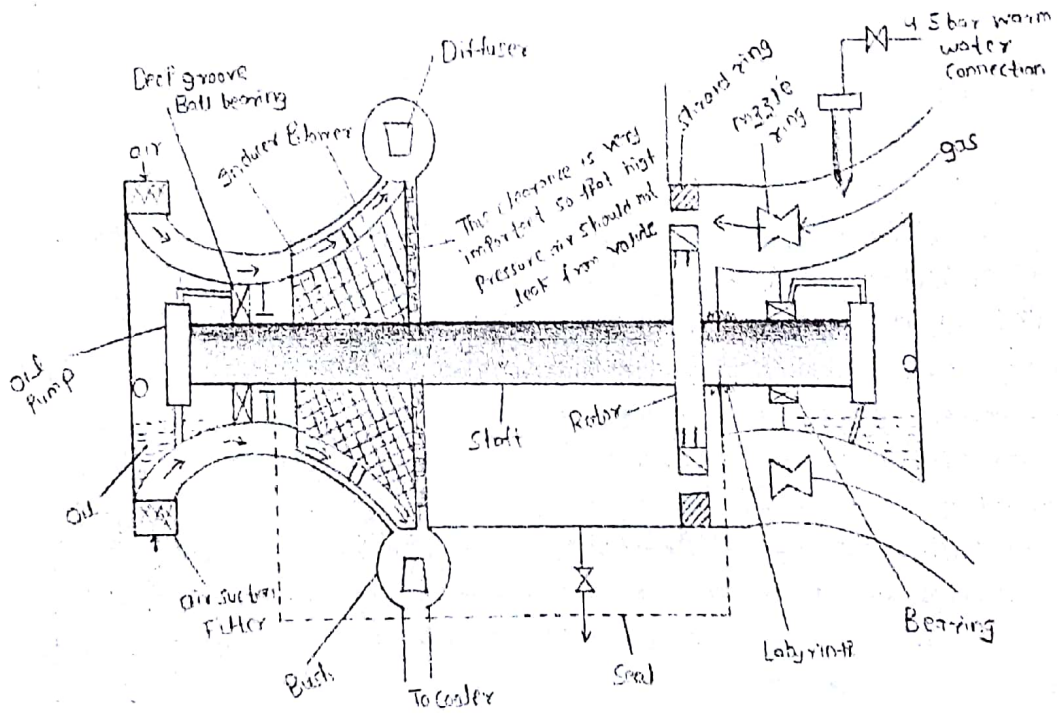
These two bearing require lubrication so separate lubrication is been provided and attach pump is there to give the lubrication , which is been run by the shaft itself

2.Whether turbocharger is radial type or axial type that depend upon the flow of exhaust gas over the turbine side (important point to note)

3.Just like in this case if you see the diagram that exhaust gas enters parallel to the shaft. Blower side always be the same it is of mixed type mostly, only the turbine side changes that's why it is TCA type of turbocharger

4.Turbine side casing is water cooled but blower side is normally air cooled because it cannot deal with high temperature

5.Labyrinth seal – the purpose of the labyrinth seal is to make sure that exhaust should not go to the oil side and one air sealing connection is also provided just to give the cooling and to maintain the positive pressure so that exhaust should not come to the oil side under any circumstances



Q – How fouling take place in turbocharger and procedure of turbocharger washing (MA)

Ans – This question is very frequently asked in MMD Orals because you need to understand the basic concept of fouling

If 1 mm layer is deposited on the blower then it may drop the efficiency of your turbocharger so according to the instruction given in the manual clean it at regular intervals so at fouling of turbocharger should not occur

Note – 1.If you did not perform the turbocharger washing from a long time then don't do it unless you done a complete overhaul of turbocharger because after a long time if you suddenly do a washing then complete deposits from the blade could not be removed and it make a turbocharger imbalance and it create a heavy vibration and noise which is difficult to handle and you may break important part inside the turbocharger

2. For blower side washing of turbocharger a separate water connection has been given

3. A very important point to note is that turbine side (exhaust) fouling is less as compared to the blower side (air) because turbine side is exposed to high heat and high exhaust pressure so all the deposits will be removed because of this, but exhaust gas passes over the turbine should contain large amount of impurity like ash, calcium carbonate & carbon deposits.

4. Turbine efficiency we also get to know out with temperature difference at the inlet of the turbocharger and at the outlet because it give you an idea that how much heat energy is been transferred to the kinectic energy

Procedure of washing the turbine side of turbocharger –

1. If you are going to perform the turbocharger washing of the turbine side then you have to reduce the rpm of the engine else cold water(normally we use warm water @ 4.5 bar pressure) and hot surface cause cracking of the blade of the turbocharger because of the quenching effect
2. Inform the bridge that you are going to perform the water washing of the turbocharger
3. Don't suddenly drop the rpm atleast take 30 minutes to drop the rpm gradually and keep dropping unless you will not get 200-230 degree temperature at the inlet of the turbine (see graph)
4. Once you reached to the desired rpm, then wait over there for atleast 10-15 mins to stabilize the temperature, then open the drain
5. Open valve for water washing and continue water washing for atleast 10 minutes (90 percent of the water is evaporated and only 10 percent came out from the drain)
6. Check the condition of water which came out from the drain if you found the clean water coming out it simply means that your turbine washing take place properly and your turbine is fully cleaned, so close the drain now
7. Then close the water valve and keep running the turbine at the same rpm for atleast 10 mins this is called dry washing of the turbine and at the same time check for any abnormal noise or vibration from the turbocharger

8. Now again gradually start increasing the rpm and keep checking for any abnormal noise or vibration

Note – Water washing has only one advantage that cleaning is very good and if carried out properly efficiency of the turbocharger has been increased

Disadvantages – More time is required for cleaning

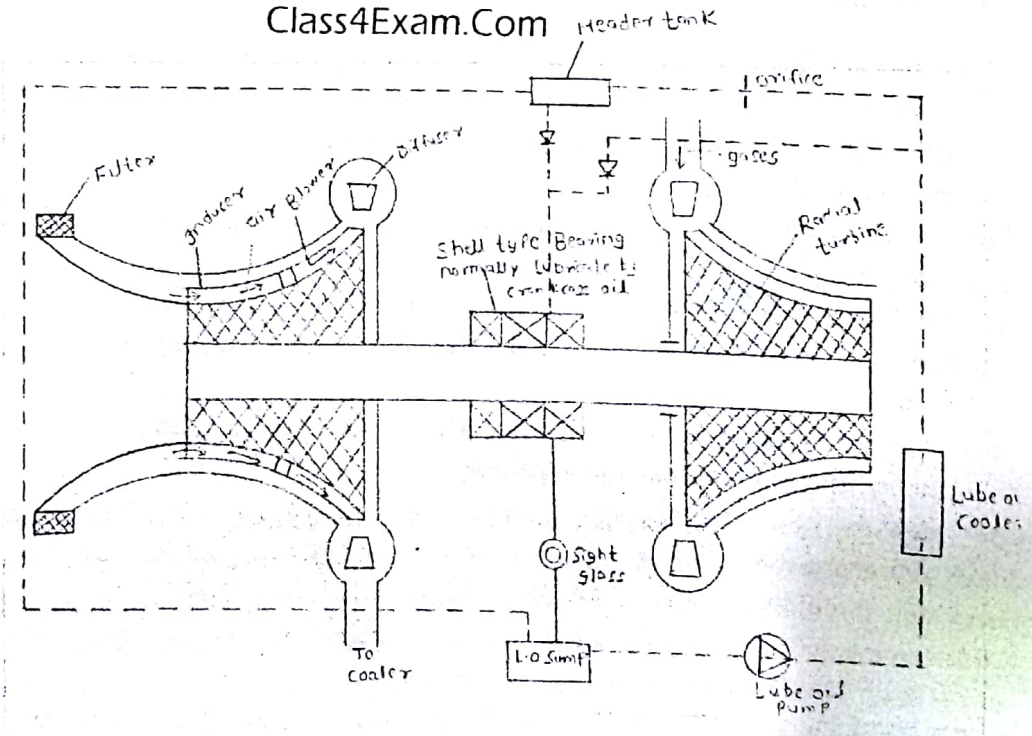
-Chance of corrosion will be there because sulphuric acid is present in the exhaust gas

-if not done properly chance of turbine blade cracking will be there (only to be done by the expert people)

So, that was the reason we normally use dry washing of the turbine side for that we will use grit or wall nut grit (at the time of doing dry washing of turbine side make sure your drain has been shut)

Q – Explain TCR type turbocharger of your ship (AA)

Ans –



Before I start with the TCR type first you need to understand that this type of turbocharger is normally used in small engine like generator and TCA type we mostly use in big engines like main engine

TCR type turbocharger has certain advantages because it is compact and bearing life is very high and TCA type turbocharger bearing is always under fatigue stresses

TCR type turbocharger bearing has more load carrying capacity

Note – If you use this type of turbocharger for M/E then you have to use two or three turbocharger

In this type of turbocharger there will be a header tank because if in case sudden black out takes place so lube oil pump for bearing lubrication has been stopped and no lubrication is been provided in that case your bearing has been gone, but this problem was not there in TCA type of turbocharger because attached lube oil pump has been there in that so till the time your turbocharger rotates it provided the bearing lubrication automatically

In this type of turbocharger we have floating type of bearing so there is hydrodynamic lubrication between the bearing and shaft/ housing and shaft (so small header tank can able to full fill your purpose)

Regular maintenance on turbocharger

1. Check and replace the filter if pressure drop in manometer more than 50mm
2. Regular washing of the turbine and blower side with respect to the instructions given in the manual
3. Change the oil of the bearing after certain number of running hours with reference to the PMS or turbocharger manual

Q – What are the different types of turbocharging with advantage and disadvantage (GA)

Ans – There will be the two type of turbocharging

1. Pulse type
2. Constant pressure type

Pulse type – As soon as exhaust v/v opens, the exhaust start coming out in the form of pulse that pulse energy use to rotate the turbine

In pulse type turbocharger has to be fit near to the cylinder to avoid the expansion of pulse energy

Exhaust pipe should be small in diameter so that exhaust should not expand in the line

Due to all this requirement exhaust piping system in pulse type turbocharger is little complicated

How to do the grouping of exhaust pipeline towards the turbocharger in pulse type –

We have to do the grouping in such a way that pulse energy of one unit could not interfere with the pulse of another unit so we never ever make the grouping according to the firing order of the engine

In main engine we don't have any problem because mostly we have two turbocharger so we can easily make the grouping but in generator we use only one turbocharger so in that case we give two inlet to the turbocharger so that one unit pulse should not interfere with the other one (see diagram below)

Above we just only talk about the disadvantage of pulse type turbocharger now lets talk about its advantages –

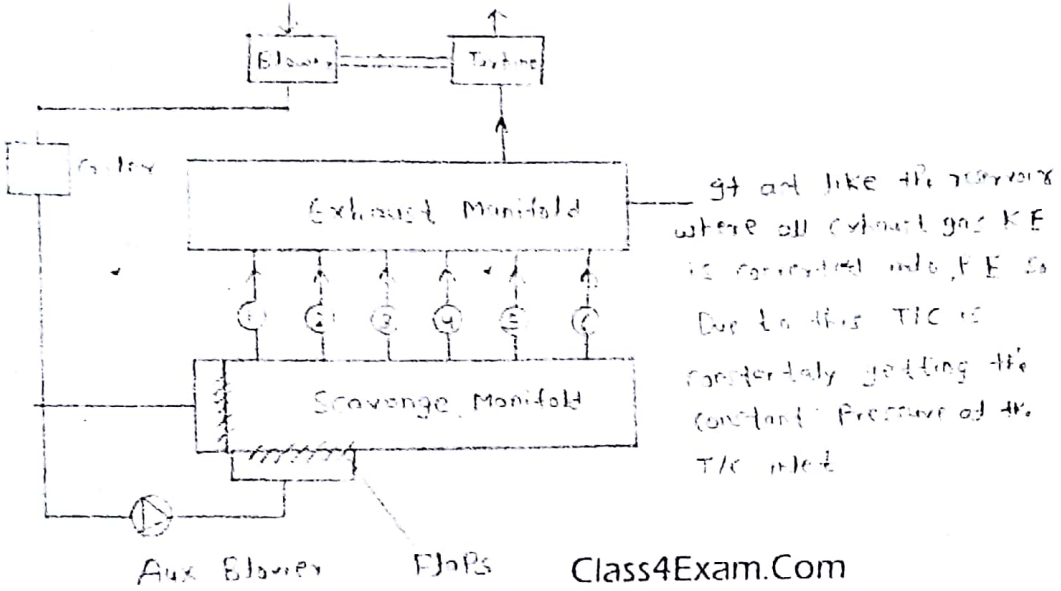
1. It does not require auxillary blower because it has high efficiency at low loads and give a quick response when load changes suddenly
2. In generator load is constantly fluctuating so in generator we mostly use pulse type turbocharger

Note – But its efficiency is very less for those engine which normally run at high load (like main engine only at the time of manoeuvring we have the problem for that we have auxillary blowers so that was the reason we use constant pressure type of turbocharger in case of main engine)

In pulse type turbocharger pulse energy is used to rotate the turbine so when every time this pulse hits the turbine blade its increases the maintenance and also reduce the bearing life one of the biggest disadvantage

Constant pressure type – As the name indicate that the exhaust gas pressure at T/C inlet is always constant

1. In constant pressure type we can put turbocharger at any place no limitation
2. No complexity in pipeline and manifold size, we can use big dia pipeline without any problem
3. Efficiency of the turbocharger is high at higher loads so it used at a place where load is not fluctuating much or engine should not run at slow speed most of the time



Disadvantages – Now lets talk about the disadvantage of this type of turbocharger

1. Low efficiency at low loads that's why it require assistance at low load (auxillary blowers)

Auxillary blower take suction from the blower only so that it also try to increase the efficiency of the blower

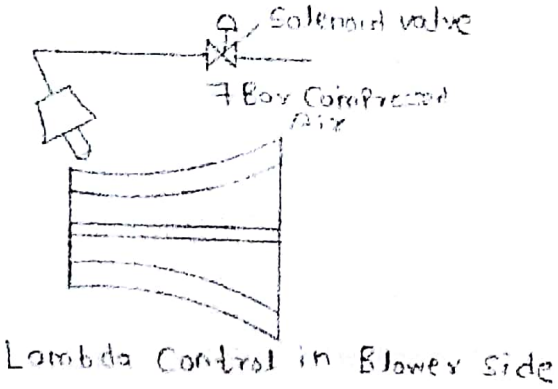
Due to this scavenge manifold pressure keep on increasing and at one point of time blower automatically cuts off when required scavenge manifold pressure has been reached by the activation of the pressure switches (at the time of manoeuvring blower keep on running)

Note – When the engine is running normally at high speed so sometime you notice that auxillary blower is rotating with a small speed so it will give you an indication that air has been leaking from the flap valve as shown in the diagram

Q – What is lambda control in turbocharger (VI)

Ans – This question is very frequently asked now a days in MMD Orals as we already discuss that pulse type have so many disadvantages and due to this reason it was not much efficient because of high maintenance and less bearing life and at the same time in constant pressure type turbocharger it has only one disadvantage that at low load it wont work properly so that's why Man B&W design a special type of turbocharger which remove this demerit of constant pressure type turbocharger

If we put constant pressure type turbocharger in generator then at the time of starting and quick load changing we also need a quick response from the turbocharger so for that reason a connection of compressed air with a solenoid valve in the blower side is provided. So the compressed air @ 7 bar directly hit the blower side blades and increase the RPM of the turbocharger instantly and this solenoid valve operates by a electric signal which keep sensing the rpm and load changing fluctuation with in the engine so this is all about the lambda control in turbocbarger.



Lambda Control in Blower Side

Q – Exhaust from the main engine come out at a temp of 360 degree Celsius and temp of exhaust gas at the inlet of the turbocharger is 460 degree Celsius how?

Ans – Some time surveyor wants to check you basic understanding of thermodynamics so try to give the best at these type of question there could be the number of reasons for this which are given below –

1. Because of adiabatic compression - if we compress the gas quickly so that it doesn't have a chance to exchange heat with its environment, the temperature will change. This sort of compression is called adiabatic compression (exhaust of all unit come in the manifold because of this adiabatic compression will take place)
2. Exhaust come out from the engine have lot of K.E which convert to P.E in the manifold

3. The sensor fitted on the outlet of the unit which sense the exhaust gas temperature will only give you the average temperature because with the exhaust gas some of the scavange air also go out whose temperature is nearly 40-50 degree Celsius

Q – What do you understand by the term matching of turbocharger and what is VTA & VTG in new turbocharger (SA)

Ans – Matching of turbocharger simply means that with respect to the load it can able to supply the sufficient quantity of air that is called matching

Our main priority is to match the turbocharger for full load means to check that the particular turbocharger should have that much of capacity so that it can able to cope up with the full load and can able to supply the sufficient quantity of air

You heard the term stoichiometric ratio this ratio simply tell you that 14 kg of air is required to burn 1 kg of fuel but we try to give 36 kg because losses will be there so that effective utilization of the power and fuel will take place

So to produce this much quantity of air we need blower and blower is been run by the turbine (so our main aim is to rotate the turbine with sufficient rpm)

Turbine rpm is mostly depend upon the nozzle ring, so we have to design the nozzle ring in such a way that it can full fill our requirement for all the loads

So the conclusion is that with the nozzle ring we can alter the rpm but nozzle ring is the fix ring, so it is not easy to alter the nozzle ring. So that's why we design the nozzle ring in such a way so that it can perform well at full load also

So that's why new technology came into action which is –

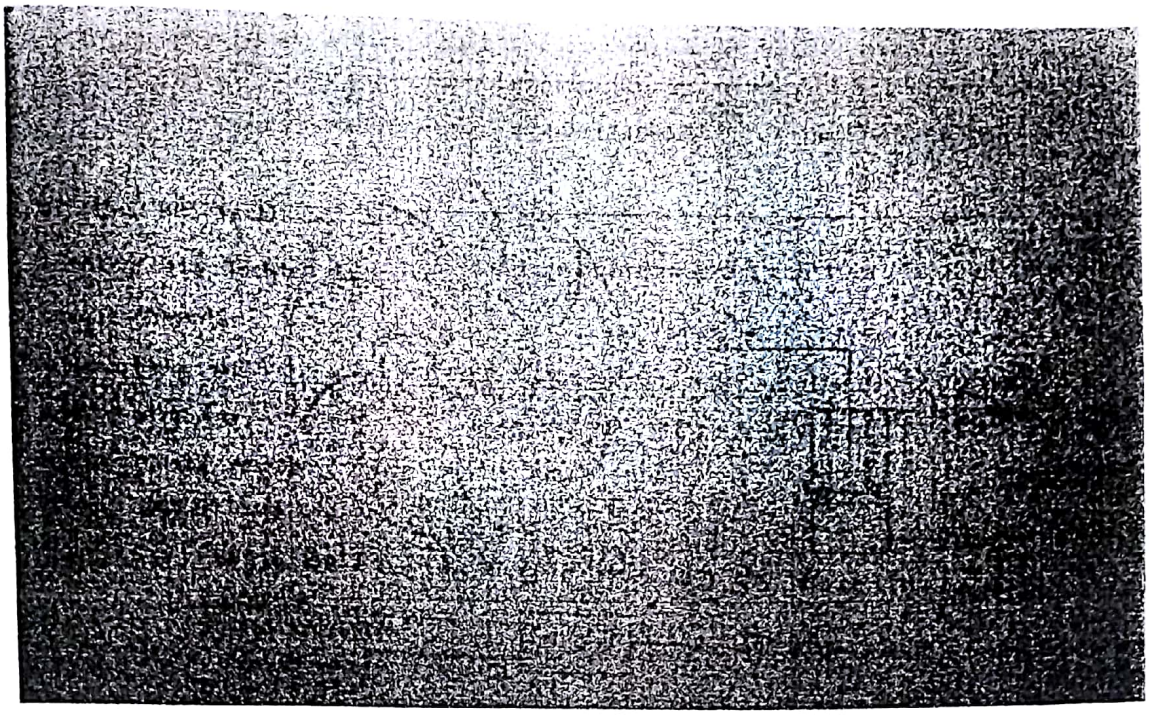
VTA – Variable turbine area

VTG – Variable turbine geometry

VTA & VTG can perform well at any rpm and fullfill the air requirement even whatever we the turbine rpm at that time

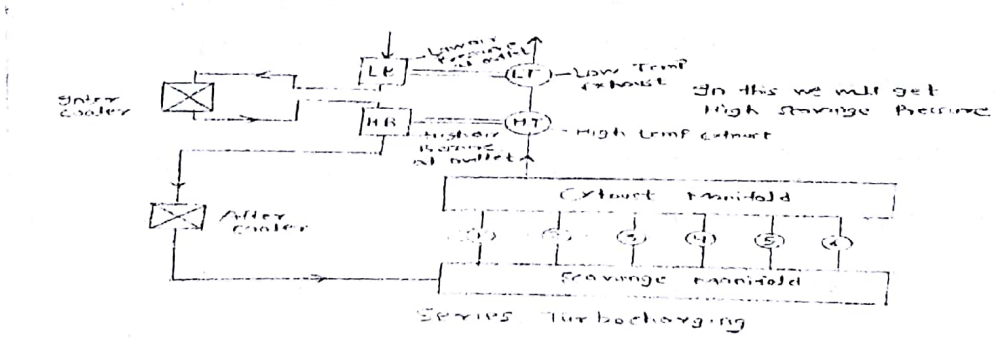
So with this new technology we can vary the angle of nozzle ring and we can easily match the turbocharger for different loads and it also help in reducing the Nox content

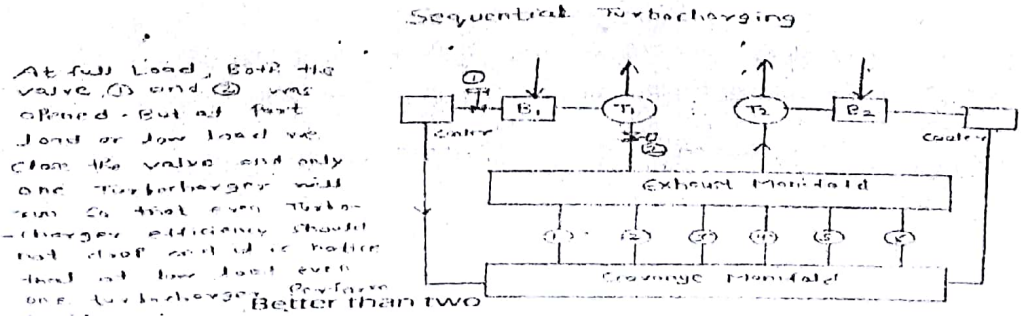
Turbocharger efficiency = Turbine efficiency X Blower efficiency X Mechanical efficiency



Q – What do you understand by the term series turbocharging and sequential turbocharging (RA)

Ans – To understand the series turbocharging and sequential turbocharging just see the diagram below –





Q – What do you understand by the term turbocharger surging? explain with graph and reasons for it (VI, AA)

Ans – At particular pressure ratio the manifold start supplying or rush into the opposite direction to the compressor side (blower side), because compressor supply pressure is less as compared to the manifold pressure. So because of this air come out from the blower side and expand with the huge sound that is called turbocharger surging

OR

Instead of turbocharger blower supplying the air to the manifold their will be the reversal of flow so that air from the manifold will blow out into the atmosphere through turbocharger blower with a huge sound

But the question is why this happens – there could be a number of reasons for this which later on I tell you but it mostly occur when you suddenly drop the rpm of the engine because in my previous article I told you about the matching of turbocharger, to better understand this I consider one example –

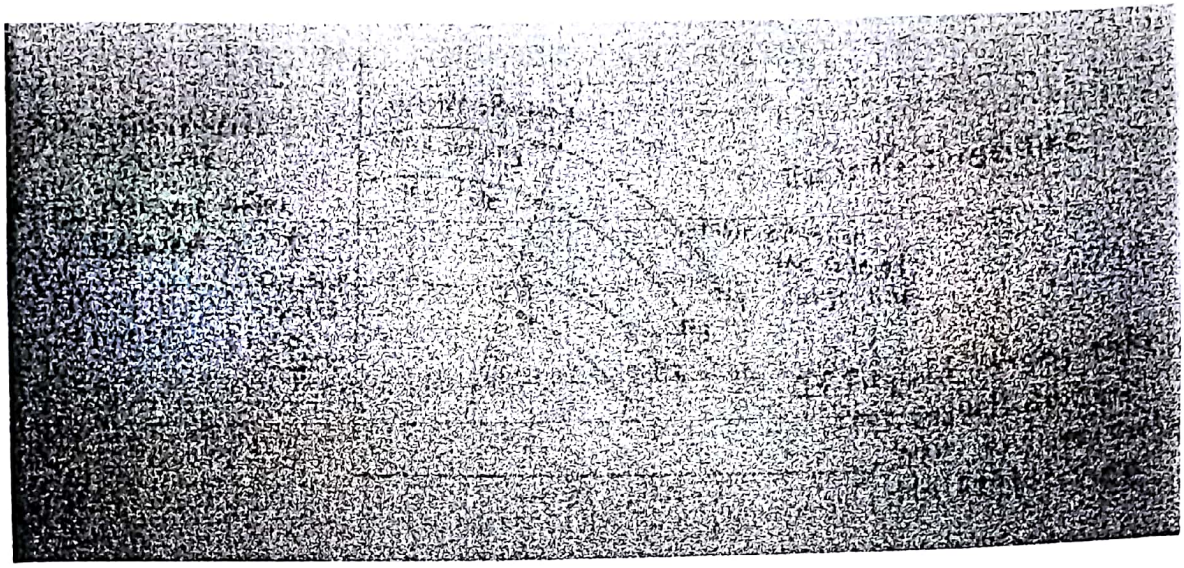
Let say your engine is running at 110 rpm and your scavange manifold pressure is 1.5 bar and now you suddenly come to 50 rpm, may you give the signal to engine to come to 50 rpm and governor suddenly reduce the fuel but turbocharger is the rotating machine it still rotate with the same rpm and supplying the same quantity of air to the engine but now engine refuse to take that much quantity of air so manifold pressure keep on increasing and at one point of time pressure of manifold increase with respect to the supply pressure so due to this reversal of flow will take place this is basic of surging

Note – Frequent surging is very bad for the engine or for the turbocharger itself, it may damage the bearing of the turbocharger so try to avoid the surging as much as possible

See the graph below which give you a idea about stable and unstable operation

In the graph it is clear when suddenly the requirement of air is not required then we approaches towards the surge line

Note – Most of the time surveyor ask you this question that frequent surging will take place what will you do to stop it – The answer to this question is given in the graph which is shown above just reduce the rpm you automatically come to the stable operation side.



Now lets talk about other reasons of turbocharger surging –

1. It can also happen due to sudden change in the engine load or speed.
2. Imbalance in cylinder power or faulty injectors
3. Un-cleaned turbine nozzle ring.
4. Damaged blades
5. Dirty or choked filter
6. The capacity of turbocharger is larger than required.
7. Increased back-pressure at the turbine side.
8. Improper power distribution between the main engine cylinders may cause turbocharger surging as one unit is producing more power and other is producing less. Due to this the air consumption required by both the turbochargers differs, which leads to surging.
9. Fouled compressor on turbine side – In this case if the inlet filters are dirty then enough air can not be supplied for combustion, which leads to surging. Similarly if the turbine side is also dirty i. e nozzle, blades etc enough air can not be produced for combustion.
10. Highly fouled exhaust i.e. economizer, if fitted may cause back pressure in the turbocharger and thus finally lead to surging.
11. Bad weather – This is one more reason for surging. Due to bad weather the engine suddenly starts racing and sudden load change takes place. This happens because during bad weather or pitching the propeller moves in and out of the water, causing the change in load on the engine.
12. Scavenge space fire / Exhaust trunking fire
13. Poor scavenging or leaky exhaust valve

How to Prevent Turbocharger Surging -

The following are the ways to prevent turbocharger surging. However, it is to note that some points may vary with design and construction of the turbocharger.

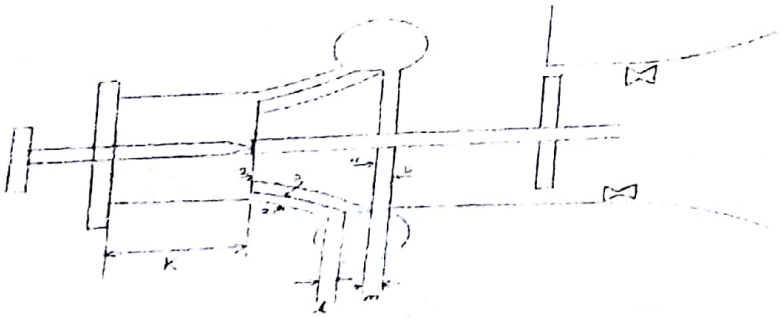
1. Keep the turbocharger intake filter clean.
2. Water-wash the turbine and the compressor side of the turbocharger.
3. Proper maintenance and checks should be done on turbocharger periodically.
4. Soot blow should be done from time to time in case of economizer or exhaust boiler.
5. Indicator cards to be taken to assess cylinder and power distribution of individual units

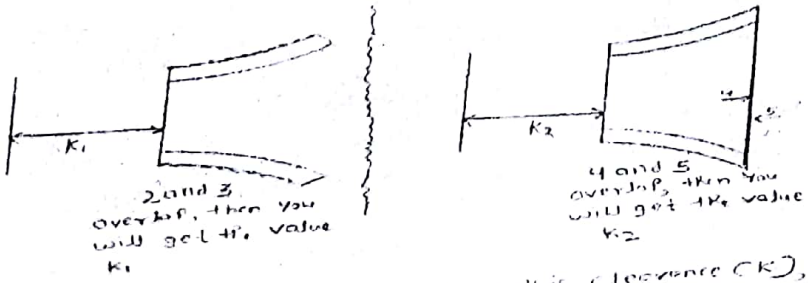
Note – So finally the conclusion is that mismatching is the reason for turbocharger surging

Q – What different values you need to check after boxing back of the turbocharger (VI)

Ans – To understand this please see the figure below –

After boxing back check the value of K with depth gauge if it was not proper then the most possible cause for this is that your blower side bearing is not properly fixed or settled at his place





Some time Surveyor ask that why to give this clearance (K),
the reason for this is -
1) For axial play
2) For small thermal expansion

Now see in the diagram you need to check the value of m and l – so to calculate the value of these two you need to loose the nut and bolt of the casing and put the eye bolt at the point as shown in the diagram and then push the complete unit to right hand side (turbine side), then again measure the distance with the depth gauge let say it comes K1 this time and now push the complete unit to the blower side and again measure the distance let say K2 this time, so

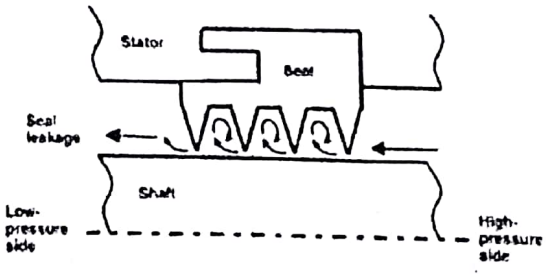
$$K - K1 = m$$

$$K - K2 = l$$

Now you have both the values, so check these value with the instruction manual that it is under the desired limits or not

Q – Draw the diagram of labyrinth seal and explain its principle of working (AA)

Ans - Labyrinth-type seals are used to minimize recirculation losses within the compressor. A labyrinth seal consists of a number of teeth (knife-edges) that can be either stationary or rotating. Stationary labyrinth teeth are fitted to the compressor stationary components very close to the compressor rotor (see Fig. below). Sealing action is the result of flow resistance caused by repeated throttling across the labyrinth teeth. Labyrinth seals are designed so that one of the two adjacent parts (labyrinth teeth and rotor) is relatively soft. The softer material yields on contact without damage to the harder material. Compressor manufacturers select labyrinth seal clearances that are as tight as practical to minimize leakage while avoiding heavy rubbing with the rotor.



Q – Explain the different parts in mechanical seal with diagram (VI)

Ans - **Introduction**

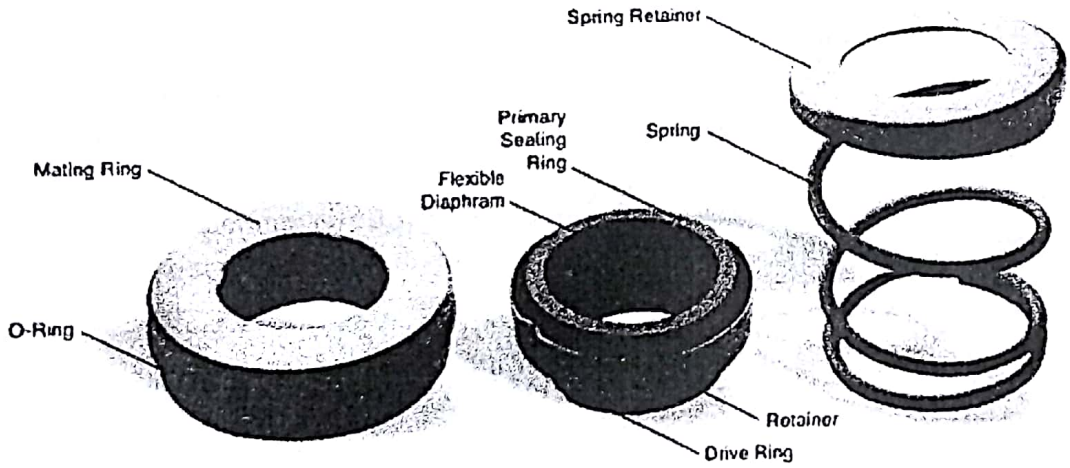
The mechanical seal acts as a check valve and a slider bearing. The obvious function is that of a check valve to prevent liquid under pressure from leaking out of the pump, or from drawing air into the pump when under vacuum conditions.

Seal Life

Since the seal must function as a slider or friction bearing, the seal has an unpredictable life span. The seal of a centrifugal pump is usually replaced many times during the life of a pump. All bearing need lubricant and the seal lubricant is the liquid being pumped. Liquid infiltrates between the contact faces of the primary and mating rings. Some of this liquid does find its way through to the atmosphere but is so slight as to only be noticed as corrosion of 'build up' on the pump adapter. The condition of the pumped liquid will greatly affect seal life.

Abrasives

The number one enemy of a mechanical seal is abrasive particles in the liquid being pumped. Abrasives may be anything from dirt to dissolved impurities in the liquid precipitating out of solution. These abrasive particles infiltrate with the liquid between the seal faces and grind away the carbon primary ring. The normal shiny face of the primary ring and mating ring.



Heat Damage

Excessive heat can damage the seal in two areas - the primary ring and the elastomer parts. The primary ring is made primarily of carbon. Should the pump be operated without liquid - even for a very short period of time - the primary and mating ring faces are denied lubricant. This causes the faces to become very hot. The binder mixed with the carbon breaks down and the face of the primary ring turns to a dull black powder.

The O-ring, or cup, and flexible diaphragm of the seal are made of one of many types of rubber-like substance called an 'elastomer'. The type of elastomertic material is selected to match the temperature limit and types of material being pumped. Should the temperature

limit be exceeded, the diaphragm and O-ring will become hard and sometimes crack. The seal will then start to leak.

Q – What do you understand by the term sfoc and how to calculate it (AA)

Ans - Specific fuel oil consumption is the measure of mass of fuel consumed per unit time to produce per KW. The marine engine efficiency is usually determined using the SFOC.

In order to achieve accuracy, the fuel consumption and power developed is always measured over a suitable time period on a good weather.

Calculation of the specific fuel oil consumption (g/kWh, g/bhph) requires that engine power, and the consumed fuel oil amount, are known for a certain period of time. The engine power (in bhp or KW) can be calculated from the Indicator diagram or from Fuel Pump Index method or from Turbocharger speed. The oil amount is measured for a few hours to avoid calculation mistakes. The engine parameters shoudnot be changed during this period. Since quantity measurements will be in volume units (m3), it will be necessary to know the oil density, in order to convert to weight units (gram). The density is to correspond to the temperature at the measuring point. Density can be calculated on the basis of bunker specifications. Density at 15 deg is available in the BDN (Bunker Delivery Note). The density at required temperature can be calculated with the density correction factor equation. But normally graphs are provided in the manual to find the density at required temperature, where the change in density is shown as a function of temperature.

Temperature Corrected Density can be calculated with the under-mentioned fomula:

Temperature corrected Density = Density of Fuel Oil @ 15 degree Celsius * [1- {(t1-15) * 0.00064}]

Where,

t1 stands for temperature of oil in bunker tanks in degree celcius,

0.00064 is the correction factor,

volume of oil in m^3 (actual sounded volume), is obtained from the sounding table.

Now to understand how to calculate SFOC just take an example –

Effective Engine Power, Po - Say 8,130 bhp (Engine power is calculated from the performance sheet. It can be calculated from the Indicator digram or with fuel pump index or turbocharger method. All methods are explained below)

Consumption, Co - 3.83 m3 over 3 hours

Measuring point temperature - 119°C

Density at 119°C - Specific gravity 0.9364 t/m^3, 3% sulphur

$$SFOC = \frac{Co \times D119 \times 10^6}{h \times Pe}$$

where:

Co = Fuel oil consumption over the period (m^3)

D 119 = Corrected gravity (t/m3)

h = Measuring period, hours

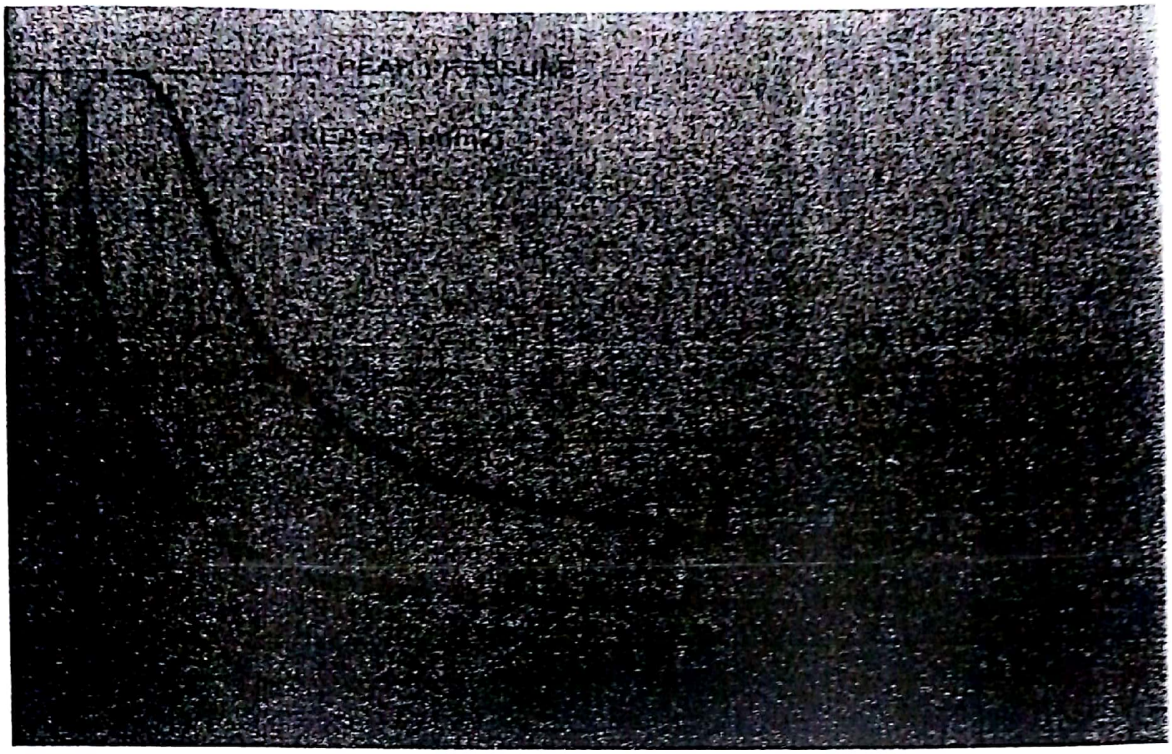
Pe =Brake horse power, bhp

10^6 is multiplied to convert the fuel oil unit in tonnes to gram

$$\frac{3.83 \times 0.8684 \times 10^6}{3 \times 8,130} = 136.4 \text{ g/bhph}$$

Q – How to calculate mean effective pressure with planimeter and indicator card (GA)

Ans



I) Calculation of engine Power with Indicator diagram

For engines with indicator drive or MIP-equipment, we can take the indicator diagram which can be used to find the Mean Indicated Pressure (MIP). Dont get confused between MIP and MEP. Former is the Indicated mean pressure while MEP is the effective pressure availabel after friction losses in the shaft.

Calculation of the indicated and effective engine power consists of the following steps:

Calculate:

- The mean indicated pressure, pi
- The mean effective pressure, pe
- The cylinder constant, K
- The indicated engine power. Pi
- The effective engine power, Pe
- The mean indicated pressure, Pi

Mean Indicated Pressure, pi

Pi (bar) = A x Cs / L

A = A is the area of the Indicator diagram measured with a Planimeter in mm^2

Cs = Spring constant of the drive in mm/bar (vertical movement of the indicator stylus (mm) for a 1 bar pressure rise in the cylinder)

L = length of the indicator' diagram (atmospheric line)

Q – How to calculate the engine power without indicator cards (VI, MA)

Ans – This question is very frequently asked now a days in MMD orals because all the people onboard very much familiar with the indicator cards but if in case your indicator card machine wont work in that case how will you calculate the power, so there will be the some method which cannot give you the exact value but atleast give you a near by value

Power calculation without Indicator Diagram

The estimation is based on nomograms involving engine parameter measurements taken on testbed. the graphs are provided in the manual

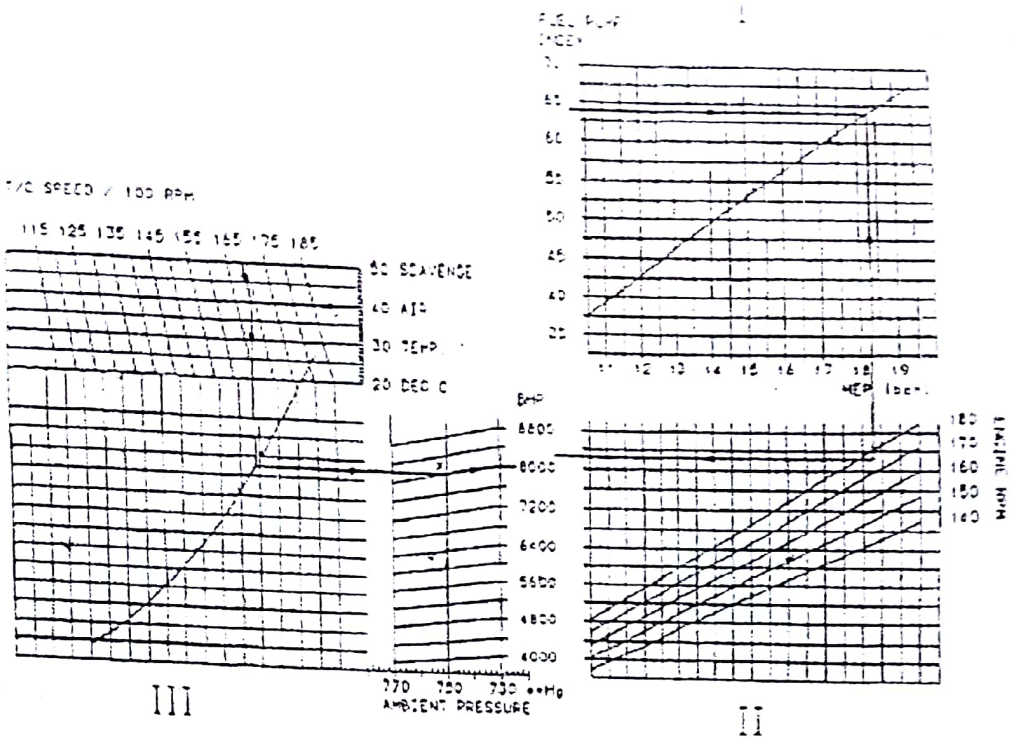
1) Fuel Pump Index method

The fuel pump index is used to find out the mean effective pressure from the nomogram graph. Again form the graph, the mep at a specific speed gives the engine bhp.

This method should only be used as a quick (rough) estimation, because the fuel oil, as well as the condition of the fuel pump, may have great effect on the index. In particular, worn fuel pumps or suction valves tend to increase the index, and will thus result in a too high power estimation.

Chart I: draw a horizontal line from the observed fuel pump index to the nomogram curve, and then a vertical line down to the observed engine speed on Chart II. From this intersection a horizontal line is drawn to the effective engine power scale. (This method is specific for some engines. many other parameters are included to calculate the BHP in bigger engines)

This effective power is used to calculate the SFOC of the engine



(Graph is specific for a type of engine)

2) Turbocharger speed method

This method id more accurate than the Fuel pump index method. Chart III: draw a horizontal line from the observed tscav value and an inclined line from the observed turbocharger speed. From the intersection point, draw a vertical line down to the nomogram curve and then a horizontal line to the vertical tine from the observed ambient pressure (point x in the ambient pressure scale). Finally, a line is drawn parallel with the inclined 'ambient pressure correction' lines. The effective engine power can then be read on the scale at the right hand side, i.e. 8,000 bhp.

Q – Working of different types of governor and explain different terminology related to it (GA)

Ans – Governor function is to control the fuel supply with respect to the load or any other parameter which it is suppose to maintain under all the conditions

Different types of governor

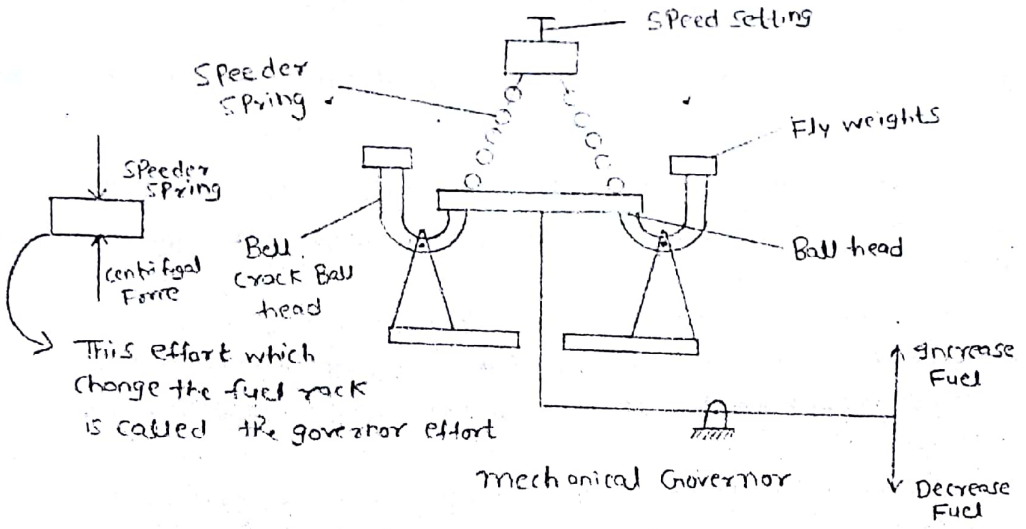
1. Speed control governor (maintain constant speed irrespective of the load)
2. Load sensitive governor (according to the load it control the fuel supply)

3. Speed & Load sensitive governor (mostly used in main engine)

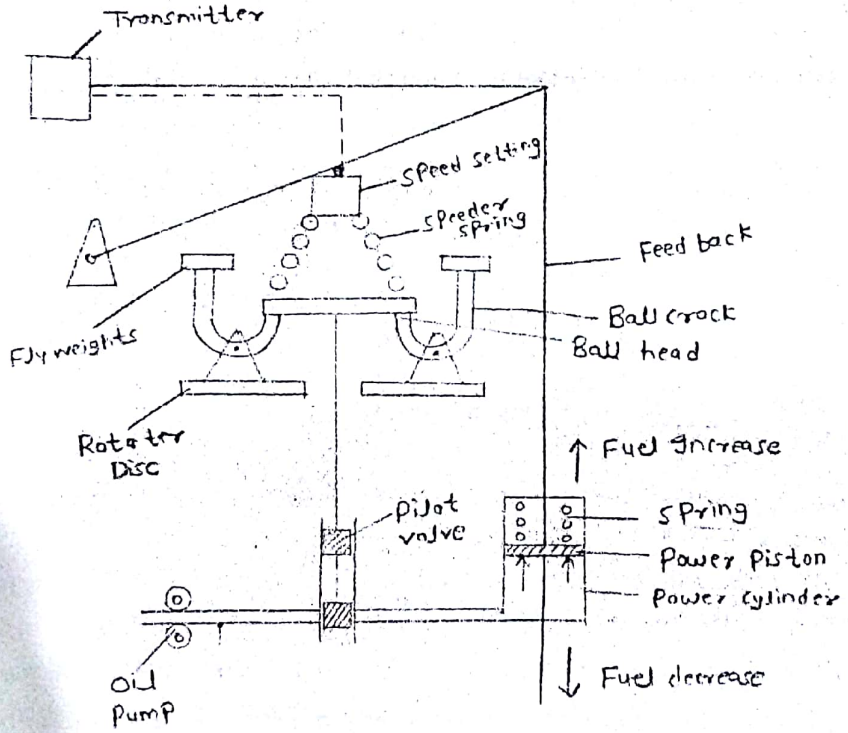
For auxillary engine we use constant speed governor because we have to maintain the frequency constant all the time irrespective of the load

M/E is the variable speed governor it sense both the speed and load which ever is higher that we have to control

Note – Just like in bad weather RPM is dropping but load on M/E is very high so if in that case governor only sense the RPM so they try to increase the fuel and increase too much load on the M/E which may break any part of your engine (extreme critical condition)



Mechanical Governor



Mechanical Hydraulic Governor

Most of the governor are of centrifugal type governor –

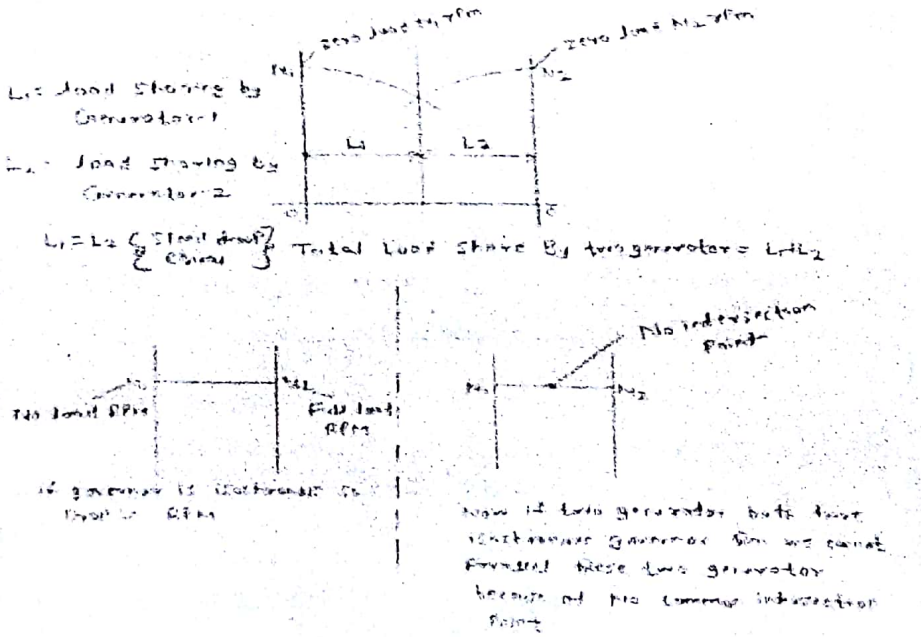
To understand the working of this just check the diagram given below -

1. If we increase the compression of the speeder spring then your engine rpm has been increased
2. Due to the rotation the weight try to move outwards and on the opposite side spring force will act so these two forces decide whether to the increase the fuel or not as shown in the diagram
3. This is the pure mechanical governor which is not used in big engines because force required to move the rack is very high so that much force we cannot obtain from these type of governors that's why we use hydraulic governor now a days.

Hydraulic type governor - To understand the working of this just check the diagram given below –

1. When RPM is more and we need to reduce the fuel then oil from line 1 drains out (small quantity) and because of this power piston comes down and fuel quantity automatically gets control.
2. Now if rpm is less then oil from line 2 goes towards the underside of the power piston by a oil pump and increase the quantity of fuel to the engine
3. Basic principle of working is same only we use hydraulic power to move the rack efficiently
4. Any control system must have feedback else it wont work properly same given in this type of governor as shown in the diagram

Note – Most of the time surveyor ask you a simple question that what is droop and why it is required –



In simple terms I can say drop of speed due to change in load that is called droop because when load is increased the spring compression reduces due to which it run at lesser rpm than the previous rpm that was the characterstic of the governor

Let's take an example to understand this- your generator is running at 900 rpm @ 0 % load and now load increase to 100 % so now the rpm becomes 891, so now how to calculate the droop –

%Droop = (No load RPM – full load RPM / No load RPM) x 100

So in this case,

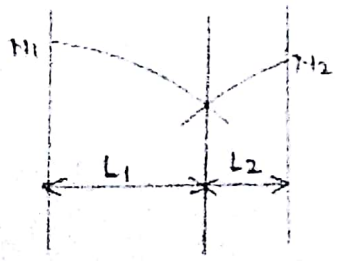
(900 – 891)/900 x 100 = 1 % Droop

Note – Your droop should not be too high else your generator could not be able to maintain the frequency and it will trip

But the main point is that why droop is required – if droop was not there then it is impossible to parallel the two generators, for better understanding just see the diagram below –

If droop is zero it means your governor is isochronous governor and two generator which contain two isochronous governor we unable to parallel that governor because they don't have any line of intersection as shown in the diagram above

Note – Surveyor favourite question is that you are on watch and you parallel two generators but you notice that one generator is taking more load as compare to the other what could be the reason for that – if you fully understand what I told you above then you can easily able to answer this question but still I can try to explain my best to you, just see the figure below for better understanding –



Generator 1 droop setting is less as compare to generator 2 so as load increases rpm of generator 1 not drop so much but generator 2 droop setting is high so its rpm drop suddenly when we increase the load, so the point of intersection tell you that generator 1 share L1 load which is much more than L2 load as share by the generator 2. So to rectify this problem you have to decrease the droop of generator 2. So that it can also share the same load.

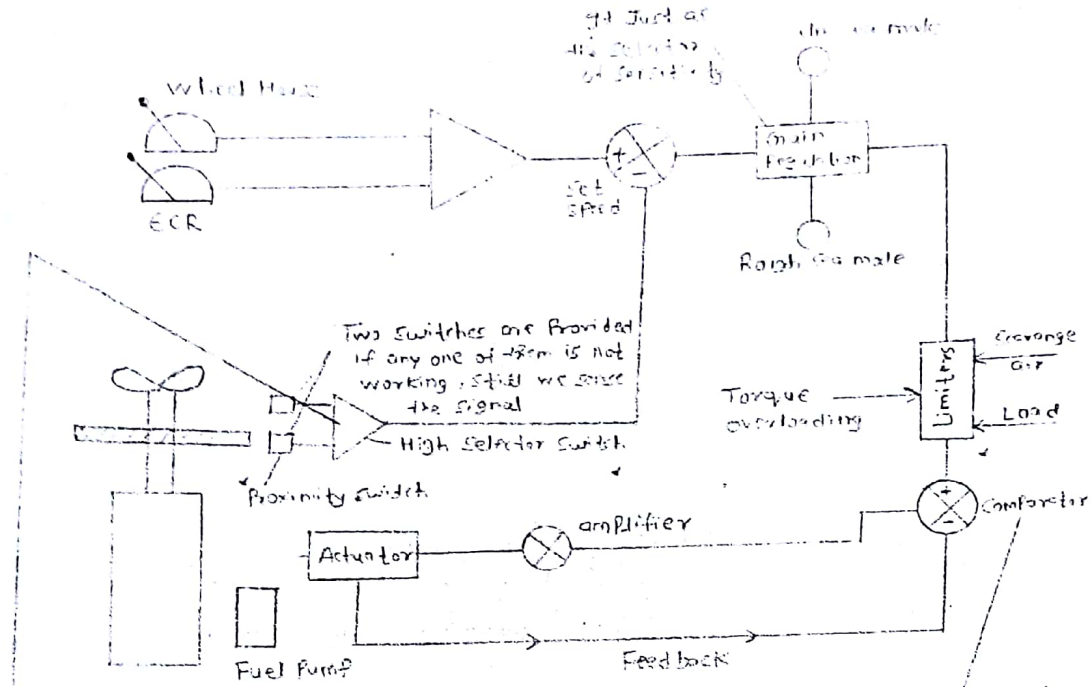
Note – Most of the people have the confusion that if load suddenly changes then how governor maintains the frequency or rpm, for to understand this lets take an small example – if you start the ballast pump so suddenly rpm of the generator drops and it may trip your generator on low frequency so that's why governor has two actions, first action has been taken by the load sensor so that it will supply the excess fuel so that drop in speed should not occur much and fine setting is been done by the speed sensor so that we can maintain the desired rpm. So this is the basic of governor in our next article we will talk about the electronic governor

Q – Explain electronic governor and why it is used so much now a days (SA)

Ans – Electronic governor we are using just for the sake of alternator life (Quick response by the electronic governor with respect to the load variation)

Basic understanding of the electronic governor you will get from the diagram given below –

Main engine governor – one of the important term that mostly surveyors asked that what is deadband in the governor – To understand the concept of deadband lets take an example that your engine is running at 800 rpm and if rpm goes to 790 so governor try to increase the fuel and when rpm goes to 805, governor will try to reduce the fuel, so like this it will keep on increasing or decreasing the fuel so that term is called hunting and we cannot able to achieve the stability so we set the deadband just like if rpm goes to 795 from 800 so governor will not take any action same on the other side if rpm goes to 805 from 800 governor should not take any action so from 795 to 805 governor wont take any action so this band is called dead band



* Feed back always to give at -ve terminal Because of to stabilize the system.

* This is AND Gate. So which ever the signal is of high amplitude, it will allow to pass that only.

Now I try to explain some basic terminology which is given in the diagram above –

1. In rough sea mode we have to reduce the rpm because propeller coming out of water so in that case we have to reduce the deadband and increase the sensitivity of the governor may it cause hunting of the governor but our main aim is to avoid the overspeed of the main engine which is one critical case during the rough weather
   Note – Deadband is less our sensitivity of governor is more and vice-versa
2. Function of limiter – Depend upon the condition it will limit the fuel supply to the engine. So that in case of rough weather he will make sure that in any condition

engine should not be overloaded. So limiter will check each and every parameter before supplying fuel to the engine

3. Scavenge air limiter – Just in case if you don't have sufficient air pressure in the charger air receiver and you increase the fuel then at the outlet you will get the black some so limiter sense the same and give signal to governor that to reduce the fuel
4. Load limiter – Normally we put the knob of load limiter to 10 means 100 percent. But in the condition of bad weather our rpm is not so high but load already reached to 100 percent so in that case governor wont release the fuel else our engine becomes overloaded
5. Torque overloading – This thing is not in our hand, it depends upon the nature. We didn't load the engine as according to the load wise condition but still your torque is more because of the weather condition

Note – Torque overloading means that same power you developed @90 rpm

Power = 2 x pie x rpm(N) x Torque (if your rpm(N) is low but still the power is same it means the value of Torque is high) that means torque overloading this was the worst condition for the engine

Torque overloading condition is more dangerous because this was the time your liner cracking, piston ring breaking take place.

Torsion meter is also fitted on the ship sometime or it is given in the governor itself.

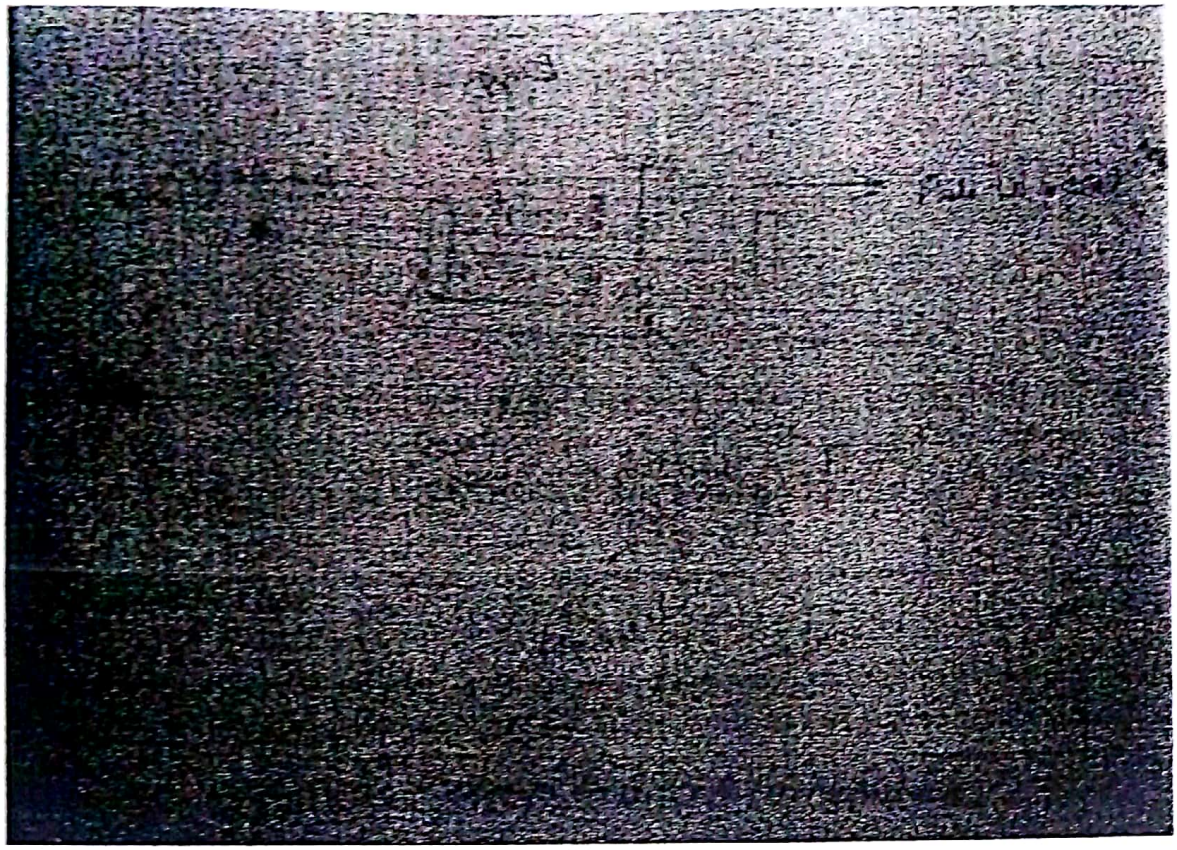
In case of load limiter or torque overloading case governor cut off the fuel but in case of scavenge air limiter it will restrict the flow of fuel not completely cut off the fuel just like in other two cases

Note – So final conclusion is, limiter check all the parameters but it control that parameter or governor work according to that parameter which was on the higher side

Q – What is overspeed trip and how to test overspeed trip in generator and main engine (AA)

Ans – This question belongs to electrical but still surveyor ask this question in motor because this was one of the critical trip, which avoid the engine to run on overspeed.

To understand how this trip will work see the diagram below –



Due to increase in speed the fly weight goes outward and one point will come when that weight hit the above point A, so due to this complete shaft B tilt downward with respect to the pivot point. So now because of the spring it will push the lever C to the fuel cut off side.

Overspeed trip don't have automatic reset, you have to manually reset it once it will get activated

Overspeed set point –

1. In generator it is 10 to 15 % of MCR
2. In main engine set point is not to be more than 10 percent

How to test overspeed trip in generator – In generator governor we have the speed knob setting, so just keep on increasing the speed and finally at one point of time when engine trip on overspeed. But actual overspeed trip is not good for engine so before performing this trip just reduce the setting and perform it because our main aim is to check that the trip is working or not.

How to test overspeed trip in generator – As we know in electronic governor we have the ramp generator, which generate the false signal and then we can check that on overspeed the main engine will trip or not but before doing this make sure your selector switch should be on test mode. Normally in main engine we never perform the actual overspeed because it may damage the engine so we always generate the false signal

Note - 1. Governor is the controlling device and overspeed is the safety device. Governor has the modulating control and overspeed has two mode either give fuel or completely cut off the fuel

2.Overspeed is the separate system not with in the governor, because overspeed occurs when your governor is faulty.

Surveyor mostly ask this question that due to faulty governor overspeed take place and fuel still keep going inside the engine so what will you do –

1. First put the canvas to the turbocharger blower side (to stop the air supply to the engine)
2. Take the fuel pump rack to zero and also operate the puncture valve on the fuel pump
3. Operate emergency stop (because at that time our main concern is to save the engine)

Once engine has stopped after overspeed then you have to do the complete check of the engine – 1. After taking all the safety precaution go inside the crankcase and remove bottom end bearing

2.Check connecting rod for bend and cracks

3.Crankshaft deflection to be taken

Note – Most of the time overspeed occurs at the time of starting the engine because at that time governor release the fuel in excess quantity so that engine should able to come over inertia, after that governor role is to take back the fuel rack.

In fuel line we have the mechanical stoppers also which restrict the fuel rack to go inside the fuel pump so in that case your governor is okay, but your fuel rack may only go upto 60%

One important point to note that before transferring control from ECR to W/H at that time make sure your fuel rack setting is same both in ECR & on W/H, else if fuel rack setting in E/R is zero so the time you transfer control to W/H from ECR your engine suddenly stops without any warning.

Q - What is a tie rod bolt pinch screw? And what is its purpose (GA)

Pinch screw is normally provided at the foot of the engine cylinder jacket to stop the tie rod from vibrating during the normal service of the engine.

The pinch screw is fitted at the antinodal point of the tie rod to limit its transverse vibration amplitude, thereby preventing its fracture due to vibrations. These can be arranged as a

group of three screws positioned equilaterally at the antinodal point. Each screw consists of a stud, which is hand tightened by screwing the outer sleeve and held in place by a lock nut which is tightened to a torque specified by the manufacturer.

Q – What are the symptoms and causes of exhaust gas temperature rise (MA)

Ans – There could be the number of reason which are given below –

1. Thermometer defective (local or remote)
2. Load on the engine is too high
3. If the size of hole in injector nozzle becomes enlarged due to which proper atomization will not take place and lead to rise in the exhaust temperature
4. Incorrect timing of the fuel pump
5. Bad quality of fuel or incorrect fuel treatment
6. Fouling of Exhaust Gas Passageways - Combustion products build-up on the turbocharger nozzle and the surface of turbine blades, clogging the exhaust gas passage and reducing turbocharger efficiency.
7. Fouling of the Scavenge Air Ports – If we give excess lubrication then that oil stuck on the scavenge ports and also clogging of the scavenge ports because of the combustion product which goes down because of the blowpast in the unit

Q – One unit exhaust temperature drop what could be the reasons (RA)

Ans – On board we only much worried about increasing exhaust gas temperature but sometime we found one unit exhaust temperature is on low side with respect to other units, so there could be the number of reasons for that –

1. If exhaust valve not opens so sensor unable to sense the exhaust outlet temperature but this is a worst case scenario
2. If injector hole has been chocked so adequate quantity of fuel has not been supplied to the unit
3. Some time fuel pump badly worn out and so many internal leakages takes place so again it effect the quantity of fuel supplied.
4. Some time itself control system is faulty like sensor or thermometers which give the wrong reading on the panel

Q – If your engine running irregularly what could be the possible reason for that(RA)

Ans – Irregularly means that engine is misfiring, no proper combustion inside the engine etc.

1. Quality of the fuel oil is not proper (water content may be too high inside the fuel)
2. Fuel pump or booster pump worn out so because of this it unable to develop the proper fuel oil pressure
3. The size of the injector nozzle increased too much (so proper atomization of fuel is not there which cause after burning)
4. Governor malfunction due to which it will not able to send the proper quantity of fuel oil inside the engine
5. Turbocharger surging

Q – Engine turns on air but not on fuel, what could be the possible reason for that (VI)

Ans – There could be the number of reasons for that, which are given below –

1. Seized delivery valves or broken plunger springs in injection pump.
2. Injectors are not overhauled from a long time so there may be the possibility that holes are choked.
3. Water is present inside the fuel (bad treatment of fuel)
4. Pre-set control air to the governor is too low
5. Fuel oil booster pump or supply pump filters are not cleaned from a long time (chocked filters)
6. Malfunctioning of the governor (unable to release the excess fuel at the time of starting
7. Mechanical stopper wont allow the rack to go inside the fuel pump (check locally)
8. Fuel lever on local manoeuvring stand is not inremote mode
9. The trips have been not reset after the last stopping.
10. Level of fuel oil in service tank is low and gauge give you the wrong reading in ECR
11. By mistake puncture valve of the fuel pump is operated so because of that

Q- What could be the reason of increase in jacket water temperature (MA)

Ans – On these type of questions most of the people can able to give the answer but still surveyor fails you because the reason is that he just want to listen as much reason which is possible for this because that show your intellectual level of thinking, so in these type of question I try to cover as much as possible valid points –

1. Jacket water controller itself malfunction (this was the thumb rule that before going for any big point like liner cracking and all that, first check the basic thing)
2. Temperature control setting was inappropriate
3. Defective sensor at the outlet side

4. There may be the possibility of crack in liner or in cylinder head, so because of that high temperature exhaust gases may enter into the water side (but in this case you notice black smoke at the header tank and found black smoke at the funnel)
5. If sufficient lubrication is not provided between piston and liner so there may be the possibility that piston is running hot and also scratch the liner, which could increase the jacket water temperature
6. If engine is overloaded, which mostly take place during bad weather or because of the incorrect timings may increase the jacket water temperature
7. Because of no proper venting there should be the air lock in the jacket water system (for that reason expansion line is there in jacket water system which sometime may block)
8. Insufficient flow of water because of the blockage in the line

Q – Engine does not fire, possible reason for that (RA)

Ans – There could be the number of possible reasons for that –

1. Puncture valve of the fuel pump is operated because of that short circuit take place inside the fuel pump and nothing is going inside the engine
2. At the time of starting governor has to release the fuel in excess but due mechanical stopper it unable to release the fuel
3. No proper treatment of the fuel like inappropriate temperature and viscosity due to which no proper atomization
4. Starting air pressure is too low which can not able to give the proper kick to the engine (unable to attain minimum start rpm)
5. Compression pressure is too low and no sealing is there, because of the wear down of the piston rings
6. Injector hole is blocked due to which less quantity of fuel goes inside the engine
7. Worn out fuel pump plunger (due to which all effective timing will be altered)

Q – Engine not reversing or starting in only one direction, possible causes for that (SA)

Ans – There could be the number of possible causes for that which are given below –

1. If the engine is running in one direction and reversed, propeller continues to run in that direction. Therefore, more air and fuel is required for starting against the propeller force (first to bring the propeller to standstill like braking). If the engine still does not start, i.e. opposite to the given movement. Therefore the rotational direction safeguard blocks the fuel

2. The reversing servomotor of the fuel or start air distributor is jammed or gets stuck before reaching a new end position due to insufficient oil pressure. Therefore the engine turns on air, but no fuel is released as the rotation direction safeguard blocks it.
3. Start air valve for that unit is sticking . The remedy is to give a kick in the opposite direction. Now a different unit will receive start air due to change in the crank position.

Note – In this type of situation the best way is to give the kick in other direction

Q – If your piston is cracked, how will you get to know out (VI)

Ans – There could be the number of indication with which you get to know out –

1. At the time when piston going to BDC (oil or water) which ever type your piston is (oil or water) goes to the scavenge side and you will notice a high quantity of drain in scavenge drain box tank.
2. If your piston is water cooled then you will notice a white smoke at the funnel.
3. If your piston is oil cooled then you will notice a bluish smoke at the funnel
4. If your piston is water cooled so there will be the separate tank for that in which you notice a exhaust particle or black film on the top of the water
5. If it is oil cooled then temperature of the oil suddenly increases and the whole lube oil system is contaminated because of the combustion
6. You will notice a knocking sound when that particular unit reaches TDC

Reason of piston cracking – There could be the number of reasons for that which are given below –

1. If you suddenly increase or decrease the speed at the time of starting or sometime you may bypass the load up program for the engine, due to which high thermal stresses will be induced on the piston, liner or on the cylinder head
2. If your piston is oil cooled then there may be the possibility that your nozzle holes hs been blocked due to which sufficient cooling has not been there
3. Some time your telescopic pipe break in between so no cooling oil will be there inside the piston crown and due to this inadequate cooling piston may crack (if telescopic pipe break then you will notice that piston cooling oil outlet temperature is very low)
4. At the time of manoeuvring we have to supply the lube oil in excess quantity because we keep on starting and stopping the engine several time during the time of manoeuvring (if excess oil or adequate oil is not provided then piston may run hot)
5. If injectors are dripping so the change of after burning is very high, which put excessive thermal stresses on the engine components.

6. If engine is too much overloaded

Q - If your liner is cracked, how will you get to know out (SA)

Ans – There could be the number of indication with which you get to know out –

1. At the time piston goes to TDC or at the time of combustion, the pressure inside the cylinder is high so exhaust gases goes inside the jacket water and you will notice black smoke at the header tank
2. At the time when piston goes to BDC so the pressure inside the cylinder is low, so at that time jacket water come inside the piston and you will notice the white smoke at the funnel

   Note – Some time surveyor asked why the white smoke at the funnel, because of the evaporation of water particles
3. If water is kept on evaporating then after some time or suddenly depend upon your size of crack you will get the water low level alarm in the header tank
4. You will notice a lot of fluctuation in jacket cooling water pressure because of the high temperature exhaust gas enter into the jacket water system, which also increase its temperature
5. You will also get the knocking sound when piston comes to TDC (if leak is excessive then large quantity of water is accumulated over the piston crown and we all know that liquid is incompressible)

Q – Lube oil sump level rising, what could be the possible causes for that (GA)

Ans – There could be the number of possible causes for that which are given below –

Note – Before checking for the machinery error, first check the human error because these type of condition mostly occur because of the human mistakes –

1. By mistake if you lined up the wrong valve from the storage tank to wrong generator
2. If you forgot to shut off the sealing water to the purifier then continuously water will go out with the lube oil and increase the sump level
3. Lube oil purifier wrongly lined up may the discharge valve of some other purifier lined up with some other generator
4. Transfer pump valves wrongly lined up
5. If outside weather is rough then you will get the alarm because of the heavy rolling and pitching
6. If you are on the port and you will get the alarm then possible cause is due to change in the trim of the ship because in port mostly loading/discharging is going on.

Q – Individual piston knocking at TDC, possible causes for that (RA)

Ans – There could be the number of possible causes for this –

1. Excessive clearance between piston and cylinder, so the time piston reaches TDC compressed air leaks out from the sides with the sound
2. Faulty timing of the individual fuel pump (check VIT & FQS setting)
3. Overloaded engine unit (check effective delivery stroke of respective fuel pump)
4. Top piston ring strikes against the ridge worn at the cylinder liner top (for to remove that ridge we are using anti-polishing ring now a days)

Note - Its basic that fuel will be injected before the piston reaches TDC during a compression stroke(while traveling up). This is because the fuel requires some time to ignite and release power.

The amount of degrees before TDC by which injectors starts injecting fuel is determined by Cetane rating.

Cetane rating determines the gap between injection timing and combustion timing. If cetane rating is high ,then time between ignition and combustion will be less . Similarly the other way lower cetane rating , more is time period between injection and combustion.

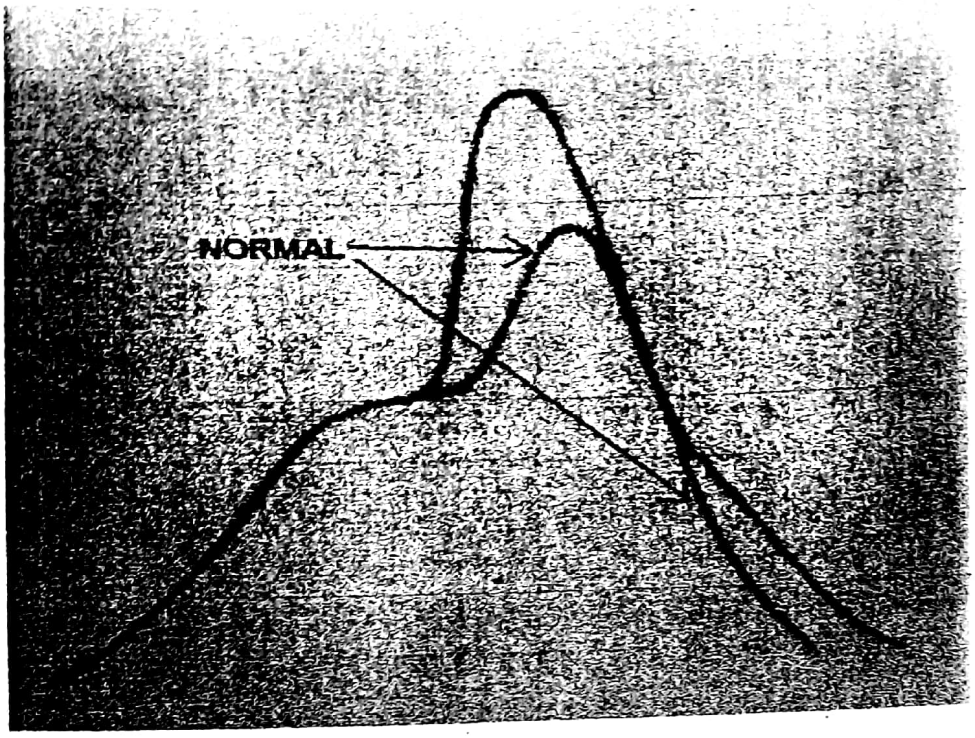
So if the fuel quality is bad so it take more time to burn and chance of after burning will be more which is also one of the reason of knocking

Q – Analysis of all the indicator diagram with graph and causes of it (AA,VI)

Ans – These type of graph very frequently asked in MMD orals because indicator card/draw card give you the complete picture that what exactly is going inside your engine, with that you can able to know the complete details like peak pressure, compression pressure, fuel oil quality, operation of the exhaust valve, injector, fuel pump and so many more things you can easily make out with these graphs. So that was the only reason why it is so much important to know, so below I try to cover as much as possible –

Irregularities in the shape of indicator diagrams are indications of faulty engine operations. If irregularity seems for all units, problem may be common like faults in fuel oil system, intake air, turbocharger, air cooler, exhaust, etc. When the irregularity is confined to a single unit, problem could be of fuel injectors, fuel pump, exhaust valve, etc.

Early Ignition



Indications and Effects

Abnormally high peak pressure of the unit is recorded at the top of the piston stroke.

Knocking sound comes out of the engine due to heavy loads passed to bearings via running gear.

Early ignition causes increased thermal efficiency of the engine. Also exhaust temperature reduces since combustion starts long before it is supposed to. But the shock loads and vibrations results in damage of the engine.

Causes

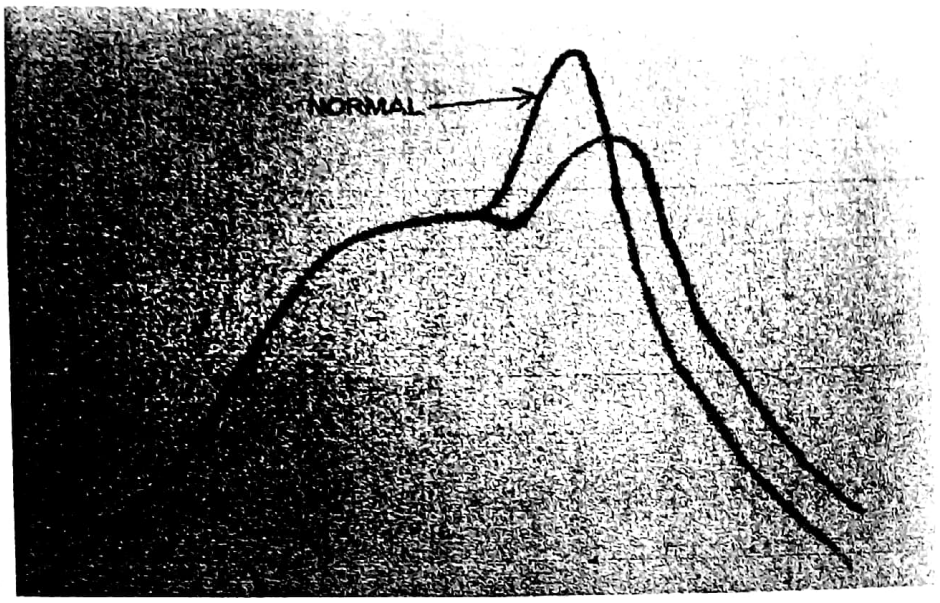
Incorrectly adjusted or accidentally changed fuel pump timing

Damaged or incorrectly set fuel valve or fuel injector

Undesired fuel quality

Parts inside the cylinder are overheated.

Late Ignition



Indications and Effects

Low peak pressure is indicated for the unit after top dead center.

Combustion continue during expansion stroke, give rise to incomplete combustion of fuel, loss of energy, elevated exhaust gas temperature for the unit, and black smoke at the engine exhaust.

Reduced power of the engine due to incomplete combustion of the fuel and energy lost in the exhaust.

Causes

Faulty fuel injector or injector spring tension tighten beyond setting.

Poor fuel quality

Wrongly timed or leaking fuel pump

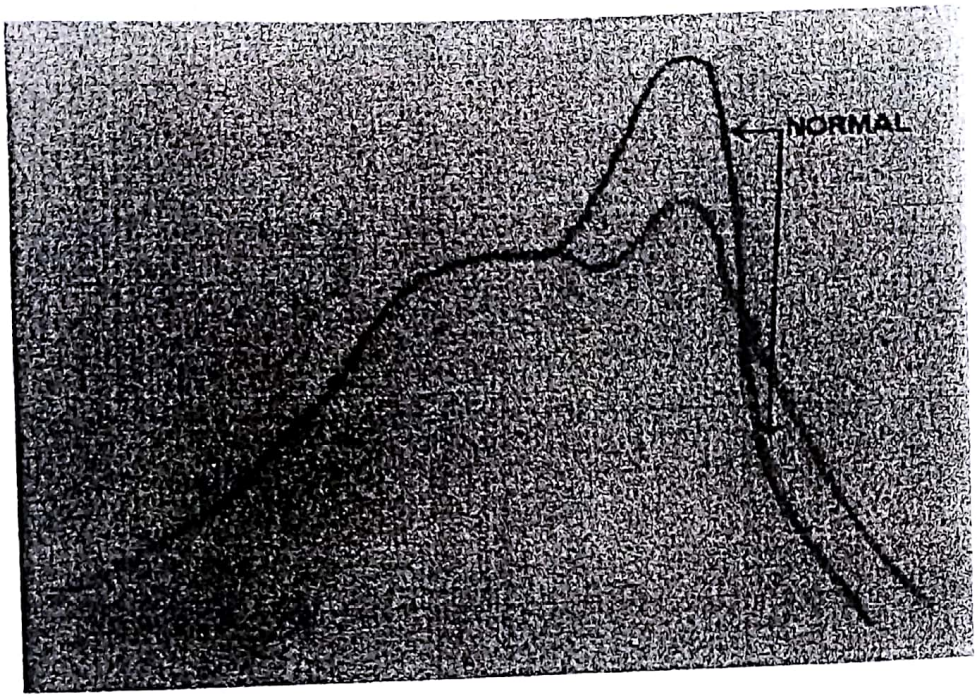
Engine parts inside cylinder are under cooled

Incorrect atomization

Compression pressure low

Combustion air supply is low

After Burning



Indication and Effects

A rise in expansions line is recorded in the later part of piston stroke

Since burning of fuel continues, exhaust gas temperature and pressure increases, causing black smoke at engine exhaust.

Unburnt carbon deposits fouls exhaust system, cause damage to exhaust valve and seat, turbocharger surges and there are chances of uptake fires in exhaust gas economizer.

Elevated temperatures inside cylinders cause breaking up of lubrication and increased wear of liners, piston rings, burning of piston crown, etc.

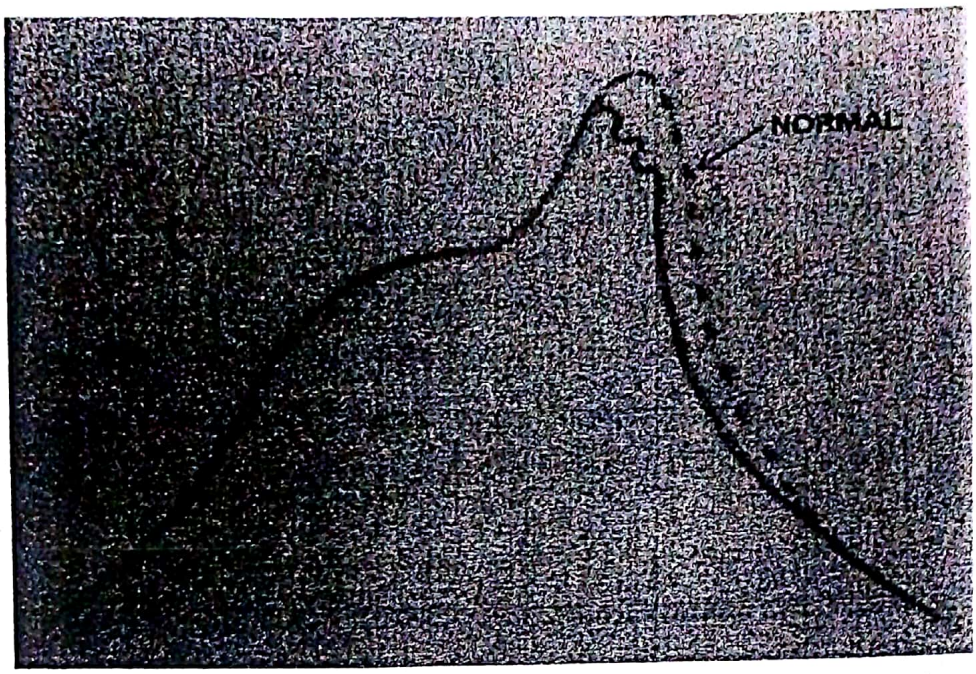
Causes

Slow fuel combustion

Quality of fuel is less

Low temperature of fuel (Means high viscosity)

Leaky Fuel Injector



Indications and Effects

Reduced power in the affected unit, high exhaust temperature and presence of black smoke in exhaust.

Possible knocking sounds or pressure waves in fuel injection system.

Sudden up and downs in indicated diagram in the fuel injection and expansion side.

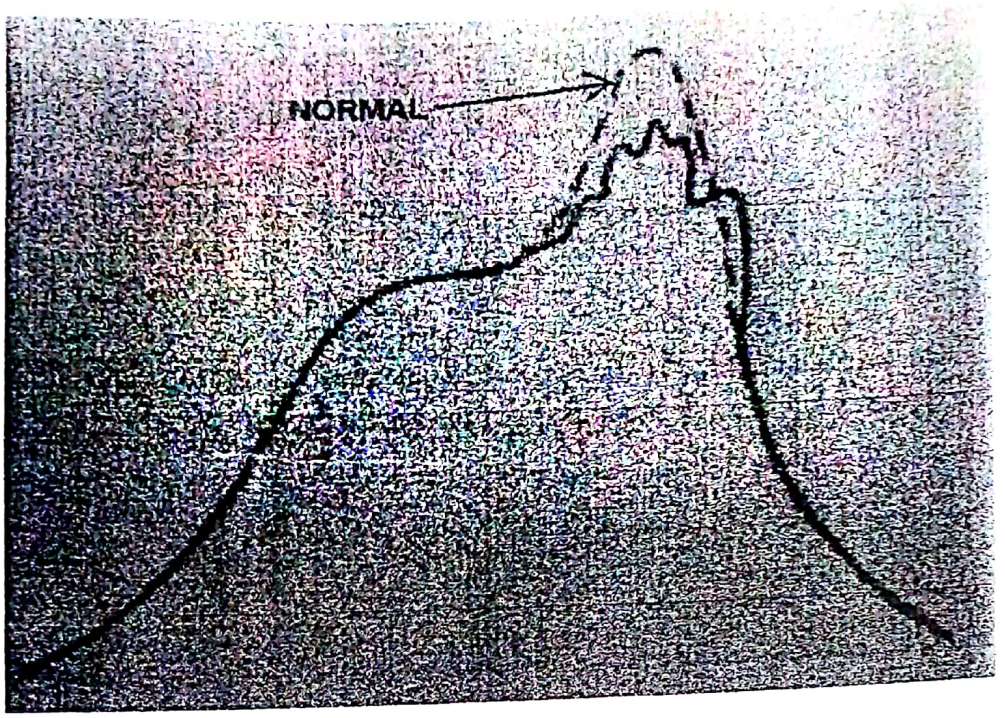
After burning due to incomplete combustion of fuel.

Causes

Leaking fuel injector.

Chocking of fuel injector spray holes, which leads to improper atomization and dripping of fuel.

Partly Choked Fuel Valve



Indications and Effects

Low exhaust gas temperature of the unit

Power card and draw card indications

Loss of engine power

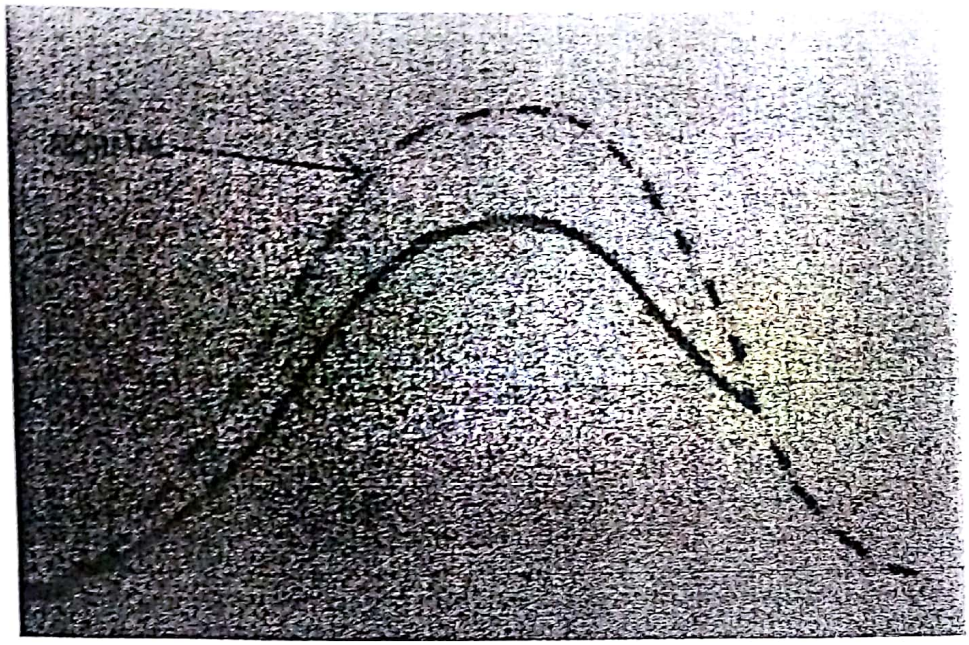
Causes

Fuel oil contamination and improper purification

Carbon formation at injector tip

Carbon deposits on fuel valve due to over heating

Low Compression



Indications and Effects

Low pressure in the indicator card

Reduced power of engine

Causes

Improper combustion

Insufficient air for combustion

Leakage of air in between piston rings and liner while compression stroke due to worn out liner or piston rings.

Q - Analysis of all the light spring diagram with graph and causes of it (AA,VI)

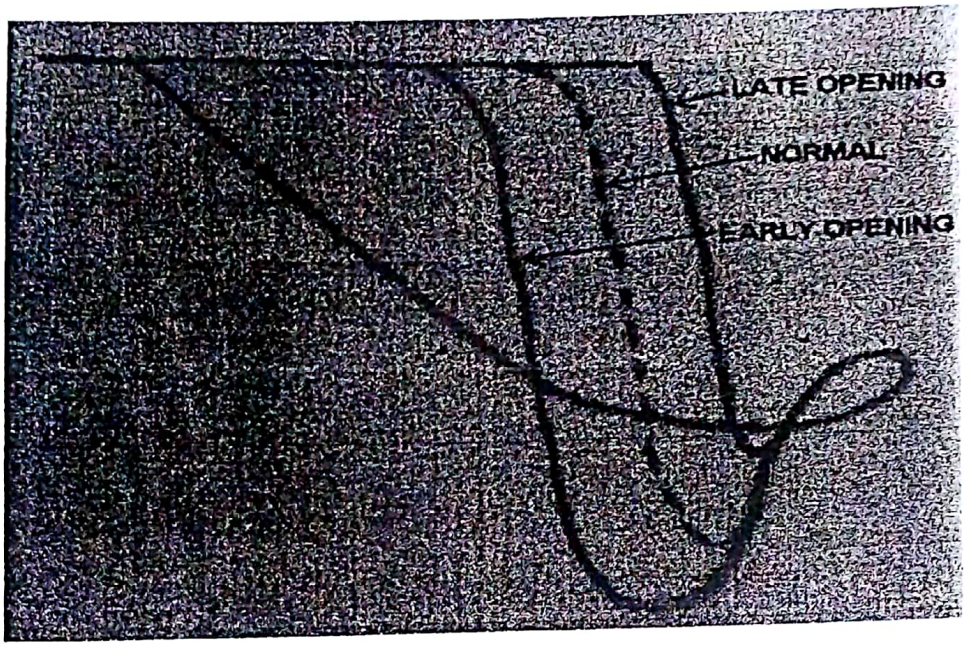
Ans - This diagram are taken for determining the pressure variation in the cylinder during the exhaust and scavenging periods

The diagram shows-

1.Choke exhaust ports or valves

2.Loss of scavenge air

Exhaust Valve Opening



Light spring diagram gives indications on faulty exhaust valve and intake port operations.

Early Opening

Elevated exhaust gas temperature and fouling of exhaust system

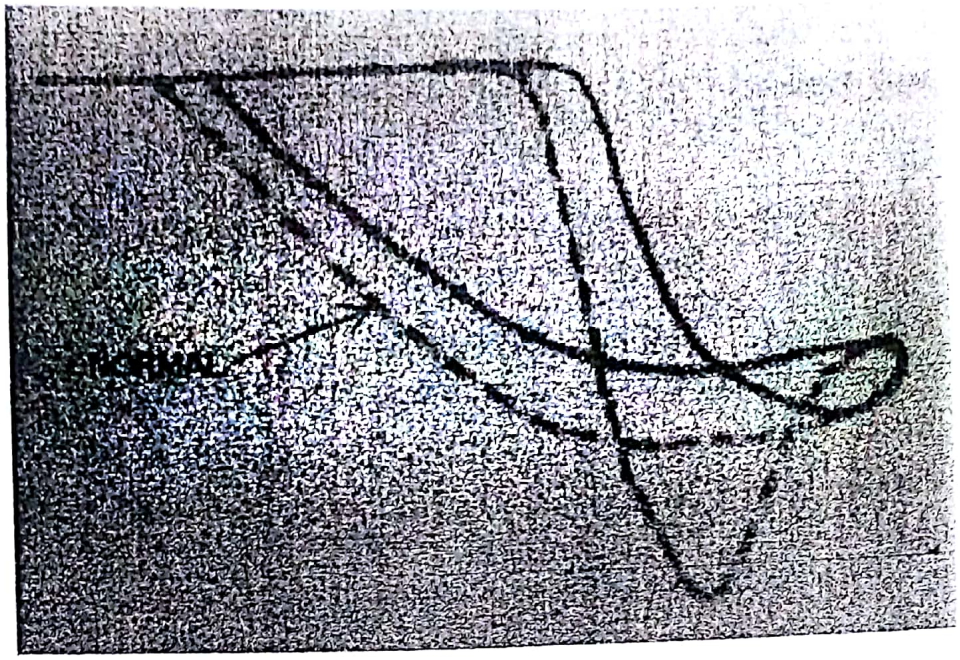
Loss of engine power

Late Opening

Reduced blow down effect and hence reduced scavenging efficiency

Low quality of exhaust gas delivered to the turbocharger inversely affect its operation

Choked Exhaust



Indications and Effects

Power loss in the unit

Increased exhaust temperature

Turbocharger surging

Adversely affect scavenging efficiency

Causes

Improper combustion

Increased cylinder lube oil

Q – What all indicator diagrams we use onboard the ship and what is the significance of all (MA)

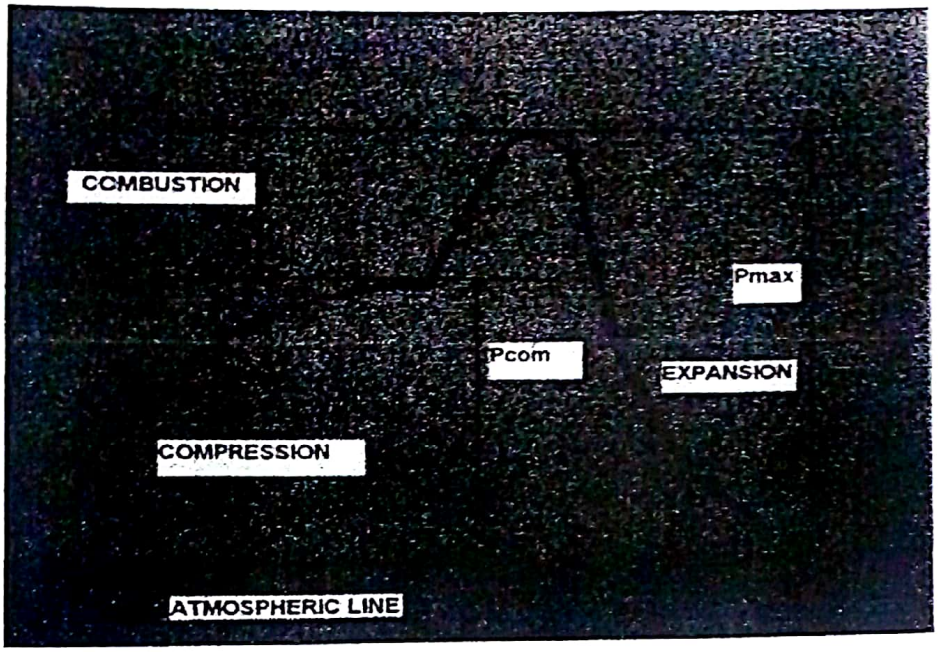
Ans – 1. The indicator diagram is very important to know the combustion in the cylinder and also to adjust the engine.

2.The diagram is taken periodically from the indicator valve equipped on he cylinder head and combustion condition is to be confirmed.

3.The compression pressure and maximum pressure in the cylinder can be presumed from the indicator diagram.

4.Engine indicator is the device used to take the indicator diagram, which can be considered as a 'stethoscope' for diesel engines.

5.Indicator diagrams give efficiency of combustion in the cylinder, condition of the running gear, irregularities in fuel pumping and injection and a lot of things.



Pcom – Compression Pressure

Pmax – Maximum Pressure

There are 4 types of indicator diagrams that can be taken from the engine cylinder to know the condition and performance of the engine.

1. Power card / Power indicator diagram
2. Compression diagram
3. Draw card / Out of phase diagram
4. Light spring diagram

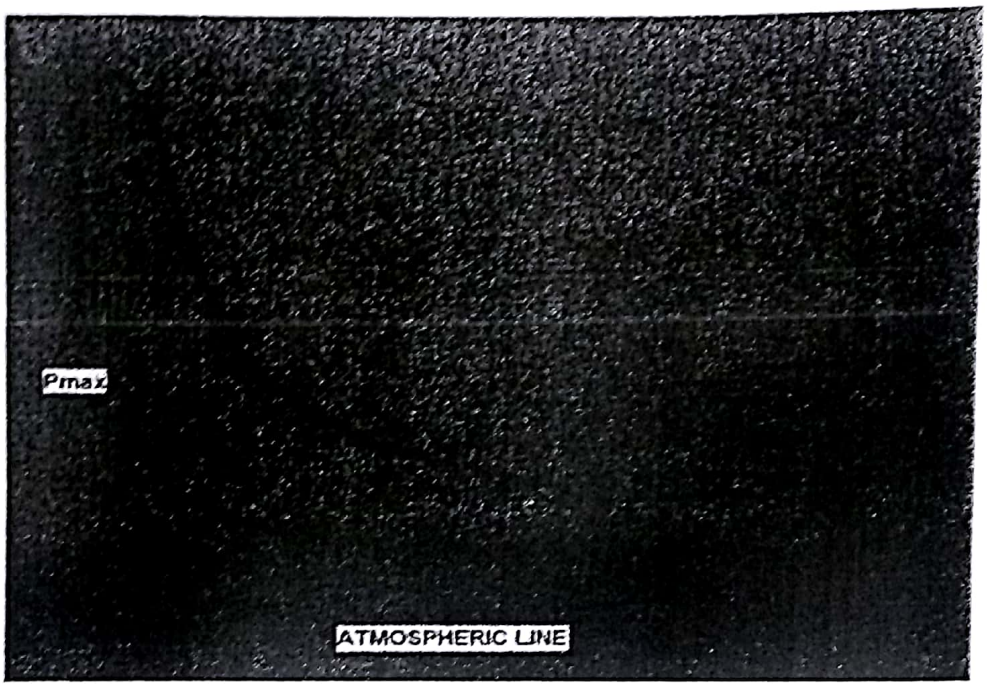
The area of indicator diagram is calculated by

Planimeter (Usually used on board)

Mid Ordinate Method

Power Card

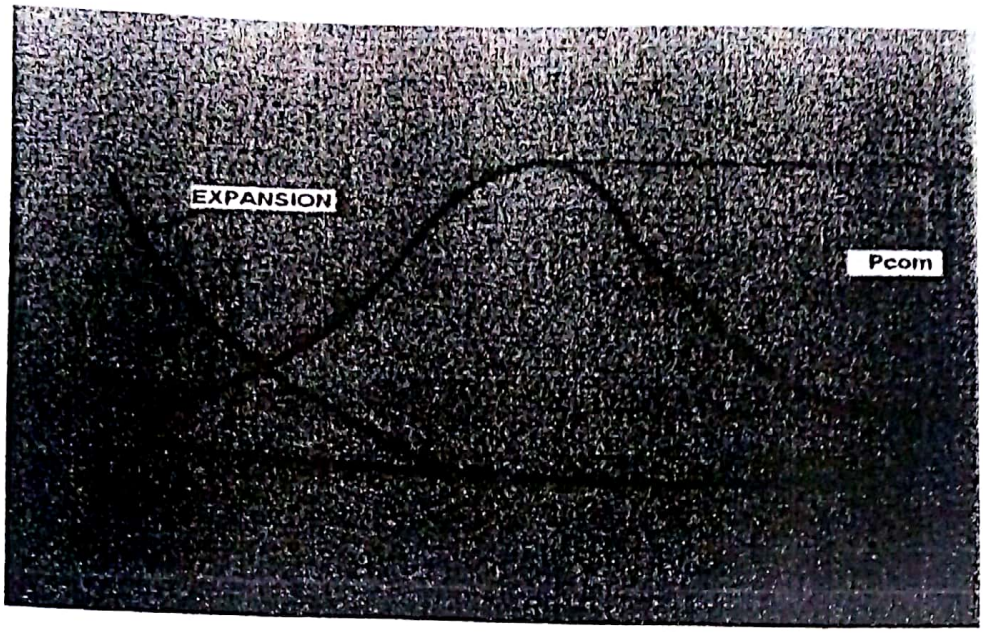
1. Power card is taken with the indicator drum rotating in phase with the piston movement
2. The area within this diagram represents the work done during one complete cycle to scale
3. Mean Indicated Pressure (MIP) is obtained from this diagram to calculate power produced in the cylinder



POWER CARD

Compression Diagram

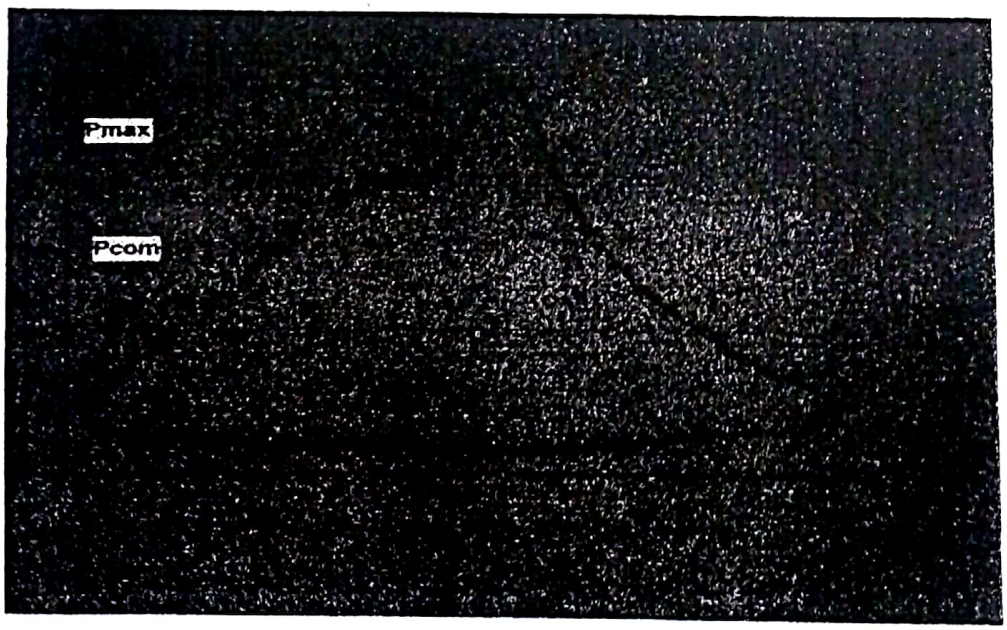
1. Compression diagram is taken in similar manner to the power card but the fuel shut off in the cylinder
2. The height of this curve shows maximum compression pressure
3. If the compression and expansion line coincide, it indicates that indicator is correctly synchronized with the engine
4. Reduction in height of this diagram shows low compression which may be due to worn cylinder liner, faulty piston rings, insufficient scavenge air or leaky exhaust valve



COMPRESSION DIAGRAM

Draw Card / Out of Phase Diagram

1. Draw card is taken in a similar manner to power card with fuel pump engaged but with the indicator drum 90 degree out of phase with the piston stroke
2. This diagram illustrates more clearly the pressure changes during fuel combustion. Fuel timings or injector faults may be detected from its shape

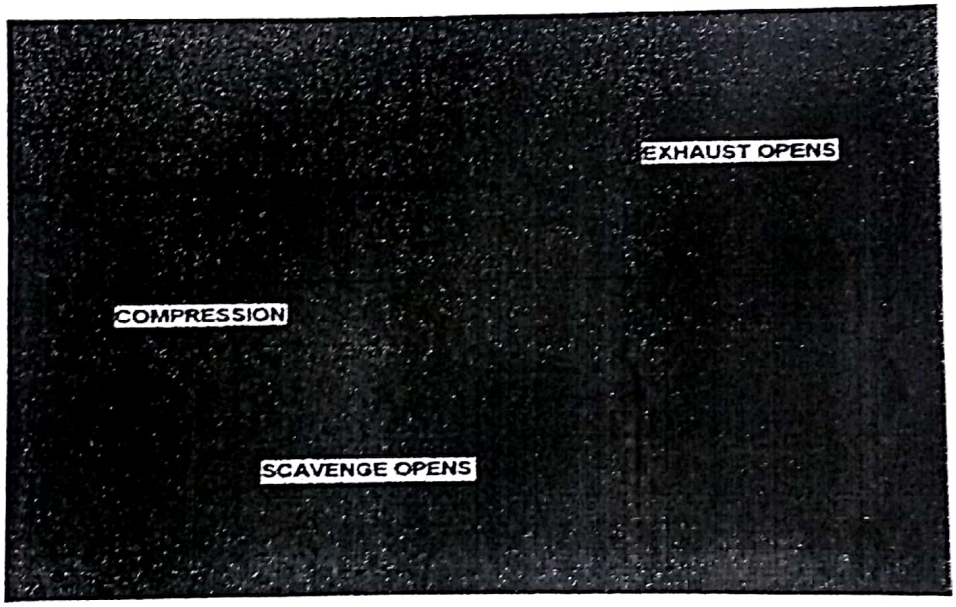


DRAW CARD

Note – Surveyor mostly asked that why the indicator drum 90 degree out of phase with the piston stroke because some engines are provided with special indicator gear drive that can be set at 90 derees out of phase and you can get perfect draw cards without manual turning of the indicator instrument drum. When such gear is not provided you are trying to do the same thing but it is nearly impossible to get a perfect 90 degree out of phase card. With some acquired skill you can get a draw card manually which may not be perfect but good enough for you to study the changes in pressure with crank angle and get an idea of the working of the engine

Light Spring Diagram

1. Light spring diagram is taken similar to the power card and in phase with the engine and with a light compression spring fitted to the indicator
2. This diagram shows pressure changes during exhaust and scavenge to an enlarged scale
3. It can be used to detect faults in these operations



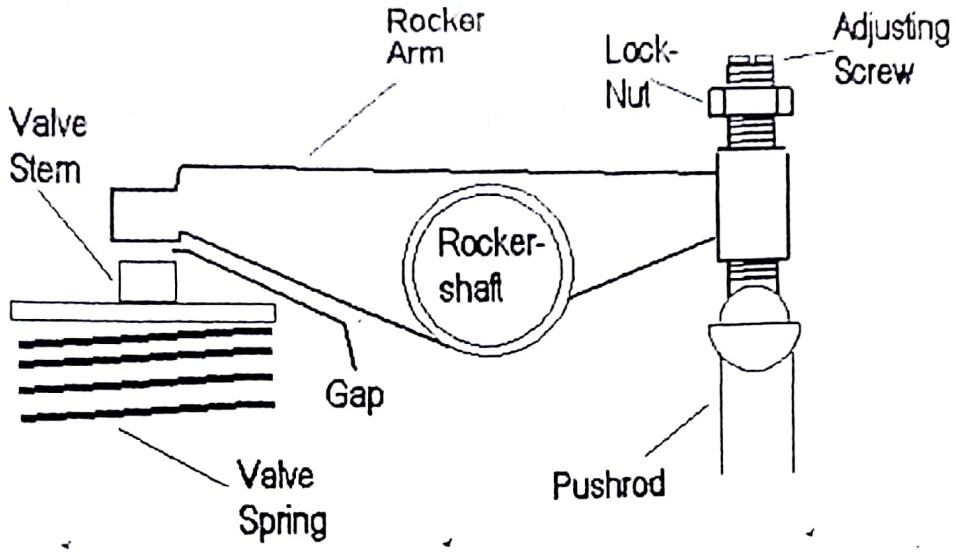
LIGHT SPRING DIAGRAM

Q – What is tappet clearance and how to take the tappet clearance (MA)

OR

Q –What are the different methods with which you get to know out which unit at TDC (MA)

Ans –



How To Check Tappet Clearance

1. Taking all safety precautions.(like take out from stand by, close the breaker, close priming pump etc)

2. Make sure the piston is on TDC. (To find out this all methods are explained below)

3. Make sure the engine has cooled down.

4. Loosen the lock nut of the rocker arm.

5. Now adjust the tappet clearance between the rocker arm & valve stem by tightening or loosing the nut below the lock nut.

6. Use feeler gauge to adjust the suction valve clearance as .35mm an exhaust valve clearance as .45mm (Exhaust v/v clearance is more because it always face the hot gases so there chances of expansion is more)

What will happen if tappet clearance is less:

i. Valve will open early & close late

ii. Air induced through inlet valve may leak out. So, less air for combustion.

iii. Power will be reduced.

iv. Fuel consumption will increase, engine may become unbalanced, exhaust temp. will be very high.

v. In worst condition, valve may remain open, resulting in loss of compression pressure, burning of exhaust valve, T/C fouling will increase.

What will happen if tappet clearance is more:

i. Valve will open late & close early.

ii. Lesser heat energy to T/C, so reduction in scavenge air & hence power.

iii. No proper removal of gases.

iv. Hammering of valve stem-may cause damage to valve stem.

How to know which unit piston is at TDC -

During the maintenance of a four stroke marine diesel engine there are times when we must know whether the particular unit's piston is at the top dead center of not. For example when checking the tappet clearances of the engine it is important to know which unit is at TDC.

Referring to the flywheel would indicate two units, but only one can be at injection TDC. So which one is it?

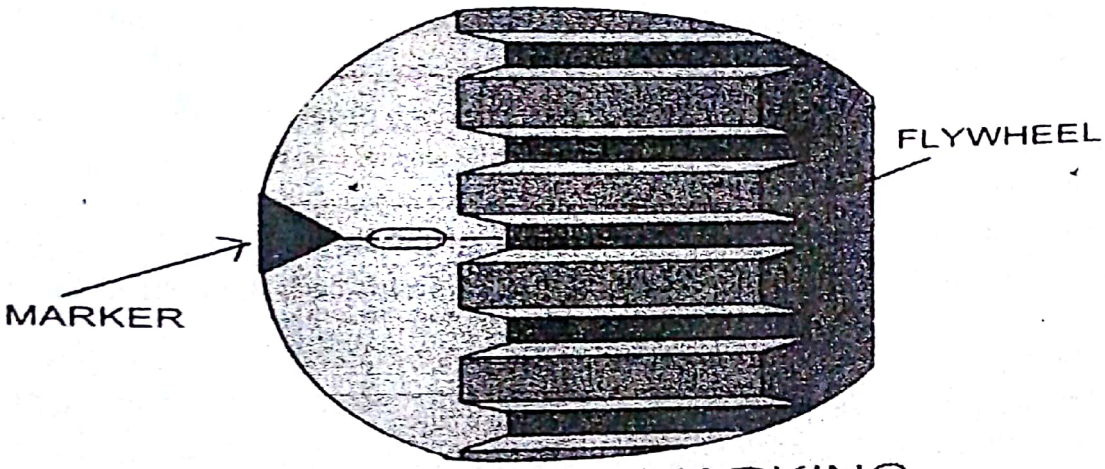
In this answer the various methods to find out the position of the piston would be discussed. Some are very simple using conventional methods. Other methods are a little bit complicated, but nevertheless important whenever you require an independent method to find TDC.

Flywheel Method

The flywheel is the simplest method to know which unit is at TDC. If the fly wheel shows two units, simply open the bonnet covers and check visually. The unit at TDC will have both the inlet and the exhaust valve closed and hence relaxed springs; the other unit would have both the arms of the rocker arm at different levels. In addition the push rods of the unit at TDC would be loose and can be turned by hand because of the release of the clearances. There is a word of caution however: this method is only useful in a working generator which you have just stopped to check the tappet clearances. In case you have removed the rocker

arms for any reason the spring height and the push rod freeness check would lead you nowhere and misguide you.

Flywheel Marking



FLYWHEEL MARKING

Fuel Pump Method

The most accurate method to know the position of the piston without opening up the piston is the fuel pump window. The fuel pumps have a window and as the plunger goes up and down, so does the mark on the bottom spring holder. On the body of the fuel pump there are cut marks which show the start of injection. In a diesel engine the start of injection is the injection TDC where both the inlet and the exhaust valves are closed. In this injection TDC we can check the tappet clearance. It must be noted however that the injection TDC is not the

absolute TDC as the piston is still some way down depending on the design of the engine. An injection TDC may be around 5 degrees before TDC.

Dial Gauge Method

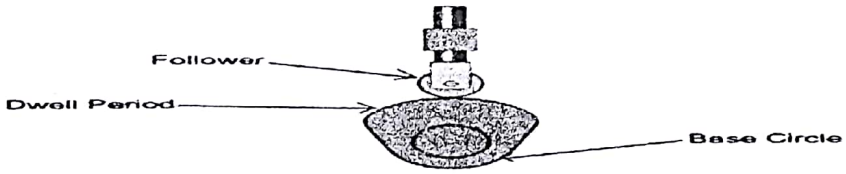
In this method the fuel injector is taken out and from the opening a dial gauge is put inside. Then the turning gear is engaged and the engine turned over. The pointer of the dial gauge

will move in one direction and then stop and start in opposite direction. The moment the pointer of the dial gauge stops and changes its direction of movement is the TDC of the unit. This method is not normally used in day-to-day practice, but may be used in the calibration of the flywheel if it is not calibrated, or after some repairs.

Camshaft Method

The camshaft window of the engine can be opened up and the camshaft inspected. The cam of the engine has a base circle, and acceleration and dwell periods. If the roller of the follower is at the base circle, then the particular valve is closed by spring action. When both the exhaust valve and the inlet valve follower are on the base circle, then the unit is also at TDC. It must be remembered that as a four stroke engine has two rotations of the crankshaft there is one injection TDC where the injection and the combustion take place. The second time the piston is at TDC is when the exhausting of the flue gases take place. It is very important to identify the combustion TDC as tappets have to be adjusted at that point.

Cam Profile



Crankcase Method

In this method the crankcase doors are opened up and the piston is visually checked whether is going up or down. This is the surest method, but a bit cumbersome. It should be used when you have a strong doubt about the other methods.

Valve Spring Method

This is not an independent method but is used in conjunction with the flywheel method. In this method if the flywheel is indicating two units, you can check the springs of both the units. The unit in which the springs are loose is the one at TDC. The caution is that this method is useful for an engine in use. If you have removed the rocker arms during the overhaul and thereafter you want to use this method then it can cause errors.

Push Rod Method

This method is like the spring method and you check that the push rods are free to turn. The unit at TDC will have loose springs. The care that must be taken is that it should be used along with the flywheel method and should be used in a working engine. By a working engine, I mean the engine that was running and has been stopped for tappets adjustment.

Spill Timing Method

This is a very accurate (and tedious) method generally used to check the start of injection in the fuel pump. It will also give you the injection TDC. It is used not in the tappet checking process, but instead to find the start of injection when you have power or thermal balance problems.

Basically in this method the delivery valve of the fuel pump along with the delivery valve spring are removed. There after a special "U" shaped pipe is put in place of the high pressure pipe. After this operation the engine is turned by the turning gear and slowly brought near the expected TDC.

Soon oil will start spilling out of the pipe because the oil is entering from the inlet port, which is uncovered by the plunger. Keep turning the engine slowly and the oil quantity will reduce. The point where the oil flow just stops is the start of the injection. At this moment the plunger of the fuel pump has closed the inlet port and if you observe the fuel cam, you will find the follower is no longer at the base circle.

As this method involves the spilling of fuel, it is called the spill timing method.

Q - Why Concentric Springs Are Fitted For Auxiliary Engine Head (RA)

Ans - Concentric springs are helps to open and close the suction and exhaust valve Following are the reasons for Concentric springs in the exhaust and suction valves

1.If one spring fails valve will be held up by the other spring.

2.The thickness of springs can be reduced.

3.Reduce the space required for one large spring.

4.When frequency due to natural vibration of spring is in harmonic with cam shaft speed, then spring may vibrate axially and surge. This can be avoided by using different size spring one inside the other.

Q – What is the material of inlet and exhaust valves (SA)

Ans – A very good point to note that all the valves are opening inward because the sealing is good

Inlet valve – It is made up of stainless steel

Exhaust valve – Spindle made up of nimonic alloy and **v/v seat** – It is made of chromium molybdenum steel, coated with stellite (It has the high temperature hardness)

Exhaust spindle made up of nimonic – Carbon =1% , Ti = 1%, Mo = 4%, Fe = 1%, Al = 5%, Cr = 15%, Co= 20% and remaining Nickel

Q – How to adjust tappet clearance where two inlet and two exhaust valves are given and what are the advantage and disadvantages of this (SA)

Ans –

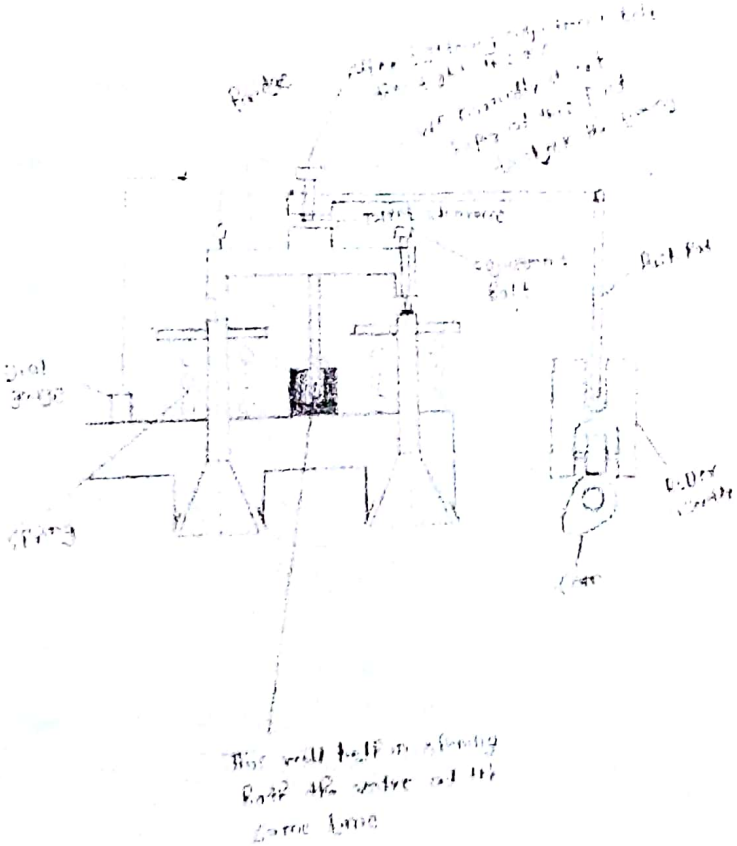
Small in size because we have two inlet and two exhaust valve so sealing is good, less area to seize, less damage t valve and valve seat, maintenance reduces, temperature has been in the acceptable range so life increases.

Note – Sudden load changing has been compensated by these two inlet valve because at the time of load changing we need to burn more fuel to compensate the drop in RPM, so because of these two inlet valve we can draw or get maximum air

Note – The only problem with the two inlet and two exhaust valve is both the valve has to be opened at the same time else all the parameters will be effected and efficiency drops

Now the main point is how to adjust the tappet clearance in this case –

1. First loose the adjustment bolt fully as seen in the diagram and touch the other side to the valve spindle
2. After that start tightening the adjustment bolt and one point will come when bridge start lift up then stop further tightening and you also get to know out from the dial gauge as soon as you notice a minute deflection in the dial gauge, just stop tightening the adjustment bolt and lock it there.
3. After that take the normal tappet between the rocker arm and bridge as previously told above



Note – There will be the number of methods with which you get to know out which unit is at TDC but sometime surveyor ask how you will get to know out when exhaust valve opens and when exhaust valve closes so for that there was the method –

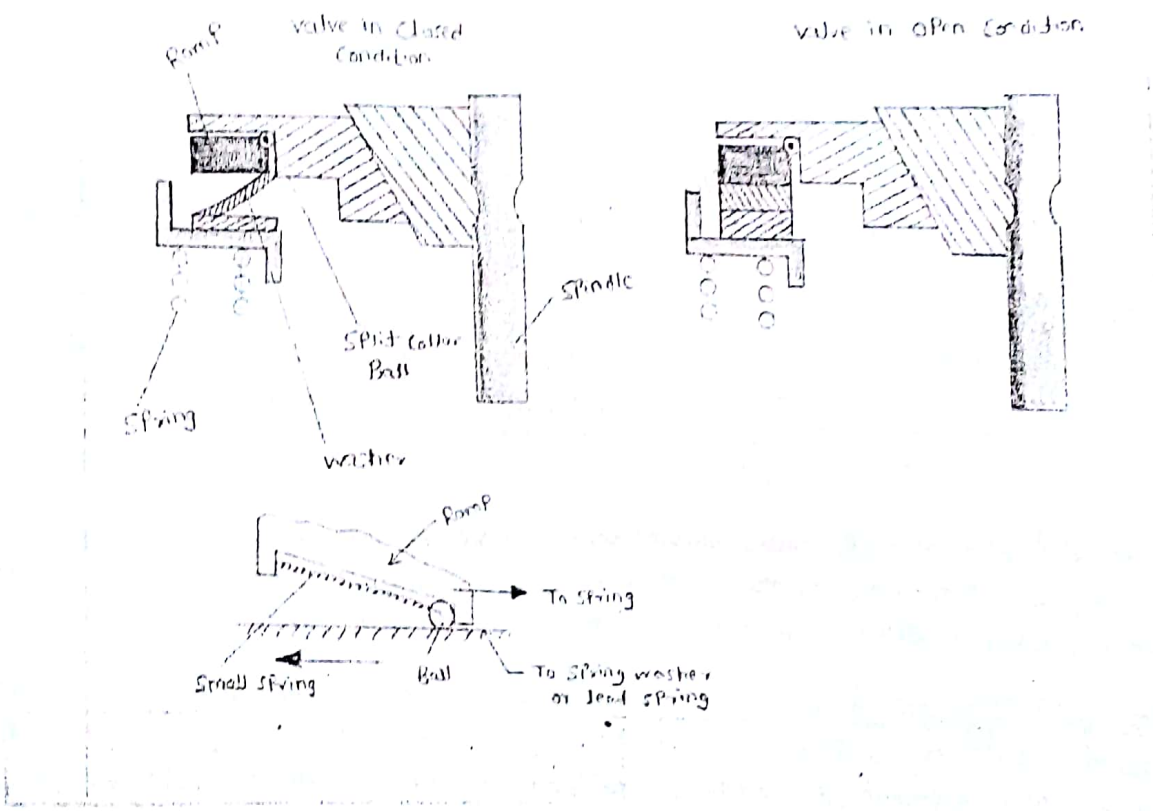
1. Just take one paper and put the paper in between the rocker arm and bridge as shown in the diagram, at the same time keep rotating the flywheel till the time you can able to remove the paper in and out (in between the rocker arm and the bridge) it will tell you that the valve is still not open and the moment you cannot able to take the paper out it simply means that your valve starts opening now that was the opening time of the exhaust valve for that particular unit (same you can mark on the flywheel also). Now again start rotating the flywheel and one point of time you can

able to take the paper out it simply means your valve completely close now (both the angles you can get from the flywheel)

Q – What is the function of rotocap and working of it (MA)

Ans – Most important thing is your valve must rotate on the valve seat because it help in cleaning the seat as we burn large quantity of HFO and due to this large quantity of ash has been generated, so we have to maintain a perfect sealing for that valve must rotate over the valve seat.

Working – To better understand the working of this please see the diagram below-



When the valve open and afterward it going to close so the spring releases its energy to the washer and from the washer it transmit to the ball and due to this ball try to move, but spring wont allow it to move as shown in the diagram, so that energy transfer to the ramp which is fix to the valve and due to this process, the valve rotates.

Note – There will be number of method with which you can check that the valve is rotating or not –

1. At the time of cylinder head overhauling, you can hit the valve spindle with the mallet and before doing this process just put the marking on the valve and body and after hitting with the mallet both the marking is coincide it means the valve wont rotate, then you have to overhaul the rotocaps

Note – The valve normally rotate 5 to 10 degree only not much

Q – How will you get to know out if exhaust valve start leaking and graph for the same (MA)

Ans - Once an exhaust valve does not seat correctly, the high pressure burning gas will pass across the faces of the valve and seat during the power stroke. This will cause the temperature of the valve and seat to rise in this area, weakening the material and distorting the surfaces. The velocity of the burning gas will erode the surface, allowing more gas to leak by. The temperature of the valve in this area will rise further, leading to further burning and greater distortion. The first indication of a valve burning out will be a rise in the exhaust temperature, which will rapidly increase together with a loss of power from the unit.

Vanadium slag deposits which occur at temperatures above 540º C cause corrosion of the valve surfaces which can lead to exhaust gas blow by. This is combated by effective cooling and the use of suitable materials (stellite and nimonic alloys).

Note – When large amount of gas which have excessive heat and pressure pass through the small opening it create the wire drawing effect and due to this valve seat and valve starts burning and you will get the high exhaust outlet temperature alarm

Reasons – There will be the number of reasons which are given below –

1. Fuel quality – fuel contain large amount of sodium, vanadium and chromium sulphate which is not good for the exhaust valve
2. If you run the engine on low load for long time then acidic corrosion takes place.
3. High temperature corrosion also takes place – vanadium is liquid and cannot be removed during purification, but alone vanadium could not cause any problem in the engine, but if it mix with sodium (Na) then it will form vanadium pentaoxide. If vanadium pentaoxide forms then it goes to the valve seat and form a hard film on it so the time valve sit on the seat, then valve break this hard film somewhere so the place where film breaks has the perfect sealing and place where film doesn't break do not have the perfect sealing so, due to this wire drawing effect take place and valve and valve seat starts burning.
   Vanadium + Sodium in the ration of 3:1 forms V2O5 (Vanadium Pentaoxide)

4. Also valve is damaged if valve do not have valve rotating arrangement like in CFC engine there was the mechanical system is provided so maximum problem takes place over there.

Note – If all other unit valves are okay and only one unit valve burn out then reason is that unit valve will not rotate properly

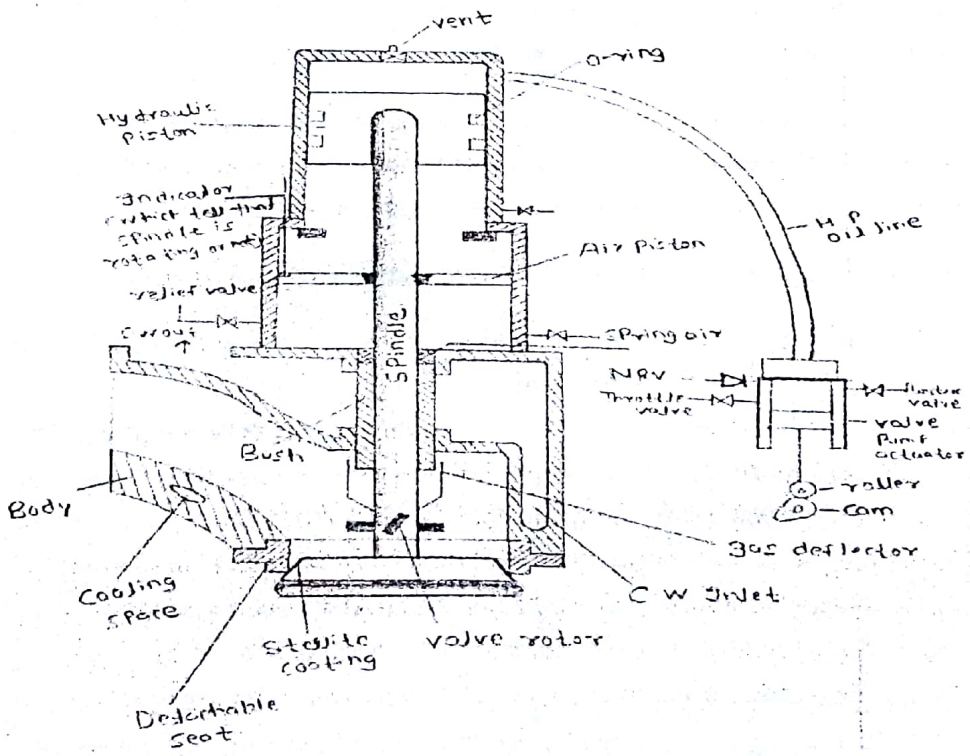
How to make out that valve burnt out –

1. First make out is that unit exhaust temperature keep on increasing
2. Excessive cooling of the valve casing is also not good so for that reason we put the orifice at the outlet side which control the flow rate (because excessive cooling cause corrosion)

Q – Explain Man B&W exhaust valve with sketch and all terminology related to it (VI, MA)

Ans – **Seat** – chromium molybdenum seat coated with stellite

Bush – brass or cast iron



1. It rotate at the time of opening because at that time pressure is high
2. Gass **deflector** – the purpose of gas deflector is not to allow the exhaust gases to go upward
3. Valve open by hydraulic pressure and close by spring air
4. Spring air at 7 bar (under chamber of air piston is filled with air see in the diagram)

Note – To check that exhaust valve of main engine is rotating or not for that one indicator is there on the exhaust valve whose vertical distance is not the same and every time it keep on changing due to the rotation of the exhaust valve

In sulzer there was the ball on which there was the strip and from the sight glass you can check that the valve is rotating or not

5. Hydraulic actuator develop pressure at 120 bar to open the exhaust valve so when exhaust valve opens and line pressure drops now the main engine piston start coming up and pressure inside the cylinder start increasing which suddenly close the exhaust valve and exhaust valve hit very badly on the seat so for that reason one throttle valve is given which wont allow all the hydraulic oil to leak instantly because if this take place then no hydraulic pressure is there on top of the hydraulic piston and cylinder pressure and spring air pressure instantly close the exhaust valve, so for that reason we provide throttle valve as seen in the diagram above
6. The ship in which cam shaft lube oil pump is separate just make sure before starting the pump, you open the spring air else air piston completely comes down and cover the line from where spring air came into the underside of air piston in that case it is very difficult to close the valve
7. **New advancement in exhaust valve** – 1. We put some amount of oil underside the air piston for better lubrication of the spindle because it keep on moving up and down 2.Sealing air supply has to be given so that no exhaust gas should go upward as shown in the diagram above
8. **Note** - Throttle valve also have one more function to perform but before that I would like to make you familiar with one more term which is called virtual tappet, it is to be given in main engine exhaust valve because due to high heat of oil which come in contact with valve spindle there may be the possibility that valve will not close fully because of the expanded oil (due to heat). So for that reason little amount of oil has to be released from the system and this thing has been done by the throttle valve, but throttle valve should not release excess oil else no pressure will be there and exhaust valve hit the valve seat because of no hydraulic pressure above the hydraulic piston this term is called bang-bang of exhaust valve if throttle valve is not properly adjusted.
9. At the time of starting banging is there because vent valve take time to vent the exhaust gases or air but if banging is continuous it simply means that your throttle valve is not properly adjusted.

Note – Surveyor mostly ask this question that what is the role of puncture valve which is provided in the valve pump actuator - In 2stroke engine we want maximum power from the engine that' why we open exhaust valve late and also want to close it late but during astern running we want exhaust valve to open early and close early else it was impossible to run the ship in astern because we don't have any kind of reversing for astern running just as like in for air and fuel, so puncture valve serves the purpose –

1. Puncture valve only work during the astern running of the ship because we perform the reversing only for the air distributor and fuel pump. So puncture valve delay the exhaust valve opening during the astern running of the engine because we didn't perform the reversing for exhaust valve so during normal running (Ahead) if valve opens late then at the time of astern running valve opens early so whatever air comes from the starting air valve that air completely goes out from the exhaust valve and we cannot able to start the engine

Concept of variable exhaust closing – Concept of variable exhaust closing simply mean to close the exhaust valve little early, some time before even closing of the scavenge ports but the main point is that how to do that – For that we have the solenoid valve when signal comes to it then that solenoid valve opens and release some hydraulic oil pressure from the hydraulic line so because of this exhaust valve comes little upward and now the exhaust valve has to travel the less distance for complete closing with respect to the original distance, to completely understand this please see the diagram below –

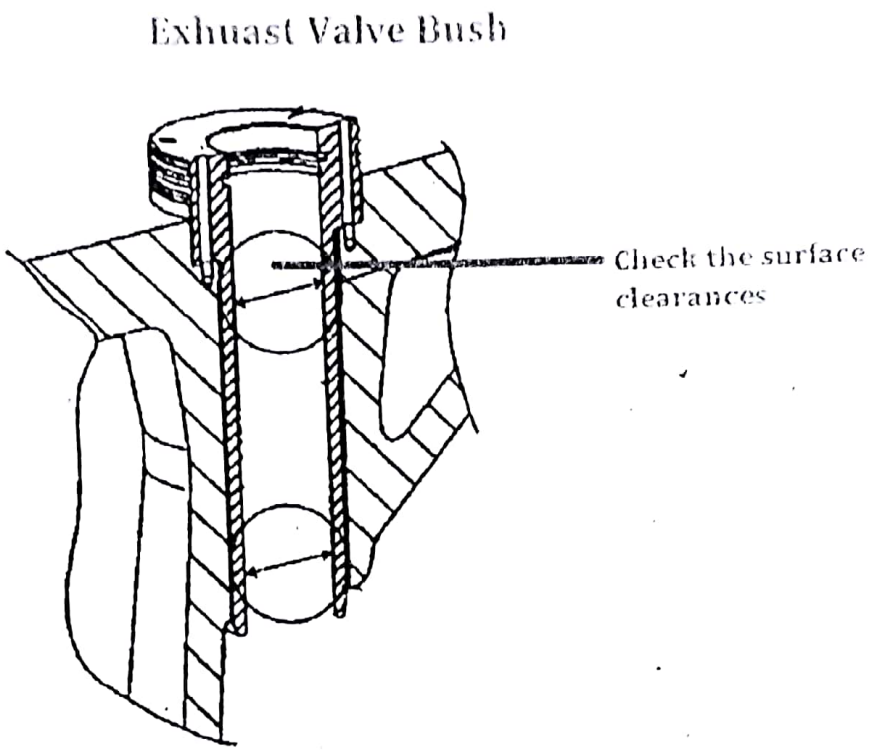
Note – Every early closing will increase the compression pressure by 10 bar that was the reason why concept of variable exhaust closing came into action.

Q – What all clearances need to be checked during the main engine exhaust valve overhaul (SA)

Ans – A very important point to note that valve seat and valve spindle are grind at different angle so that we will get the perfect sealing

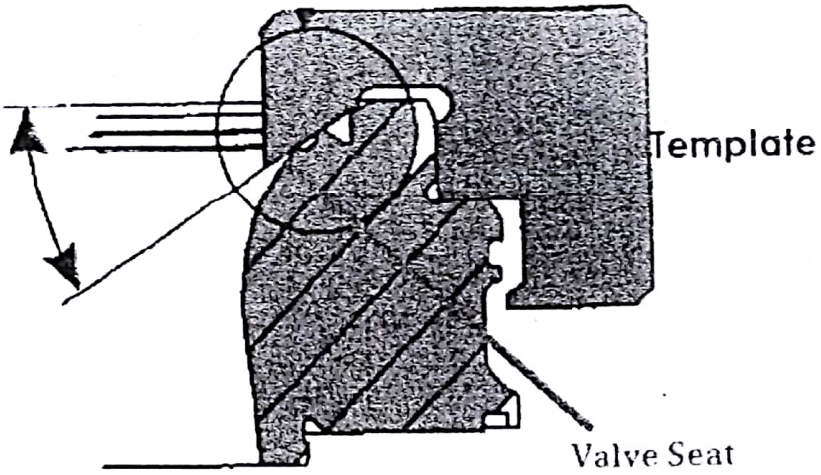
Checking the Exhaust Valve Spindle Bushing

In the diagram below you can see what you have to check. You can use the dial gauge to measure the clearance.



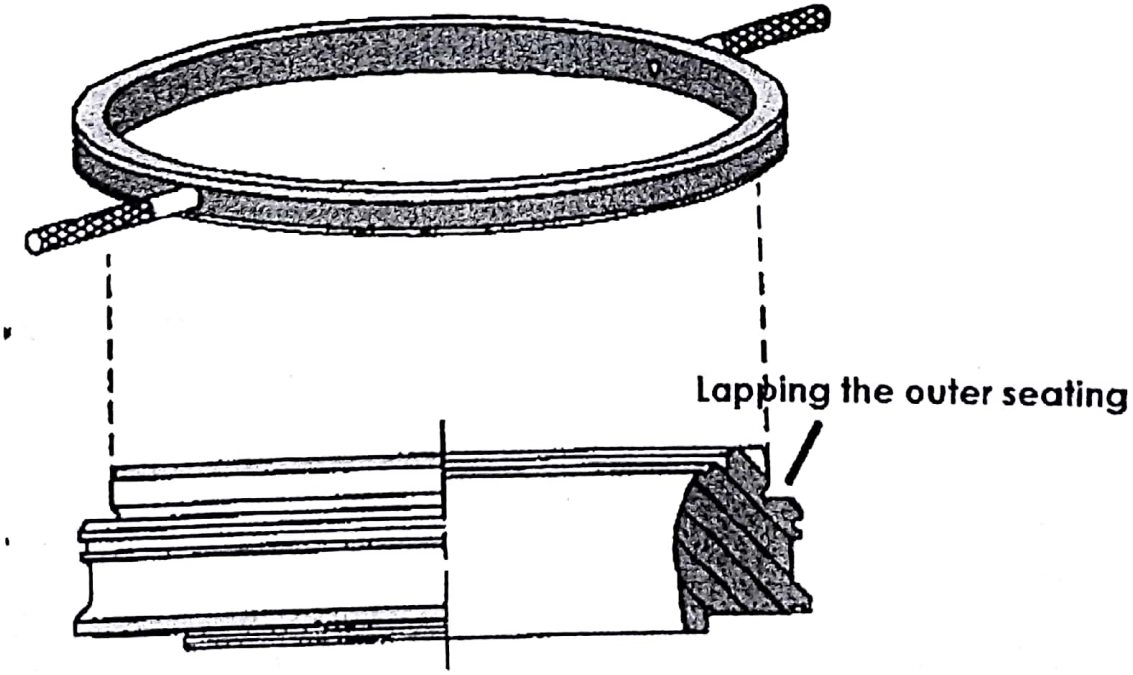
Checking the Bottom Seat Surface

Checking with the help of template, you can check whether clearances are in the right limit or not. Before putting the template, it is wise to remove any type of carbon being deposited on the seat.



Small dents, that cannot hamper the sealing of seat, should be avoided for any repair. But yes, if there are tends and erosion, that are damaging the sealing between the exhaust valve spindle and the seat, then some grinding is necessary.

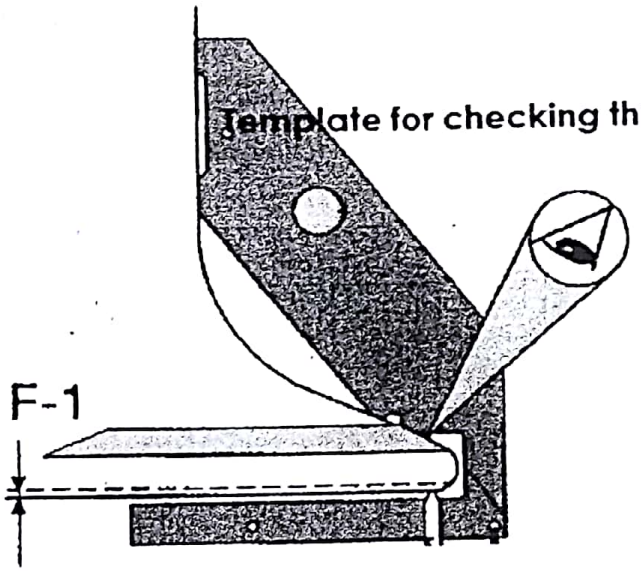
Outer seating needs to be lapped smoothly, with the help of special tool shown below. The lapping needs to be one half turn clockwise and half turn anti clockwise.



Checking Exhaust Valve Spindle Seating Surface

Manufacturer of the engine provides the standard template for the measuring the clearance of the spindle face. If it is not satisfactory, you can grind it.

Secondly, with the help of template, you can also, check the amount of burn off on valve face.



Template for checking the seating clearance

Sometime, you need to grind the face, to remove the black carbon depositing on it, so that you can get the actual surface to measure on.

You also need to check the trueness of the spindle shaft. This can be done by putting the one end of the shaft on rolling point and on the other end you can fit the dial gauge. Any difference will tell, whether shaft is true or not.

After doing all the checks and putting necessary spares, it is time to box back the exhaust valve. This exhaust valve overhaul was for the MAN B&W engine. So for other engines, things might vary.

Q – What are the different types of crankshaft (RA)

Ans – Before starting with the crankshaft first I would like to tell you some of the basic details about that –

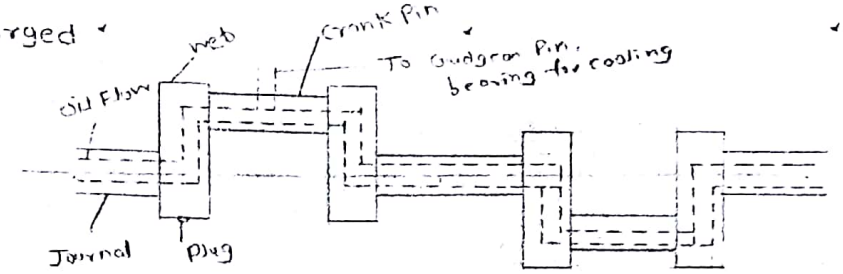
1. It is made up of steel
2. It should have ductility
3. It should have torsional stresses due to hogging and sagging

4. As we increase the carbon content hardness of the crankshaft increases and ductility decreases
5. So maximum allowable carbon % in steel is not to be more than C less the or equal to 0.23% and T.S = 450 to 500 MN/m2

So this was the some basic detail about the crankshaft now lets talk about its method of manufacturing –

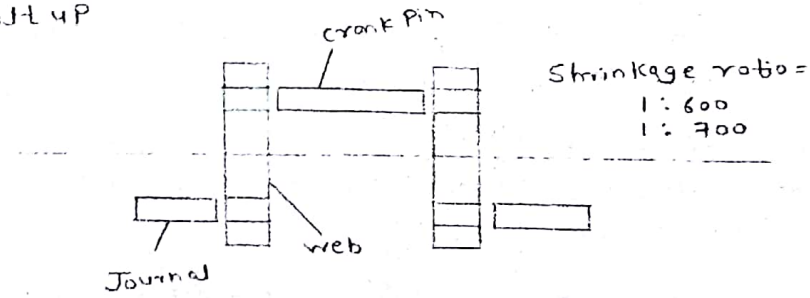
1. Fully forged
2. Semi built up
3. Fully built up
4. Welded type

1) Forged

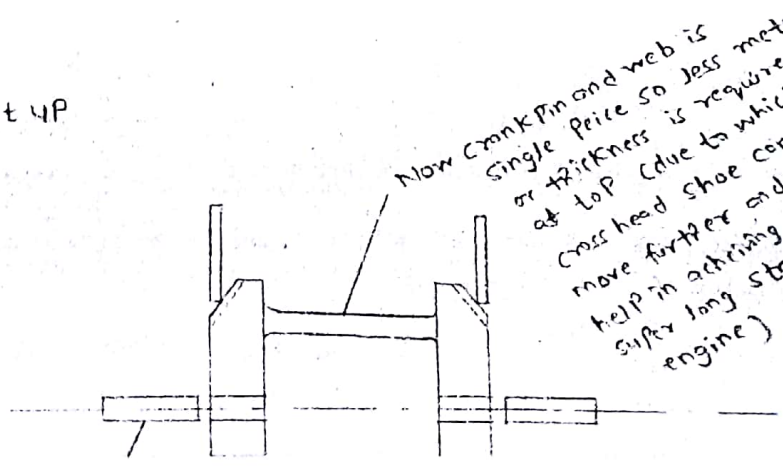


* we have to make the throughout drill after that Plug on that side which is not required

2) Full Built up



3) Semi Built up



Fully forged – Grain of the crankshaft should be align with the centre line so because of this it can wear more fatigue stresses because it is fully forged crankshaft

But the only disadvantage in this crankshaft is it cannot be built for large engine, it is only limited upto the generator engine

But it should have so many advantages like – 1. No slip – because of single forging

2. High strength because we pour it, so its density will be higher and it is very rigid (this was one of the reason why it is not suitable for main engine)

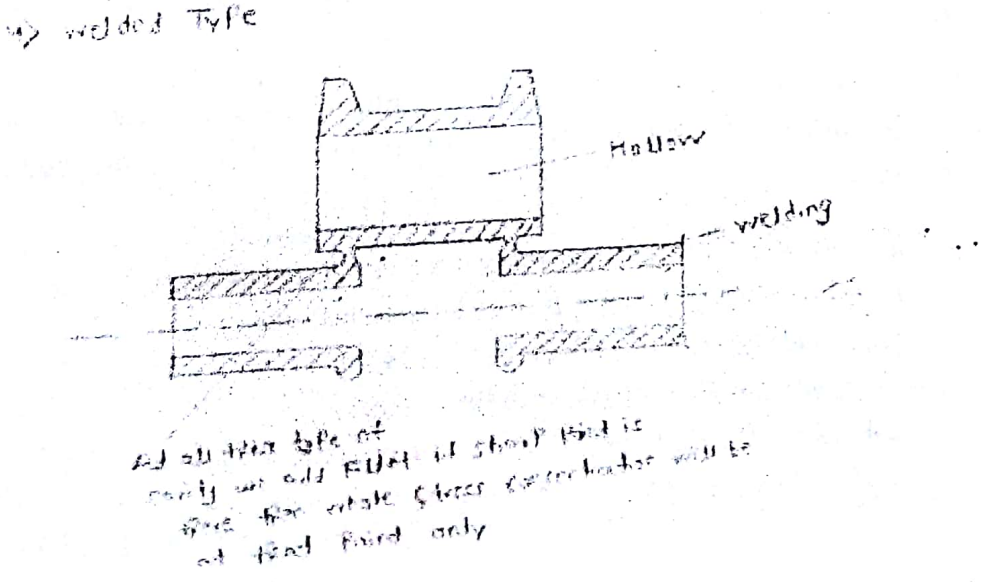
Fully built up – In this web, journal and crank pin all these are fabricated separately, after that web is heated upto 700 degree Celsius in a furnace, so because of this size of the hole in web is increased and then we will insert the journal and crankpin

Note – Previously we are using the concept of key as shown in the diagram but because of this all the stresses are concentrated at one point only so that was the reason it was no longer in use now.

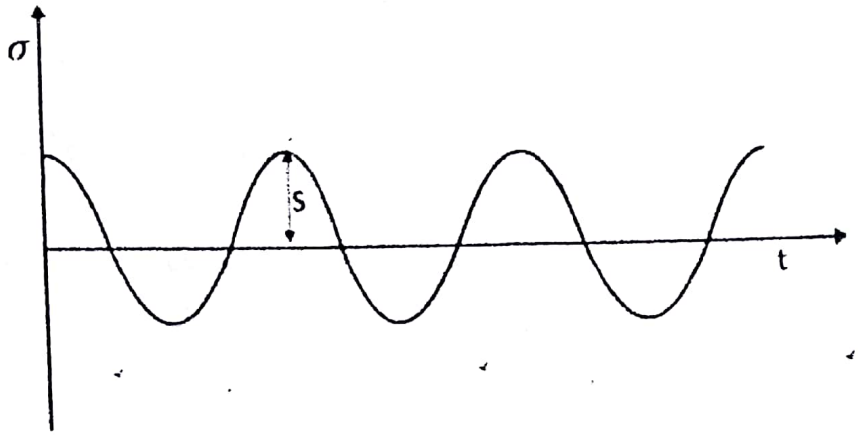
Fully built up crankshaft is very heavy because the material near the crank pin is very heavy because it should have to support the shrinkage fit

Semi built up –In semi built up crankpin and web are single piece and journal is connected to the web with the help of shrinkage fit, so because of this we can increase the stroke of the engine as shown in the diagram.

Welded type – Welded type of crankshaft is hollow, so because of this it is heated very easily during the normal running of the engine and cracked out easily. So that was the reason it wont be used anymore.



Note - Maximum failure of the crankshaft is because of the fatigue stresses, fatigue failure is defined as the tendency of a material to fracture by means of progressive brittle cracking under repeated alternating or cyclic stresses of an intensity considerably below the normal strength.



If one unit of main engine is cut out and you run the engine or may your crankshaft is not aligned, then the intensity of fatigue stresses will be more

A good point to note is that under compressive stresses there will be no fatigue, the fatigue will only take place under tension.

Q – What do you understand by the term swelling of journal (SA)

Ans – This question is generally asked by the surveyor if they ask the question related to the crankshaft – As shown in the diagram below we have to add the fillet to reduce the stress concentration at a particular point, so the point where we add the fillet at that point we cannot put the main bearing so because of this the size of the crankshaft increases which is called swelling of the journal

Note – In 2 stroke we avoid the oil hole in the crankshaft because it will increase the stress concentration but if it is not possible to avoid then better it should be rounded off as shown in the diagram

1. If alignment is not proper - fatigue stresses will increased
2. Engine is less vibrating – fatigue stresses will reduced
3. All unit Pmax equal – fatigue stresses will reduced
4. One unit cutoff – fatigue stresses will increased
5. Critical speed – fatigue stresses maximum may break the crankshaft
6. Lube oil quality not good – fatigue stresses will increased

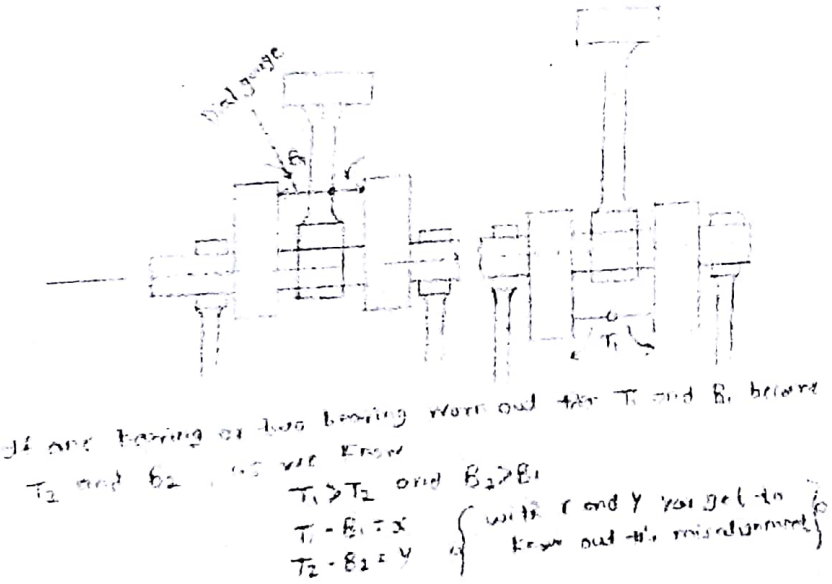
Note – Some people misunderstand the meaning of alignment, it simply means that all main bearing shares the equal load

Q – How to calculate the misalignment in main engine (SA)

Ans – To understand this please see the diagram below –

When piston move from TDC to BDC, the deflection of web changes from outward to inward.

Piston and connecting rod put the force on the crankpin and try to push the web(inward) when the piston was at TDC and push the web to outward side when the piston was at BDC. So if one bearing or two bearing worn out then, T1 and B1 becomes T2 and B2. As we seen from the diagram that-



T1 > T2 and B2 > B1 , so we can say that –

T1 – B1 = x and T2 – B2 = y (So with the value of x and y you get to know out the misalignment)

Note – There could be the number of reason due to which misalignment take place –

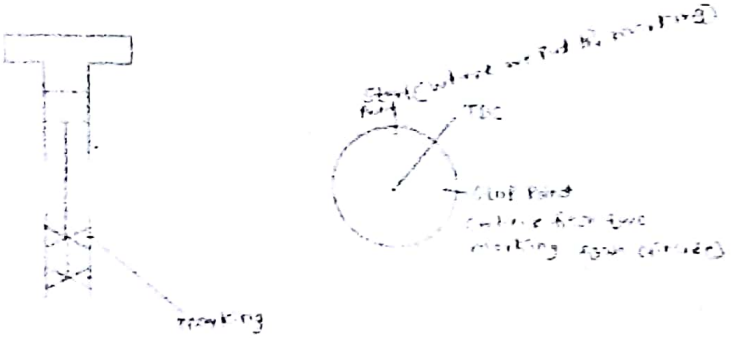
1. Misalignment main cause is uneven wear down of the main bearing
2. Uneven distribution of load on bearings
3. Loose foundation bolts
4. Loose tie rods
5. Distortion in bed plate (normally take place because of grounding or if dry dock is not proper)

6. Rough weather (during rough weather load is fluctuating too much, because propeller keep coming out form the water)

Q – How to know the TDC of the unit, if no marking was there on the flywheel (VI)

Ans – To understand this please see the diagram below –

1. First make the marking on crosshead shoe
2. Now make one more marking on the stationary point (straight) with respect to the previous marking
3. Now at the same time mark one point (A Start Point) on the flywheel of the circle
4. Now start rotating the engine with the help of turning gear, the time when both the marking coincide once again stop rotating the engine and put the mark on the flywheel let say (B Stop Point)
5. Now you have two mark or point, the centre of between these two mark let say TDC is the TDC of that unit.



Q –What is crankshaft deflection and why to measure it (MA)

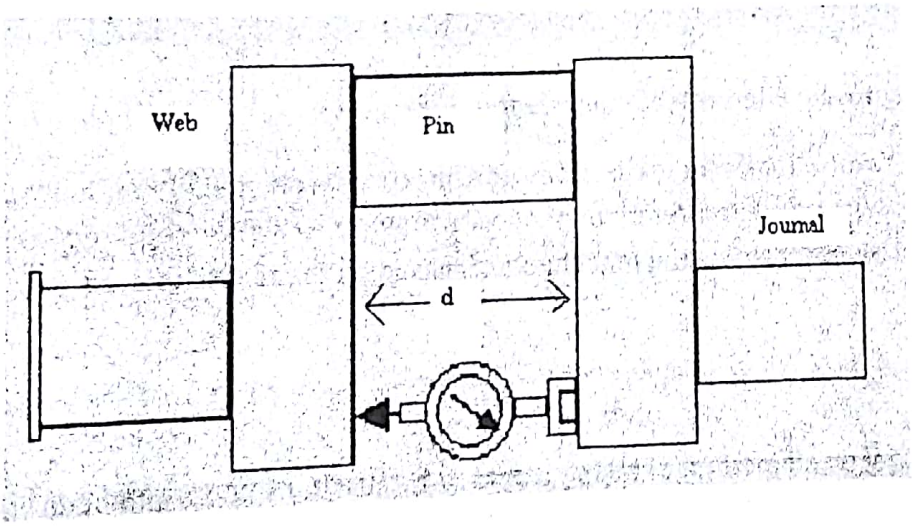
Ans - **The Need to Measure Deflection -**

If you remember about the construction of the crankshaft, you will recall that apart from other parts, it consists of crank-webs, crank-pins and journals along its length. The weight of the crankshaft is supported by the main bearings at the journals. Over a period of time as the engine keeps running, the wear in the bearings may not be uniform across the entire length of the crankshaft. This means that the crankshaft will not remain in the initial straight

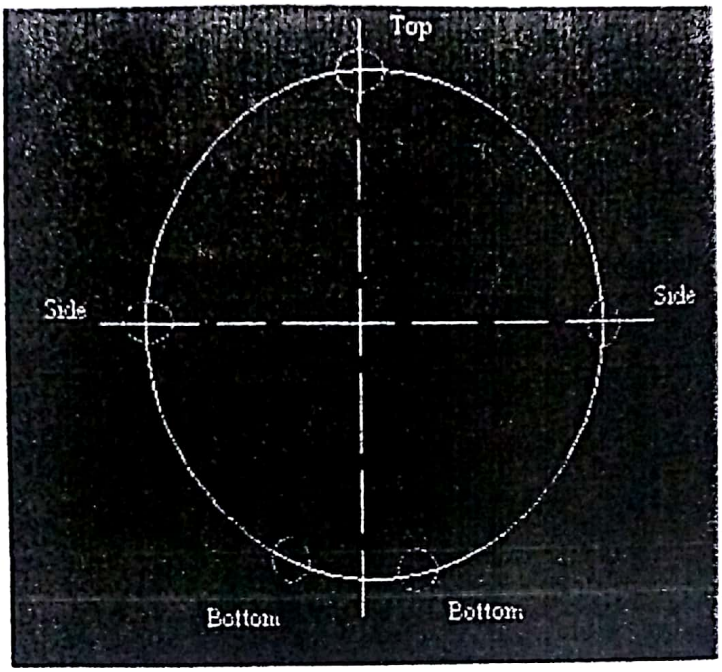
line but will get bent either upward or downwards to a slight degree which may not be visible with the naked eye but could be sufficient to cause dangerous levels of fatigue in the crank-webs. Hence there is the requirement of measuring crankshaft deflections at regular intervals to ensure that the alignment of the shaft is within permitted limits and these deflections can be measured as described in the next section.

How to take Crankshaft Deflections -

The figure shown below gives an idea of which measurement is taken to find the deflections of the crankshaft. As you can see from the picture a dial gauge is inserted between the crank-webs to find out the distance between them. If the deflection is measured after the specified interval, it is necessary that it is taken at the same point otherwise the reading will not give a real reflection about the degree of deflection. Normally a center punch is used to make markings so that each time the deflection is taken at the same point.



Apart from using the same point on the crank-web for measuring deflection there are other factors which need to be kept in mind and these include load on the ship, trim, hog, sag etc. Ideally the deflection needs to be taken at four points of the crank namely top, bottom and the two sides. In actual practice however the bottom reading is not taken due to chances of fouling by the connecting rod and instead reading is taken on both sides of the bottom position, thereby in total 5 readings are taken from each crank-web at the positions shown by the following figure.



Q – How to record and interpretent crankshaft deflection (VI)

Ans - Having taken crankshaft deflections the practical work might be finished, but a theoretical analysis and interpretation of those results is certainly required to take any meaningful decisions regarding the main bearings based on the recorded data.

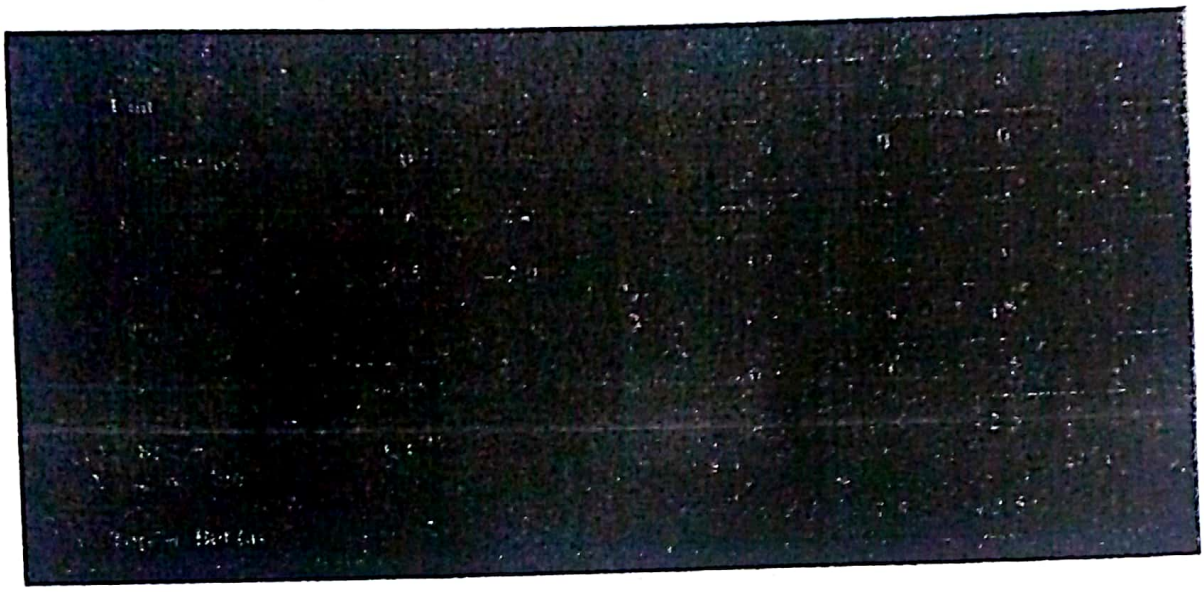
Introduction

We learnt the need and method of taking crankshaft deflections in our previous article. But taking the readings is one thing and it is equally important to properly record, analyze and interpret those readings. This is exactly we are going to learn in this article in the following sections.

Tabulation of Results

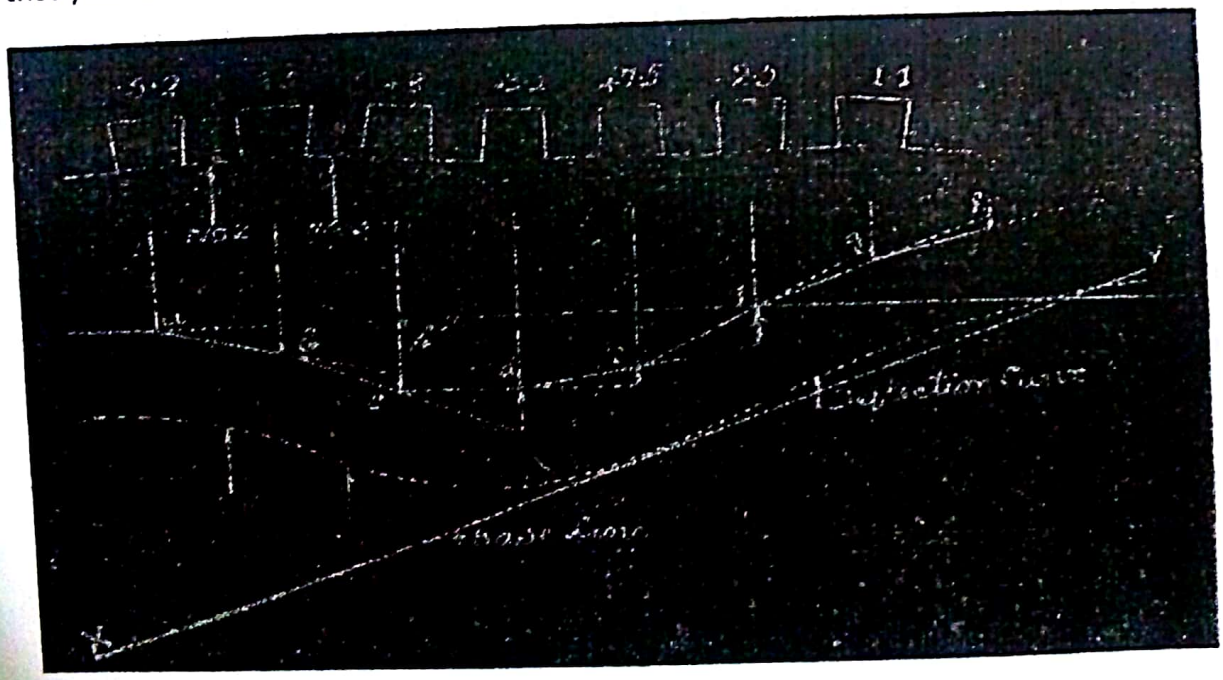
The results are tabulated in a manner shown in the example table shown below which represents the readings taken from a real engine. You will note that the numbers in the first row represent the unit or cylinder number and the first column shows the position at which those readings are taken. These positions had been graphically illustrated in the previous article so feel free to turn back if you have forgotten about them. The final row shows the difference between top and bottom readings which gives the vertical misalignment of the

shaft. The values of the vertical misalignment need to be compared to the maximum permissible limits specified by the manufacturer of the engine.



Plotting the Deflection Curve

A majority of the people find that the graphical representation of data is more appealing and easily understood, rather than a list of numbers hence we will see how we can use the above data to plot the deflection curve. Take a look at the deflection curve diagram first so that you can correlate to what you read next.



Crankshaft Deflection Curve

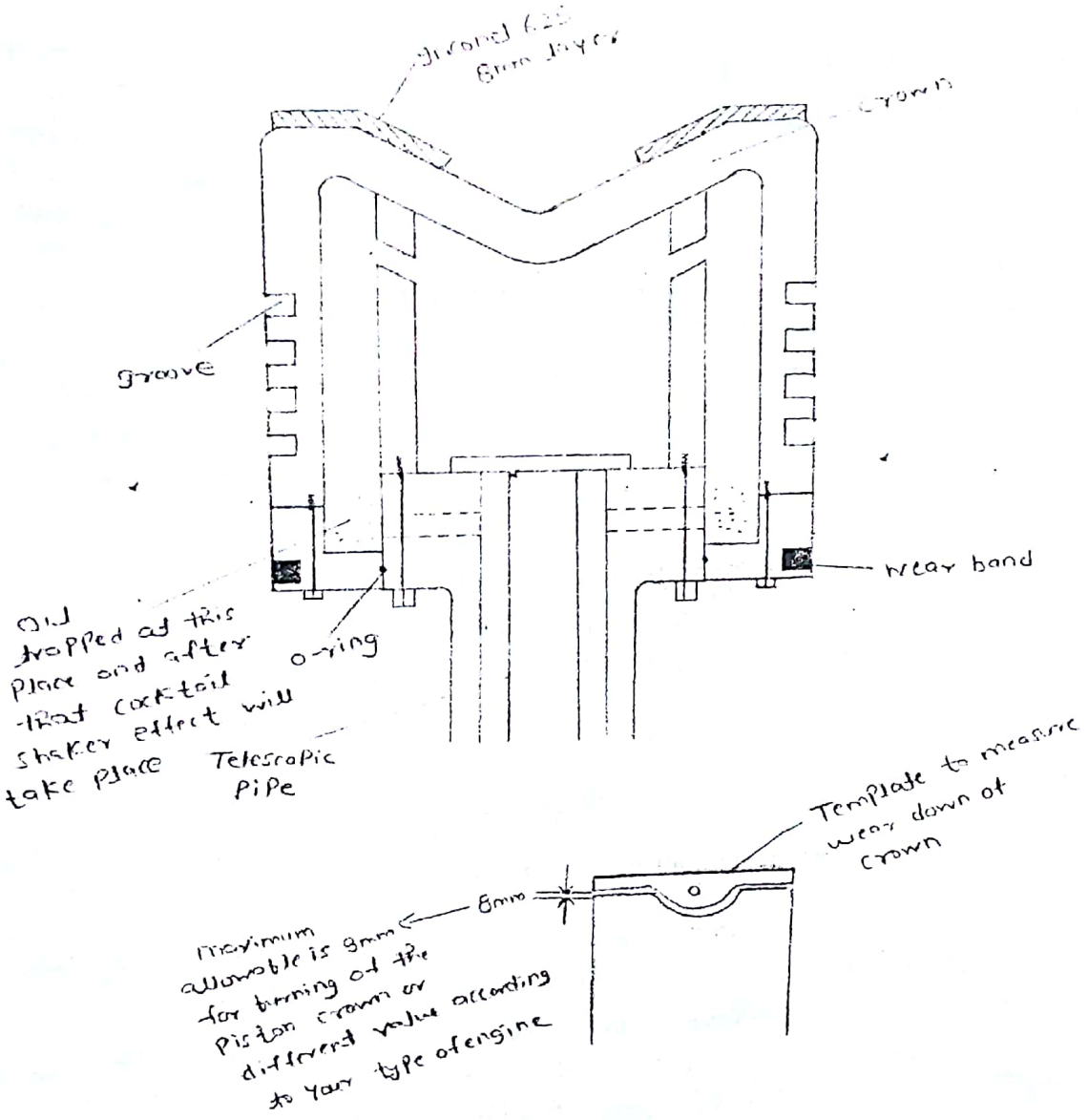
1. As you can see above on the top is the crankshaft which shows the 7 units and the vertical misalignments written on top of each unit (these values are taken from the last row of the table above).
2. A straight line is drawn beneath the crankshaft and the center lines from each unit are drawn downwards through this line. This now acts as our basic infrastructure upon which to start plotting the deflection curve.
3. Since the first deflection is -5.2 units (remember they are normally mm unless otherwise specified), we plot this distance downwards from the reference line on the center line of unit 2 (not unit 1) and make the line ab which is at an angle proportional to the deflection at a. This line is further extended to intersect the center line of the next unit.
4. The next step is to measure the deflection from this point of intersection (downwards for negative value and upwards for positive value) and join the point from the previous point, in this case which gives rise to the line bc.
5. This step is repeated till the last unit

A smooth curve is drawn between these points and the position of this curve with respect to the base line XY gives an idea about the state of various bearing. For example in this particular case you can easily make out that bearing of units 1 and 2 are too far away from the base line and hence need attention.

You must have realized by now that why only comparing the values of vertical misalignment against the manufacturer's specifications is not sufficient? This is so because even if the values are within limits, the relative wear and tear might be sufficient to cause too much misalignment hence this is a method to be double sure about the crankshaft being aligned properly.

Q – Explain with diagram 2 stroke piston and what is cock tail shaker effect (MA)

Ans – There could be the number of important points which need to be understand –



1. It is of crosshead type that is piston rod connected to the cross head bearing both reciprocate along the axis of the piston
2. The crosshead slipper transmits the connecting rod angularity thrust to the crosshead guides
3. More height for same power and speed
4. Higher engine manufacturing costs
5. It has compression type piston ring
6. More head room
7. Usually, used in low speed engines
8. Special Inconel 625 coating is there at the top of piston crown
9. 2 stroke piston rod don't have pockets

Note – Cocktail shaker effect - It is seen in the diagram that some amount of oil is trapped inside the piston at some place which give the better cooling effect due to the reciprocating action of the piston up and down

The oil is sprayed up matching bores onto the underside of the crown. This allows the crown to be made as thin as possible, to allow for maximum heat transfer while maintaining strength, and combined with the "cocktail" shaker effect caused by the reciprocating motion, gives efficient cooling.

Wear band – Very less people know about this terminology that what is the function of wear band, so to understand this please read the complete article properly - At the time when we insert the new liner or we insert all the new piston rings so perfect sealing will not be there so at that time sealing is been provided by the wear band unless and until the two new mating faces/surfaces cannot accept each other. It is fitted on to the skirt as shown in the diagram.

Note – Maximum deposits occur at the top of the piston crown so every time when we take the piston out from the unit we have to clean it properly and also need to check the clearance/wear down with the help of template which is provided by the engine maker

Q – How to pressure test the piston after overhauling (GA)

Ans – At the time of pressure testing the piston has to be rest on the wooden block

1. For pressure testing of the piston, it is to be turned 180 degree and then fill the complete line(telescopic pipe) and area under the crown with the oil
2. One plate is to be attached to the piston which have connection for air and vent
3. Vent is to be opened and from the other side oil has to be put, till the time oil will not start coming out from the vent side (which give you the indication that complete air is vented out from the system) after that close the vent
4. Now 7 bar air has to be given and one gauge is there which attached to the plate on which you can see the pressure
5. When gauge show the 7 bar pressure then stop air pressure and wait for atleast 30 minutes and check for any leakage of oil from the piston
6. If pressure did not drop for 30 minutes then everything seems to be fine

Q – If piston crown cracked what could happen (SA)

Ans – If piston crown cracked then it is impossible to run the engine because 150 to 180 bar high pressure combustion gases goes into the cooling chamber of the piston and you notice that piston cooling outlet temperature for that unit is on the high side.

It is also possible that exhaust gases goes to the crankcase of the main engine and due to this oil mist detector sounds

You can also check the gases coming out from the breather pipe because once your crankcase start over pressurising relieve door also activates and gases also came out from the breather line on the top

But the time when piston goes to TDC at that time oil come out from the crown and when piston come at TDC then it will burn with the fuel so you will notice that exhaust outlet temperature of that unit was on the higher side and bluish smoke at the funnel

Q – What are the different methods of cutting down the fuel to the main engine (MA)

Ans – This question is very frequently asked to the 4th engineers that what to do if any thing goes wrong inside the engine, so that you should immediately take action in case of any emergency

1. Pull the fuel rack to zero
2. In man b&w – operate the puncture valve
3. Lift up the roller so that the cam should not push the roller (for this you need to stop the engine because we have the tool for this and on roller there was the internal thread with the help of which we can lift up the roller)

Q – Explain 4 stroke piston and why pockets are provided in that (MA)

Ans – Some of the basic information related to 4 stroke piston is given below -

1. It is of trunk type that is the skirt (no piston rod) is connected to the connecting rod by means of a gudgeon pin and bearing
2. Trunk or extension piece or extended skirt takes the connecting rod angularity thrust and transmit it to the side of the cylinder liner
3. Less height for same power and speed
4. Lower engine manufacturing costs
5. It has compression as well as oil scrapper rings
6. Headroom is limited
7. Usually, used in medium speed engines
8. Crown is made up of chromium molybedenum steel (skirt is made of aluminium because in 4 stroke side thrust is been taken by the skirt and liner so that was the reason we made it light)

Note – Flow of oil in 4 stroke in take place from main bearing to bottom end bearing and from bottom end bearing to top end bearing through drilled holes in connecting rod

Gudgeon pin is made up of lead bronze

Note – Surveyor mostly asked that why the pockets are provided on the crown of 4 stroke piston because valve open at the TDC position in 4 stroke engine so if pockets are not provided then valve may hit the crown

Piston ring of 4 stroke engine serves the purpose of taking the oil to the upward side of the liner because excess oil is coming out from the gudgeon pin, so whatever oil is required that has been taken by the piston ring and what ever is in excess has been scrapped down by the rings as shown in the diagram

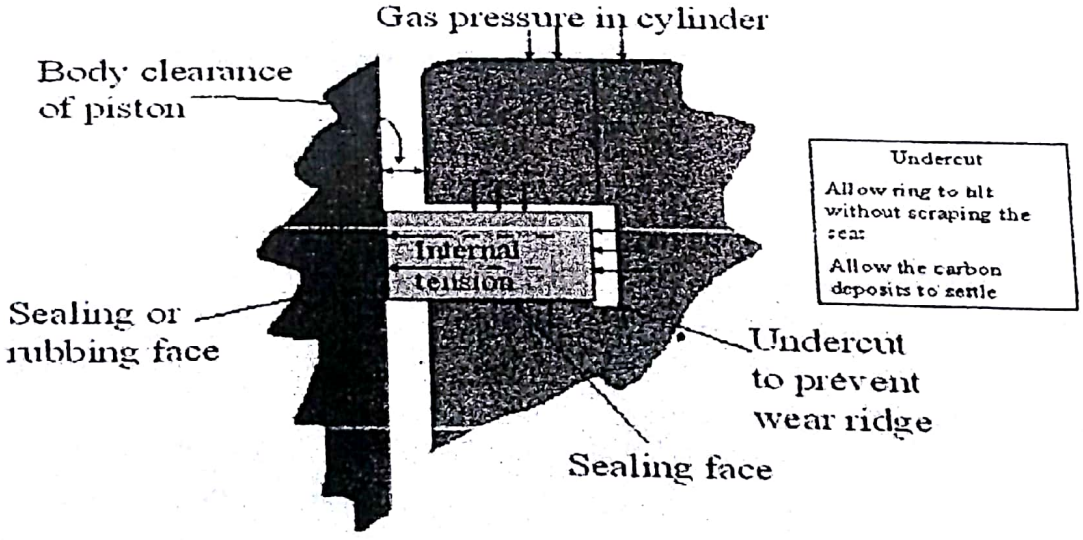
The purpose of the keep plate is to make sure that gudgeon pin should not delocate from its position

Gudgeon pin is absolutely mirror finished that's why it is made up of nitride, steel or carbonized steel

Note – Piston ring should have dry lubricating properties that's why it is made up of cast iron

Q – How sealing between liner and piston take place in 2 stroke engine (VI)

Ans – The efficiency of the engine depends upon the effective sealing between the piston and liners. Leakage will reduced compression pressure and power will lost. Piston rings seal the gas space by expanding outwards due to the gas pressure acting behind them.



So this was the reason that piston ring should freely move inside the groove, if in case it stuck then exhaust gas will not able to push from back side and no sealing will be there

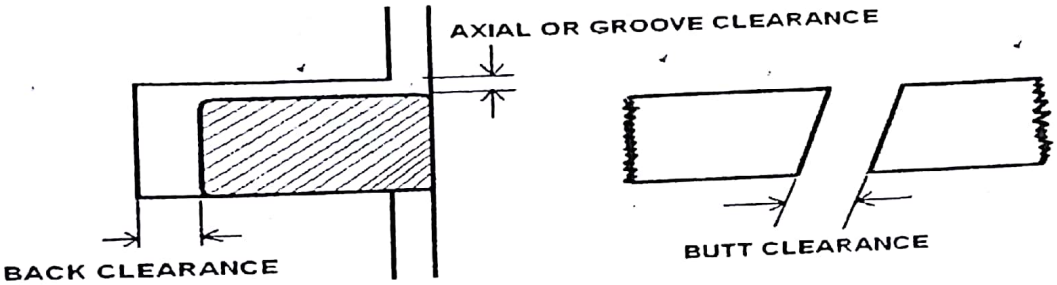
Note – Piston ring of 2 stroke engine should have contour which help in making the perfect sealing between the liner and piston ring

In piston ring normally we take three types of clearances – There are three clearances which are important;-

i) Side or axial clearances

ii) Butt or Gap clearances

iii) Back clearances or radial clearances



Groove Clearance or axial clearance – This clearance you can take with the help of feeler gauge, this clearance is very important because on this clearance our sealing depends -

Allows pressure to build up behind the ring, so that efficient sealing will be there.

This may also be termed gap clearance and is required to accommodate the ring expansion as it heats up, because ring is exposed to high temperature and pressure all the time during the combustion and expansion stroke

But now let discuss what could happen if this clearance is too small or too large -

Too small Groove Clearance

Ring will stick in the groove. This will result in poor sealing and possible blow by which will burn away the oil and cause scuffing. Insufficient gas pressure behind the ring will affect sealing.

If no sealing is there then possible or very frequent chance of scavenge fire will be there.

Too large Groove Clearance

Ring flutter and possible breakage

Now lets talk about butt clearance, this clearance you can also take from the filler gauge and to take this clearance you need to insert the ring inside the liner. But a very good point to note is that –

Note – 1. For new piston ring we take the butt clearance at that point inside the liner where minimum wear down is there

2.For old piston ring we take the butt clearance at that point inside the liner where maximum wear down takes place

Too small Butt Clearance

As the ring expands the butt will come together. This will exert a large radial pressure on the liner, breaking down the oil film and increasing scuffing wear. Ring seizure may occur.

Too large Butt Clearance

Excessive gas leakage

The piston rings operate in a hostile environment. The load is fluctuating and at top dead center the rings are at their slowest speed and highest temperature. The rings must withstand corrosive combustion products. Piston rings must therefore have high tensile strength to resist breakage, combined with good anti-corrosive properties. Rings must also maintain tension at lower combustion pressures and be compatible with the liner material.

Note – It is very difficult to take the radial or back clearance, so for that reason we will measure the width of the ring and compare that reading with the previous reading which was taken during the time of last overhaul. So subtract the present reading from the previous reading and you will get to know out the present back clearance

Note – Now the question comes which surveyor mostly ask is that how axial clearance should be increased during the normal operation of the engine

Axial clearance mostly increase because of the two specific reason, there may be some other also but these two put the major effect on the axial clearance –

1. Piston ring wear down – in this case new to be used
2. Groove worn out – in this case you cannot do much on board but to run the engine you need to take out the piston and perform some welding on the groove and take the groove to normal (even this was not the right method but for the time being you can use it)

   Note – That was the reason we done coating on the groove because it is easy to replace the piston ring not the complete piston

   For sulzer – chromium plated groove and **For man b&w** – flame hardening

Note - If wear down keep on increasing then more and more ring will come out and due to which radial clearance will increased

If more and more ring will come out then there will be the very less support for the piston ring and it start hanging on to the groove and ultimately it will break during the normal running of the engine

And due to increase in radial clearance, our butt clearance will be increased so from all this discussion it is very much clear that all the clearances depend upon each other

Note - Butt clearance should be maintained within this range of 0.4 - 0.5 % of cylinder bore and maximum 1 % is allowed, but still it is better to check the instruction manual

Note – A very important point to note as we know that high pressure is there at the top of the piston ring (first), so to increase the life of the piston ring we need to leak some of the exhaust gases from the first piston ring to the second piston ring so that we can increase the life of the first piston ring that was the reason why it is called control pressure relief ring and you will find a small hole on the surface of the first piston ring to leak of the gases

Q – What is Running In and Breaking In in new liners (AA)

Ans - The newly fitted liner, piston, or piston rings are machined prepared in the workshop ashore. They have surface asperities and there is no bedding between the moving surface i.e. liner and rings.

Under such situations, if proper step running is not followed then it may lead to heavy blow past of combustion gases. The blow past can be dangerous as it can lead to scavenge fire. Hence initially a step running program is required for newly fitted piston, piston rings and liner.

For a complete d'carb engine, it is important to keep an eye on various parameters of the engine under increasing load which can be achieved by breaking in and running in.

Breaking In and Running In

Breaking In - It is a short period of running of the marine engines under no load so that the piston rings are allowed to seat and lubricated properly. The breaking in time may differ from engine to engine and is provided in the engine manual by the makers An average breaking-in time for a four stroke engine is 48 hours.

Breaking in is carried out to achieve maximum wear rate, so that asperities break faster. For this reason HFO and low TBN oil is used. If low sulphur fuel or marine diesel oil is used, the

breaking in period will increase. A low jacket water temperature is maintained to increase the rate of wear.

Running in - It is a program followed after breaking in and it is a long run program with step by step increase in the load and speed of the engine.

Just like breaking in, the running in schedules are also provided in the engine manuals and differ for parts to parts.

In two stroke engine, the cylinder lubrication is kept in higher side in terms of oil quantity for proper lubrication of piston rings and liner.

For four stroke engines with common sump lubrication, low TBN lube oil is used initially and after 30 % of load, the new recommended oil is used.

Conclusion -If the proper Breaking In and Running In period is not followed after the maintenance, it may lead to blow past of the combustion gases, leading to scavenge fire. It can lead to heavy scuffing resulting in increase in liner wear.

Note – We have the special type of running in coating which is made up of phosphor bronze or nickel graphite coating or aluminium bronze

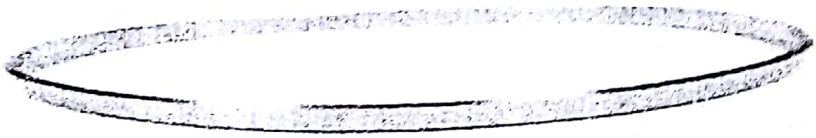
Q – How sealing is done between the liner and piston ring in case of 4 stroke engine (SA)

Ans – In 2 stroke engine as we now that sealing has been done by the exhaust gas pressure itself but in 4 stroke engine we have the garter spring which pushes the piston ring outside and effective lubrication is been done by the scrapper ring whose function is to scrap the excess oil to the crankcase if scrapper ring is fitted in the wrong direction then wear rate increased too much because they have the coating of hard material at one specific point.

Q – What is carbon scrapper ring and its function (MA)

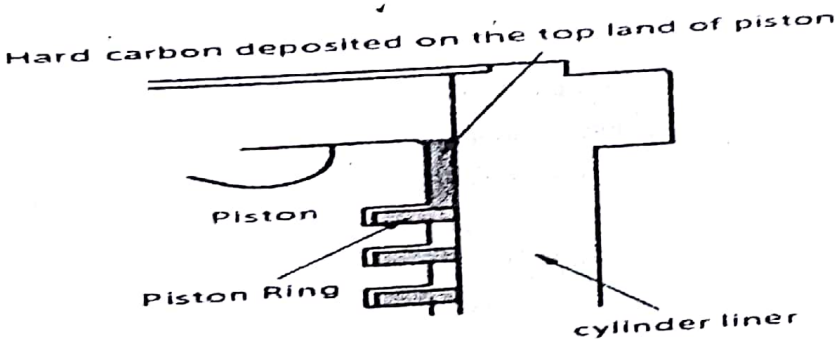
Ans – Carbon scrapper ring have so many names like fire ring, scuffing ring and anti polishing ring, it is fitted on the liner

It is a cylindrical component that is inserted in the upper part of a cylinder liner (in the position of a top dead centre above the top land of the piston) which is inside the engine

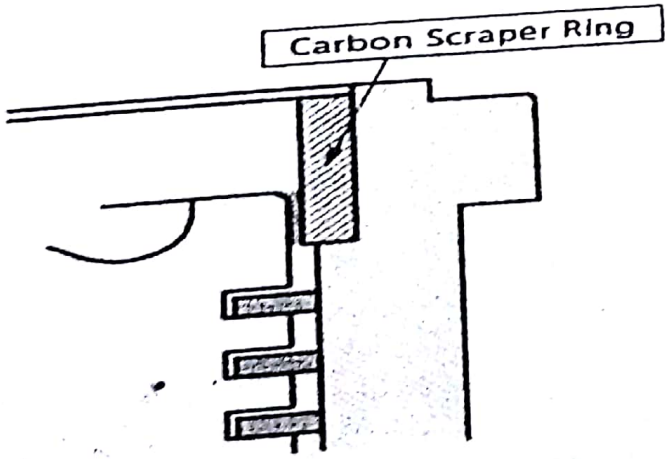


Function of Anti polishing Ring

1. Scrapes off the hard carbon deposit which forms on the top land of the piston.
2. Helps to prevent the inner cylinder wall from wearing and to keep lubricating oil consumption low level.
3. Same heat expansion as a cylinder liner by using same material.



Local wear is happened inside the liner and lubricating oil consumption increases, since the hard carbon deposited on the piston contacts the internal circumference of the liner at the time of a piston up-and-down motion



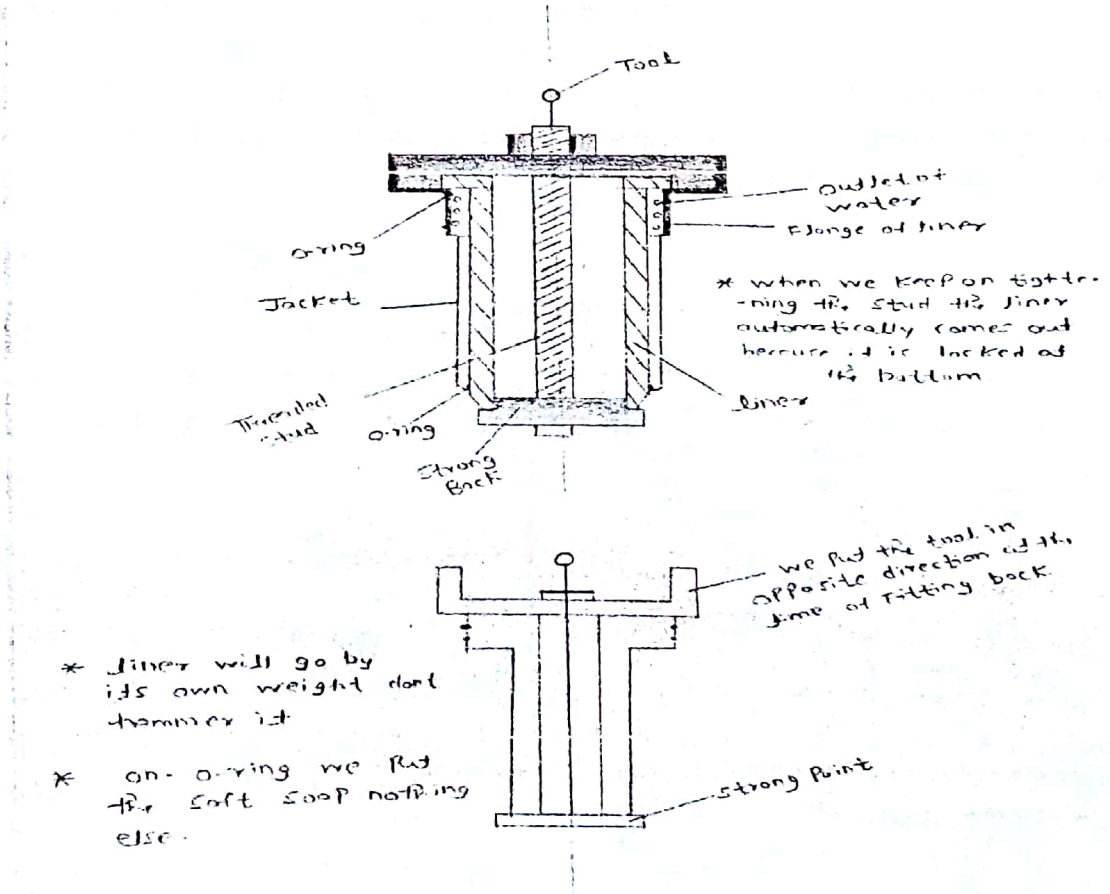
1. Scrapes off the hard carbon deposits which forms on the top land of the piston at the time of the piston rise.

2. Since the scraper ring is designed smaller than the peripheral surface of liners, hard carbon does not grow more than inside diameter of scraper ring , and doesn't contact the peripheral surface of liners.

Q – Explain the basic of liner and important point regarding the changing of liner (MA)

Ans – Some important point regarding the liner has been given below which give you a general idea about the liner -

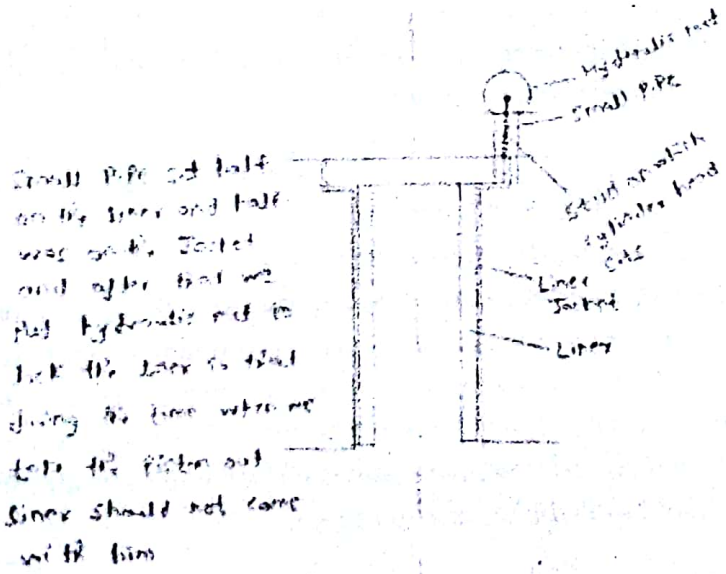
1. Liner is centrifugally casted and made up of cast iron normally spheroidal cast iron
2. 4 stroke liner is simple as compare to the 2 stroke liner
3. Some time surveyor ask that why the liner is not made up of cast steel so the answer to this is that they don't have dry lubricating property and due to this it will damage the piston ring
4. Liner is mostly thick at top because of the high temperature and pressure and normally thin at top because of the low temperature and pressure
5. To take out the liner from the engine we have the special arrangement as shown in the diagram below, so you need to keep on rotating the stud due to which liner automatically comes out because stud have thread on it



6. Before fitting a new liner you need to clean the complete space and blow through each hole with an air so that no restriction should be there in the passage
7. Before inserting the liner you need to take the calibration of the liner and you need to note a number which is written at the top of the liner
8. Now at the time of putting back the liner to the engine we need to put the tool in the opposite direction as shown in the figure
   Note – Never ever try to hammer the liner at the time of boxing back because liner automatically goes inside the engine by its own weight and one marking is there on the liner jacket and on the liner which should coincide all the time during the time of lowering
9. Before putting the liner make sure you will replace all the o-ring with the new one
   Note – On o-ring we only put the soft soap nothing else
10. When liner completely goes inside the unit then you need to open the water and fill the complete liner jacket with water just to make sure that no leakage has been there, this thing you need to do before putting the piston and cylinder head to the unit.

Q – How to lock the liner at the time of taking the piston out from the unit (VI)

Ans –



This was the most common problem that at the time of taking out the piston from the unit some time liner also came out along with the piston so you need to lock the liner but the problem is that how to do that –

To understand this you need to see the diagram below – we have the pipe which we put it on the stud and we put the pipe in such a that half the pipe was on the liner and half the pipe was on the liner jacket and after that we put the nut and lock it

Q – Why to take the liner calibration and how to take it (SA)

Ans – The main reason for taking the liner calibration is that wear down of the liner and wear down in liner take place because of so many reasons –

The wear in the cylinder liner is mainly because of following reasons:-

1) Due to friction.

2) Due to corrosion.

3) Abrasion

4) Scuffing or Adhesion

Frictional Wear

Whenever two surfaces slide over each other, friction is produced which leads to wearing down of both the surfaces. In liner wear the surfaces are piston rings sliding over the cylinder liner. The frictional wear depends upon various factors like speed of movement between the surfaces, material involved, temperature, load on engine, pressure, maintenance, lubrication, and combustion efficiency.

Corrosion

The wear due to corrosion is cause due to the burning of heavy fuel oil in the combustion space. This happens because heavy fuel oil contains high sulphur content. During combustion, acids are formed inside the space which should be neutralized by cylinder oil which is alkaline in nature. The production of acids will be more if sulfur content is more, leading to the formation of sulphuric acid. Sulphuric acid is formed due to absorption of the condensate or moisture present inside the combustion space.

Sulphuric acid corrosion is found more in the lower part of the liner as the temperature of jacket water is very low. Corrosion due to sulphur will be high due to the presence of water in fuel and condensate in the air. This wear is generally seen between the quills. The wear near the quills enlarge and gives a characteristic of the clover leaf shape to the wear pattern. This phenomenon is called clover leafing.

Abrasion

This type of wear is due to the hard particles present and formed during combustion. Catalytic fines in the fuel and the ash formed during the combustion causes abrasive wear.

Adhesion or Scuffing

This is a form of local welding between the particles of piston rings and the liner surface. As the piston is moving inside the liner, the welding which has occurred breaks and leads to the formation of abrasive material. The abrasive material will increase the rate of wear of the liner. This is generally caused by insufficient lubrication due to which large amount of heat is produced and microscopic welding of rings and liner surface takes place. Due to this type of wear the liner loses its properties to adhere cylinder oil to the surface. One more reason or this phenomenon is polishing of the surface caused by scuffing, giving liners a mirror finish.

Note - But now the main question is how to reduce the wear rate of cylinder liner –

1) Use low sulphur fuel oil
2) Run the engine at normal sea load, not on prolonged low load operation
3) By avoiding any ingress of water inside the liner by properly treating the fuel oil.
4) By maintaining the correct feed rate and grade of cylinder oil.
5) By avoiding ingress of moisture from the charge air.
6) By maintaining proper jacket water temperature.

Calibration of liner - A liner is gauged by measuring the diameter of the liner at fixed points down its length. It is measured from port to stbd (athwartships) and fwd to aft. An internal micrometer is used because of its accuracy (within 0.01mm). To ensure that the liner is always measured in the same place, so that accurate comparisons may be made, a flat bar is hung down the side of the liner with holes drilled through where the measurements are to be taken.

Note – Sometime surveyor ask that why to take the reading only at port-stbd and fwd-aft so the reason for this is that maximum wear down take place at these two points because of rolling and pitching

Measurements are taken at more frequent intervals at the top of the liner where wear rate is expected to be highest.

To ensure accuracy, the micrometer gauge is checked against a standard, and the liner and micrometer should be at ambient temperature. If the temperature is higher then a correction factor can be applied. To ensure micrometer and liner are at the same temperature, lay the micrometer on the entablature for a few minutes before starting.

The readings can be recorded in tabular form, and from the data obtained the wear rate/1000 hours can be calculated. Wear rate varies, but on a large 2 stroke crosshead engine ideally should be about 0.05mm/1000 hours. On a medium speed trunk piston engine where the procedure for gauging is similar, the wear rate is around 0.015mm/1000 hours.

Cylinder Number: 1 Nominal Dia: 840mm			Total Running hours: 60000		Running hours since last calibration: 15000			
Gauging point	P – S	F - A	Wear rate (average) P - S	Wear rate (average) F - A	last calib. P - S	wear rate P - S	last calib. F - A	wear rate F - A

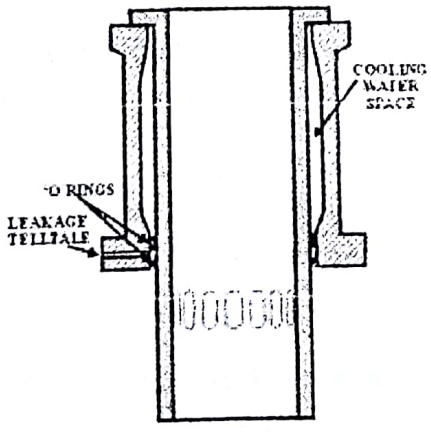
We also check the ovality = (P-S) – (F –A)

Note – All reading given above are just for the reference purpose only

Manufacturers quote max wear for a cylinder liner at about 0.8% of original diameter. If the wear rate is kept to a minimum, then the liner may last the life of the engine.

Q – How to check the integrity of o-ring outside the liner (SA)

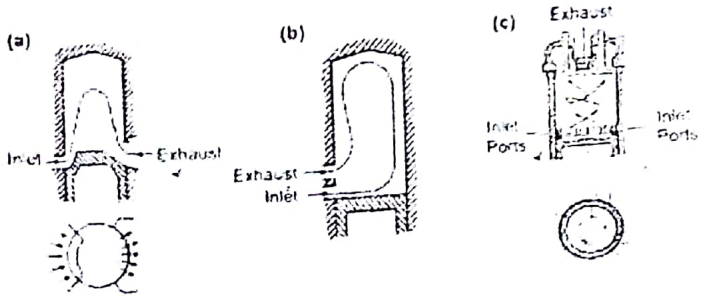
Ans – To understand this you need to see the diagram below if there was the leakage of jacket water from the o-ring then you will notice that water start coming out from the tell tale hole and other o-ring is for the air integrity if you notice that air start coming out form the tell tale hole it means that your air side o-ring start leaking and scavenge air start coming out or leaking out.



Q – What is scavenging and the different methods of scavenging, advantage and disadvantage of each (MA)

Ans - For a better combustion of fuel oil inside a marine diesel engine, an adequate supply of fresh air is needed. The method by which sufficient amount of air is provided to the engine's cylinder is known as scavenging.

Scavenging is generally provided by the engine's turbo-charging system. The more efficient the scavenging, the better is the fuel combustion and power output of the engine. Turbochargers are provided with the engine to use the exhaust gases in order to supply a consistent flow of fresh air inside the main engine.



There are mainly three types of scavenging method on the base of the flow of air

(I) Cross flow scavenging

(II) Reverse or Loop scavenging

(III) Uniflow scavenging

Note – Now a days we are using uniflow type of scavenging only

Cross flow scavenging

Cross flow and Revere loop scavenging take place with the help of piston movement. Cross flow scavenging, transfer port (inlet) and exhaust port are situated on the opposite side of the cylinder. The exhaust gas is pushed out by cross flow. The piston head is designed to have a hump shape called deflector. The fresh air enters in the engine cylinder is deflected to the upward by a deflector and pushing exhaust gas down the other side. Before loop scavenging invented, almost all two-stroke engines use this method.

Advantages and disadvantages of Cross flow scavenging

Advantages:

1. Low manufacturing cost.
2. Good scavenging at low speed and part throttle.
3. Low engine volume for the multicylinder arrangement.

Disadvantages:

1. Heavy piston with very high heat absorption.
2. High tendency to knock.
3. Poor scavenging at high speed and full throttle.
4. Compulsory water cooling, difficulty in cooling piston crown.

Loop scavenging

Similar to the cross flow scavenging, but the inlet ad exhaust port are placed the same side of the engine cylinder. The gases are encouraged to move loops. This type of scavenging used carefully designed transfer port (inlet) to loop fresh air rise towards the cylinder head on one side and pushes the burnt gas down to the exhaust port installed just above the inlet. It has a flat or slightly domed piston crown. This is the most used type of scavenging system.

Advantages and disadvantages of Loop scavenging

Advantages:

1. Low maintenance.
2. The low surface area to the volume of the cylinder (hence the heat loss reduced).
3. Good scavenging at full throttle.
4. Water cooling system not necessary.

Disadvantages:

1. Poor scavenging at part throttle operation.
2. Scavenging time is short.

Uniflow scavenging

Uniflow scavenging so called because both fresh charge and exhaust gas move in a same upward direction. In this method, fresh air enters from the lower side of the cylinder, and it pushes out exhaust through the exit valve situated at the top of the cylinder. This method is used in large two-stroke diesel engines.

Advantages and disadvantages of uniflow scavenging

Advantages:

1. Extended time for valve operation.
2. The possibility of mixing is reduced due to uniflow.
3. Increase power output.
4. Most efficient of all three methods.
5. Good scavenging at all speed ranges and throttle position.
6. Low fuel consumption compared to other scavenging types.

Disadvantages:

1. Elaborate and costly construction.
2. Difficulty in cooling the piston.
3. Construction of liner is complicated

Q – Draw main engine jacket cooling water circuit (AA)

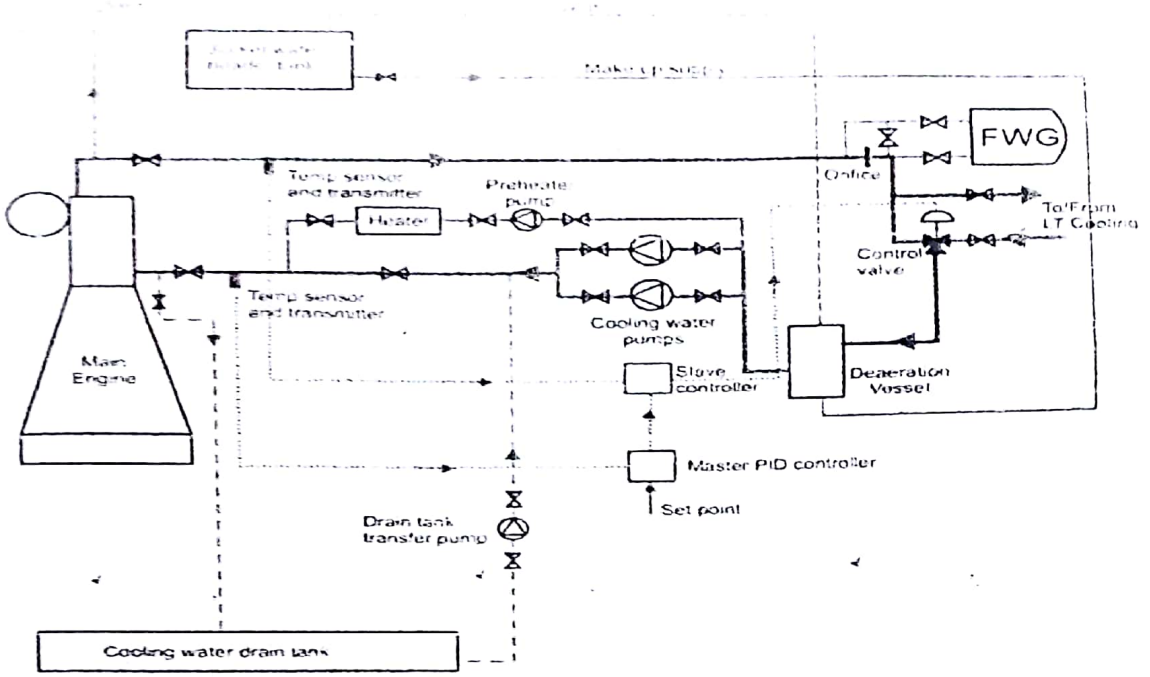
Ans – Once you done with the drawing surveyor definitely ask you 2-3 question from it which I discussed below –

Function of expansion tank in the circuit –

1. Expansion tank maintain the constant head at the suction side of the pump so that no air should enter into the system
2. As the name suggest whatever the liquid expanded due to heat it will go to the expansion tank, for that a separate line is there
3. We can easily add chemical (for jacket water treatment) to the expansion tank
4. If expansion tank level drop too much suddenly, so it will give you the indication(pre warning) that somewhere leakage is there in the system

Function of deaeration vessel –

1. Deaeration vessel has the alarm for gas detection if in case liner or cylinder head crack then high pressure exhaust gas come with the water and when that gas comes into deaeration vessel, it activate the alarm (it was just like the pre warning that something is not well inside the engine)

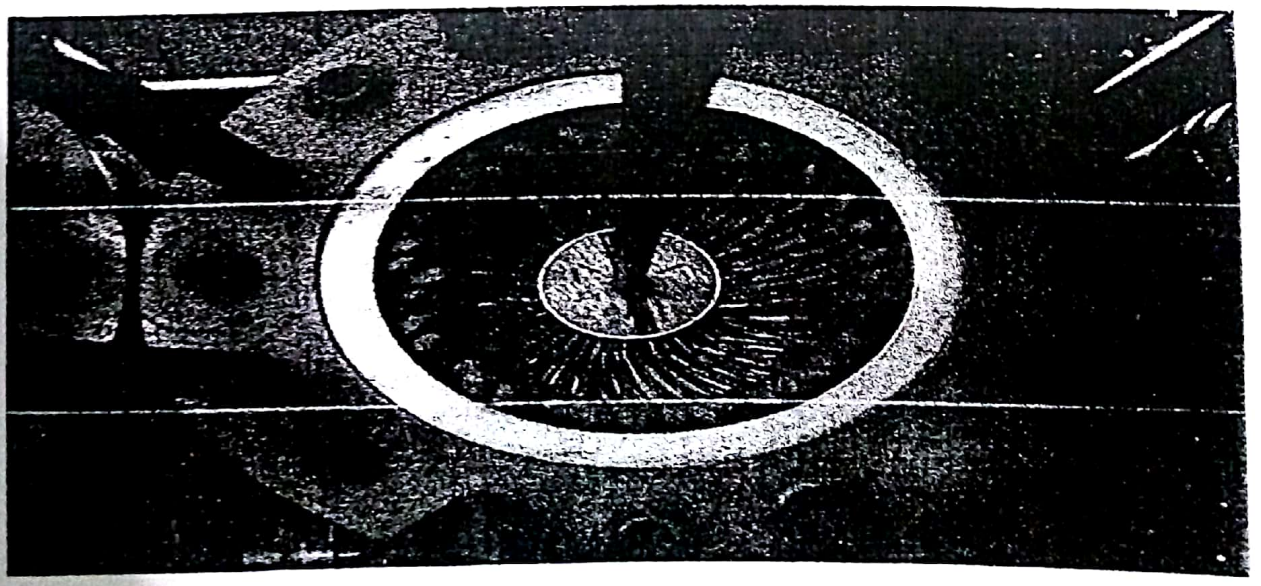


Q - What is liner honing and why it is required (SA)

Ans – When we are going to insert the new liner or when liner surface is absolutely mirror finished so at that time oil will not be able to stick on the sides of liner and due to that reason oil slips out from the liner and effective lubrication will not be there and result in wear down of the liner so for that reason we perform the honing of liner which make the liner surface little rough

Honing is to be done in place only, we don't need to take out the liner out from the engine

This complete system has been driven by the electric motor



Q – If liner is not coming out during the overhaul, then what action you will take (GA)

Ans – If liner stuck at the time when you are going to take it out so the most probable cause is that your tool will not be in the centre at the time when you are going to take out the liner from the unit

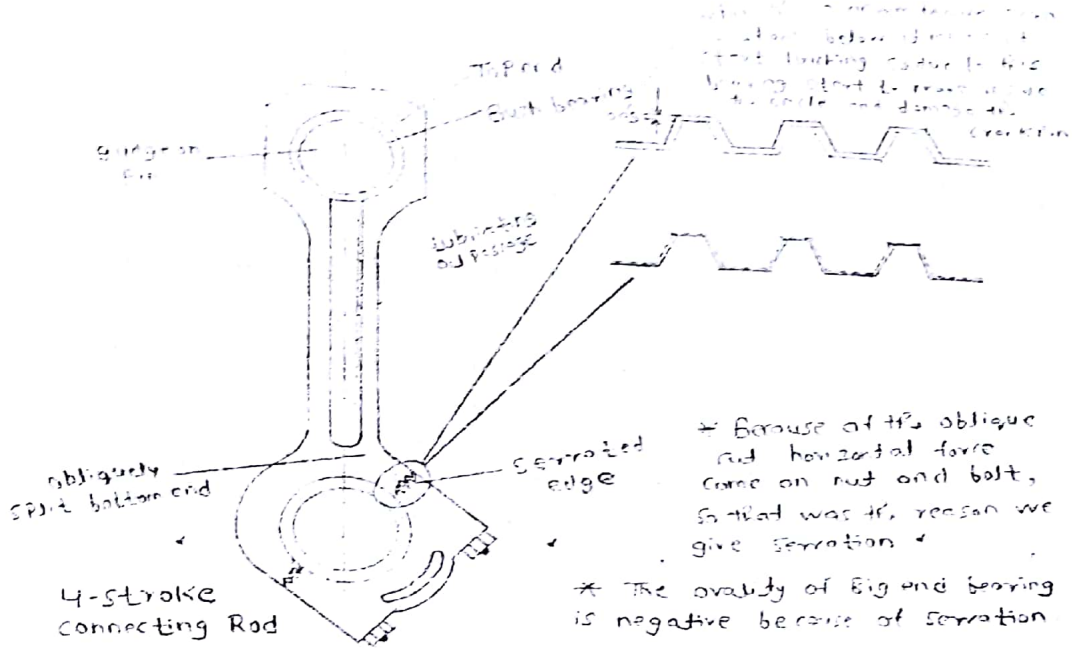
1. So put some descaling compound, so that all the deposit melt out and liner freely comes out
2. You can also cool the liner, so that it can contract and easily come out from the unit for that purpose we need to put the dry ice in the unit

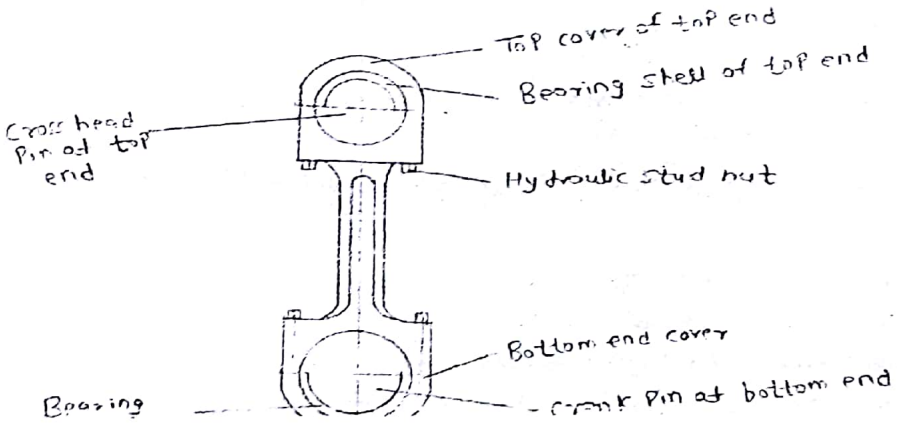
But the main concern is that how to reduce the quantity of dry ice so before putting the dry ice first put the empty lube oil drums in the centre and later on put the dry ice so with this ultimately you are going to reduce the area.

Q – Q – 2 stroke and 4 stroke connecting rod differences (MA)

Ans – **2 stroke connecting rod –**

1. 2 stroke connecting rod is of split type (means two halves for each small and big end bearing)
2. Round mid section changes to a rectangular palm section at the bearing ends by means of the elliptical fillet shape
3. A round section is cheaper to manufacture
4. 2 stroke connecting rod have telescopic pipe
5. Only compressive forces are acting on 2 stroke connecting rod
6. Connecting rod connects to the piston rod through the cross head pin





4 stroke connecting rod –

1. Only the big end bearing are of split type
2. Oblique cut is provided in the crank pin side so that it can be taken out easily with the piston from the cylinder head side because in previous design it was not possible to take out the connecting rod directly from the upward side because it width is more that was the reason we provide oblique cut
3. The top end bearing may be of bush type bearing
4. It is subjected to high compressive and low tensile stresses of bending as well as axial type
5. It connects the crank pin directly to the piston gudgeon pin

Note – Surveyor mostly ask that why serration is been given in the bottom end of connecting rod in 4 stroke engine, the reason to give serration at that place so that they can

take the shear stress because function of nut and bolt is to join the two surface not to take the stress so that could be taken care by serration

Q – What all things to check in connecting rod at the time of unit overhaul (VI)

Ans – This question is very frequently asked by the surveyor and there could be a number of things that you can check in connecting rod but the surveyor wants to listen the three main points which I covered below –

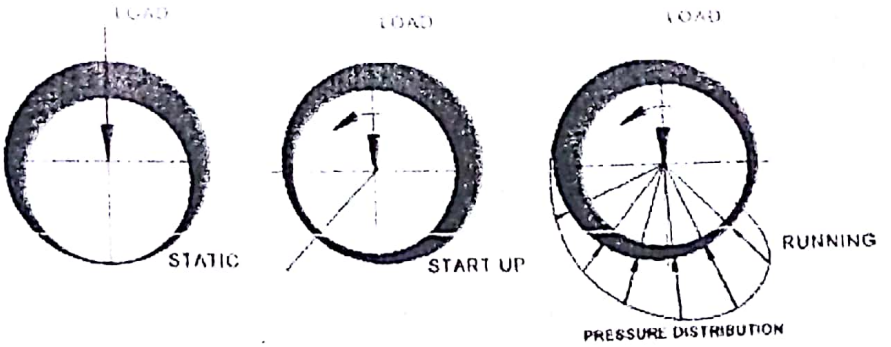
1. Check the ovality of big end bearing, for that you need to remove the pin and tighten the nut and bolt at required torque by the hydraulic jack and check the ovality after that
   Note – Max ovality allowed = 0.05 mm (Standard Value, may change depending upon your engine specification)
2. Second thing that you need to check in the connecting rod is the bending of the connecting rod for that you need to take a very fine rod and put that rod in the drill passage which was given for the flow of oil. If it move inside the passage without any restriction or it goes freely then everything is okay
3. Third and the most important thing that you need to check in the connecting rod is the serration which can take the shear stress, to check the serration you need to perform the dye penetrant test
   Note – The ovality of big end bearing is negative because of the serration, to understand this just see the diagram below

Q – What type of lubrication is there in engine, and what is the difference between hydrodynamic and elasto hydrodynamic lubrication (VI)

Ans – Engine bearing is basically of shell type

At initial boundary lubrication is there because of no motion it means there will be the no oil between the shaft/pin and bearing means metal to metal contact

But when the engine attains the minimum rpm then oil come in between the pin and bearing so that shaft lifts up and no more metal to metal contact that was the hydrodynamic lubrication

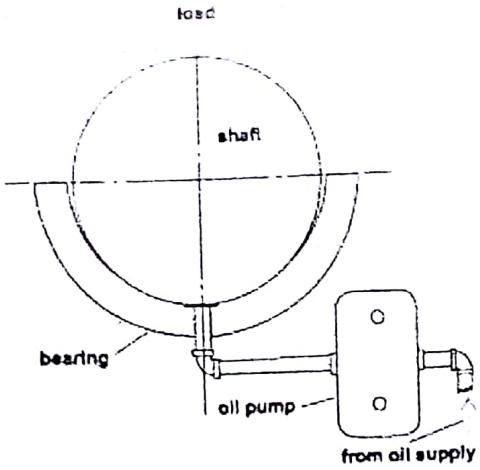


But now the question is what is elasto hydrodynamic, as we know that when load comes the thickness of the oil film reduces between the shaft and the bearing which normally happen during the expansion stroke when gases try to push the piston downwards and thickness of the oil film again increases when load goes out which normally happen during the scavenging process so the thickness of oil film keep on increasing and decreasing, this phenomenon is called elasto hydrodynamic

To better understand the relation of RPM and Coefficient of friction please see the diagram below –

Note – In sulzer we have hydrostatic lubrication in the cross head and surveyor mostly ask that what is difference between hydrodynamic lubrication and hydrostatic lubrication - Hydrostatic lubrication is essentially a form of hydrodynamic lubrication in which the metal surfaces are separated by a complete film of oil, but instead of being self-generated, the separating pressure is supplied by an external oil pump. Hydrostatic lubrication depends on the inlet pressure of lube oil and clearance between the metal surfaces, whereas in hydrodynamic lubrication it depends on the relative speed between the surfaces, oil viscosity, load on the surfaces, and clearance between the moving surfaces.

Example: the cross head pin bearing or gudgeon pin bearing in two stroke engines employs this hydrostatic lubrication mechanism. In the cross head bearing, the load is very high and the motion is not continuous as the bearing oscillation is fairly short. Thus hydrodynamic lubrication cannot be achieved. Under such conditions, hydrostatic lubrication offers the advantage. The oil is supplied under pressure at the bottom of bearing. The lube oil pump pressure is related to the load, bearing clearance, and thickness of the oil film required, but is usually in the order of 35-140 kg/cm2 .



Note – When shaft and bearing don't touch each other , then what is the reason of making the bearing of soft material so the reason for this is that at the time of starting and stopping we have boundary lubrication so it simply means that metal to metal contact so that was the reason we make the bearing of soft material only else it will damage the pin/shaft

Mostly we make the bearing of white metal which is the mixture of tin, antimony and copper

It should have high resistance to fatigue stress

But now a days we compact the engine so much so the small bearing has to take the max load for that reason we now make the bearing of tin and aluminium

Q – On what factors the load carrying capacity of the bearing depends upon (GA)

Ans – Load carrying capacity of the bearing depends upon the thickness of the oil film

Thickness of oil film depends upon = **viscosity of oil x N x N x R x L / C**

Where,

N = RPM of engine

R = Radius

L = Length

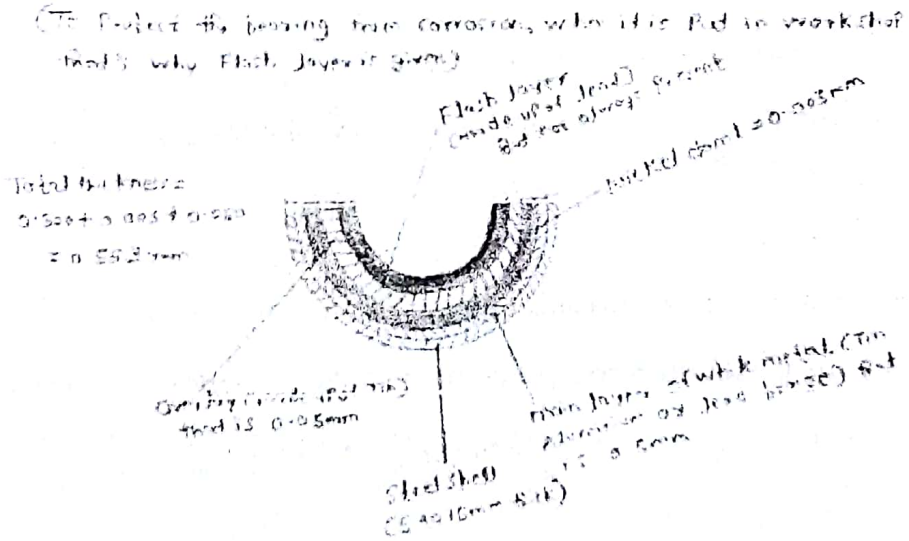
C = Bearing clearance

So the above relation indicate that higher the rpm of the engine, higher will be the thickness of the oil film and ultimately increase the load carrying capacity of the bearing

Note – Some point you need to understand for smooth running of the engine which is described below -

1. When shaft touch the bearing that term is called as wiping out
2. As we know that viscosity is directly proportional to the thickness of oil film but if viscosity is too high then it wont be able to cool the parts and oil has to perform two functions that is cooling and lubrication, so we need to maintain a balance between all the terminology
3. Minimum bearing clearance has to be there and minimum clearance is required so that some space has been there for the oil film to form in between shaft and bearing, so ultimately the conclusion is that too high is not too good or even too low is not too good

   Note - C = 0.00075 to 0.001 x Diameter
4. Main problem with the bearing is fatigue strength and fatigue strength is inversely proportional to the thickness of the bearing, so simply it means that thinner the bearing higher will be the fatigue strength or vice-versa
5. So that was the reason why we are using thin shell tin metal bearing now a days which have number of coating on the surface which is shown in the diagram below –



Q – What do you understand by the term embeddability of the bearing (AA)

Ans - Embeddability is the ability of the bearing lining material to absorb or embed within itself any of the larger of the small dirt particles present in a lubrication system. Poor embeddability permits particles circulating around the bearing to score both the bearing surface and the journal or shaft. Good embeddability will permit these particles to be trapped and forced into the bearing surface and out of the way where they can do no harm.

Note – The upper shell of the bearing we don't have any overlay and flash layer because we don't have any load on the upper bearing or even the shaft never ever come in contact with the upper bearing

Normal wear rate of the bearing is 0.01 / 1000 hours

Normally we replace the bearing when overlay layer gone off and normally it take 50000 hours if you maintain all the favourable conditions

Note – We always measure the bearing clearance between journal and top of the bearing because only bottom half of the bearing is loaded so it is not possible to check the clearance over there.

For crosshead bearing clearance we put the gauge at the top because bottom shell is loaded

For crank pin bearing clearance we put the gauge on the bottom because top shell is loaded

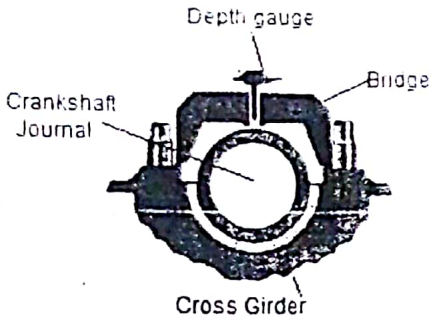
For main bearing clearance we put the gauge on the top because bottom shell is loaded

Q – What are the different methods with which you can measure the main bearing clearance (SA)

Ans - The clearance measurement of the main bearing determines the amount of wear down the bearing has been subjected to. There are various types of methods adopted by different marine engine manufacturers to measure the clearance of main bearing of marine engine. Following are some of the most prominent methods used onboard ships to measure the clearance of main bearing:

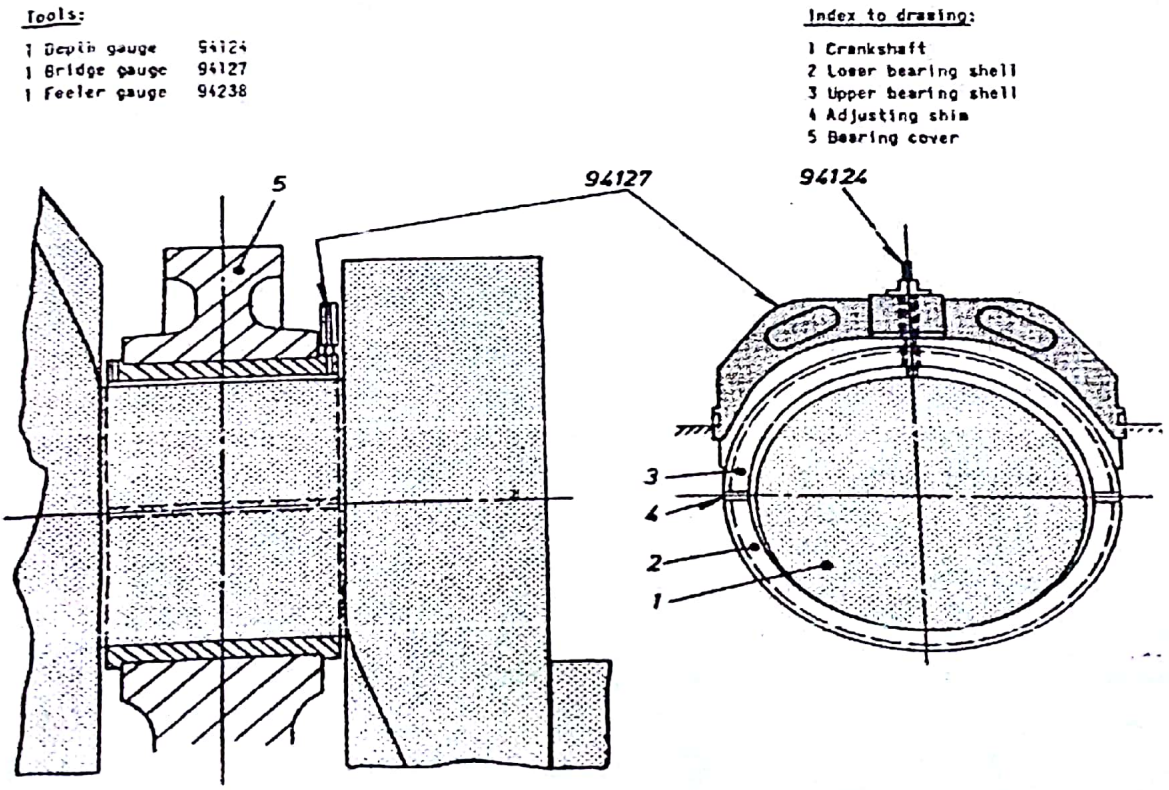
1) Bridge with Depth Gauge

This method is used in SULZER 2 stroke marine engines where the bearing's shell is removed along with the keep (the bearing shell is lined with the keep). After that a bridge is fitted over the top of journal pin, from port to starboard, making a bridge over the crankshaft with two ends supported on the cross girder.



A simple vernier type depth gauge is then inserted in the hole provided on the bridge and the scale of depth gauge is rested on the crankshaft pin. The total depth on the scale is measured and compared with the previous reading and the reading in the manual for calculating the wear down of bearing.

In old model SULZER engines, a collar is provided in the bearing shell along with a small hole. Thus without removing the keep, the bridge is fitted adjacent to the keep and the depth gauge is used from the hole provided in the shell to measure the shell wear down.

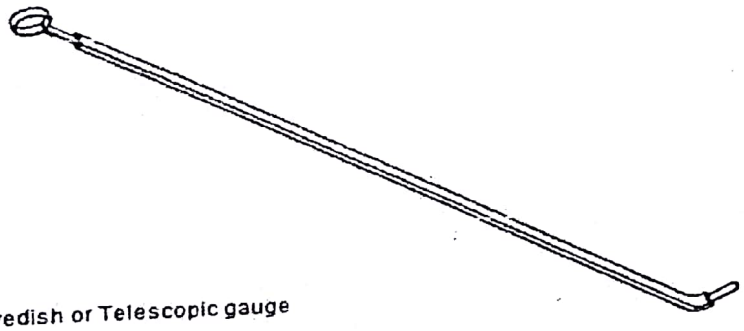


2) Bridge With Feeler Gauge

In some engines, after removing the shell and the keep, the bridge is installed as explained in the above point. Also, in place of depth gauge, a feeler gauge is used to measure the clearance between the journal pin top and the bridge bottom. The bridge used here is different in terms of height and the gap between the pin and the bridge is very less as compared to that of the bridge used in the above mentioned method.

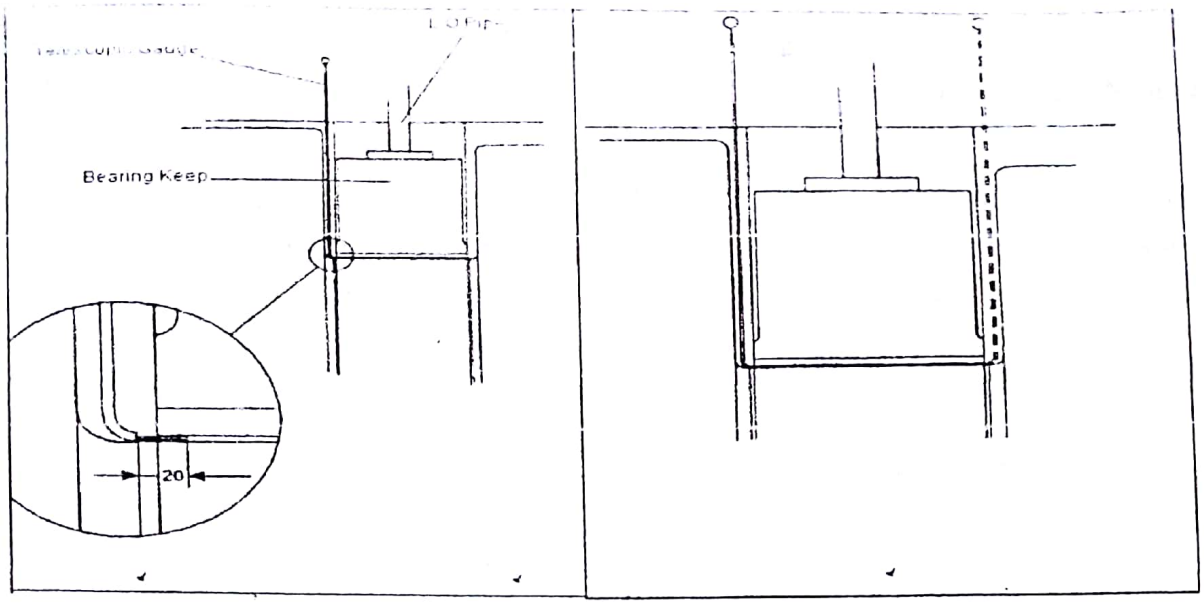
3) Telescopic or Swedish Feeler Gauge

In engines like MAN B&W, this is the most common method used to measure the bearing clearance of the top shell. In this method there is no need to remove any connection or keep for measuring the clearance.



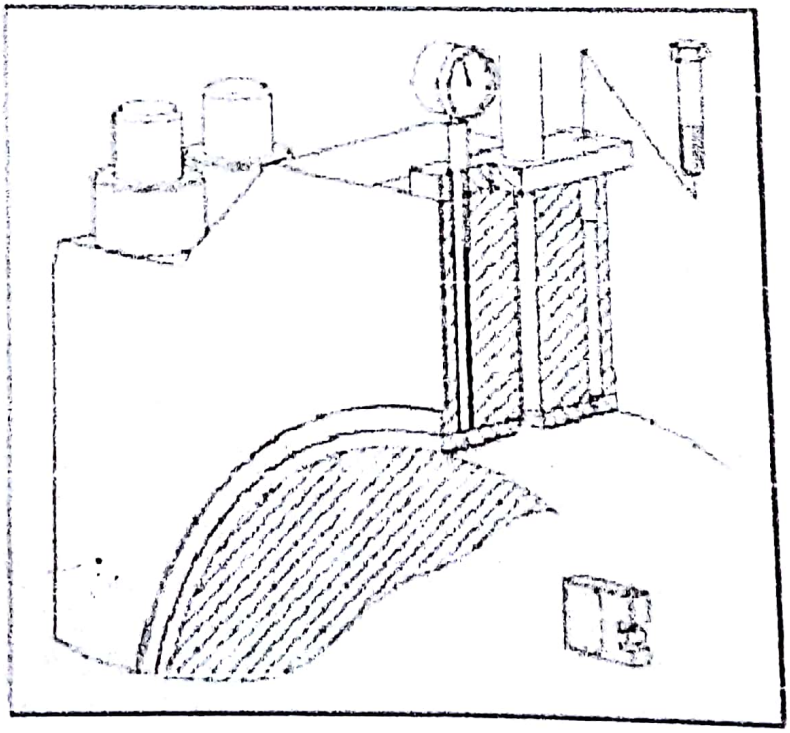
Swedish or Telescopic gauge

The telescopic gauge is inserted between the gap of the crank web and the bearing keep. When the tip reaches the shell top, the feeler is inserted between the shell and the pin to check the clearance.



4) Dial type Depth Gauge

This method is used in new MAN B&W engines (SMC-C) which does not require the top keep to be removed. The lube oil pipe connection screw hole is in the bearing keep which can be accessed from the hole on the bearing shell.



The dial gauge is inserted in this screw hole and the reading is taken as the clearance for upper shell

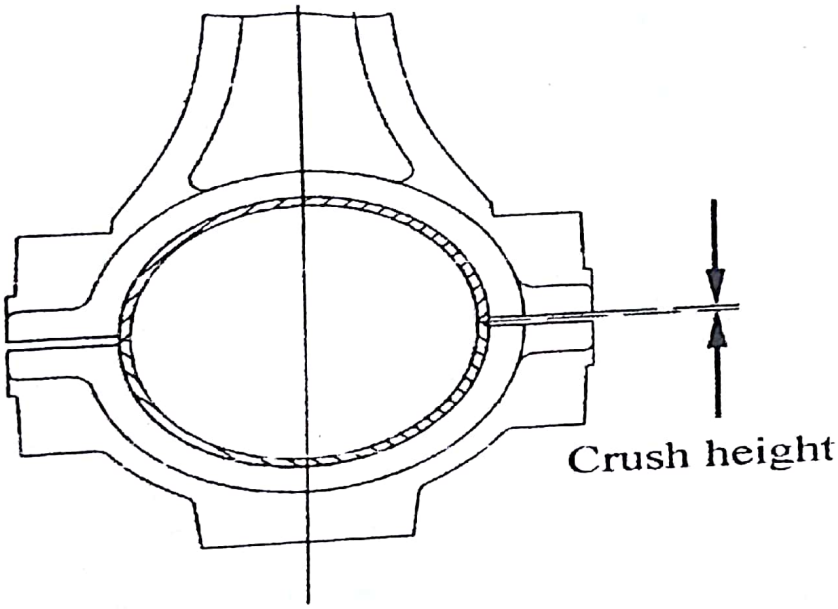
Note – But if you want to measure the wear down of the bearing then you have to take out the bearing and measure it thickness

For that we can use ball type micrometer because normal micrometer wont able to completely touch the bearing and you will get the wrong reading

Note – Some time surveyor ask that what is tangential run out – so it is used to guide the oil which come from non-loaded part to the loaded part

At the time when we are going to put the bearing in the housing so there may be the chance of misalignment for that reason base relief has been given to avoid any kind of misalignment

There may be the chance that bearing should rotate inside the housing for that reason nip or crush of the bearing is there which don't allow the bearing to move inside the housing



Q – Why it is difficult to lubricate crosshead bearing in two stroke engine (AA)

Ans – In 2 stroke engine it is very difficult to lubricate cross head bearing because there will be no reversal of load

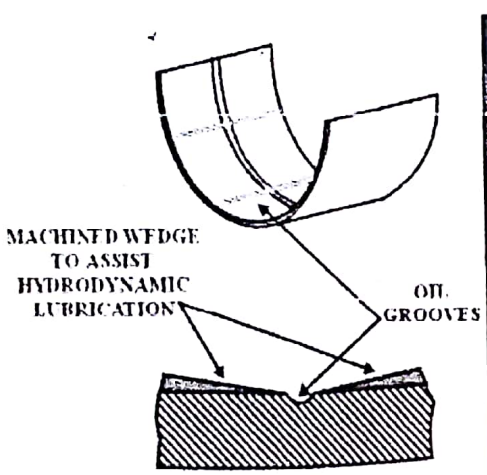
Note – All the time load will be on the bottom shell of the bearing because at the time of power stroke exhaust gas try to push the piston downward and at the time when piston start moving upward so at that time it try to compress the air so again load will be on the bottom half of the bearing shell

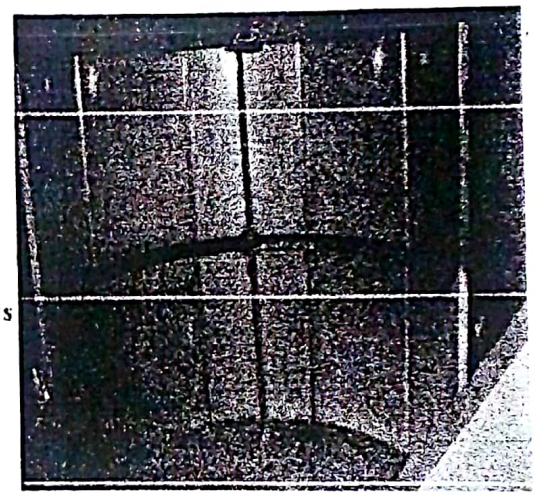
So that was the reason we are using articulate pipe which boost the oil pressure upto 12 bar in sulzer engine and that oil is pushed in between the shaft and bearing when there was the

minimum load mostly at the time when piston reaches near to TDC and exhaust valve is opened

But the question arises that how man b&w engine can easily cope up with 2.5-4 bar pressure and lubricate the crosshead bearing so the reason for this is given below –

1. In man b&w wedge artificial film will form because of the groove appearance
2. In man b&w crosshead bearing oil groove will be there in both the direction that was in the circumferential as well as in the axial direction
   Note – Because if axial groove was not there then it is very difficult for the oil to go in between the bearing and the pin because very little rotation is there in between of these two (pin and bearing)



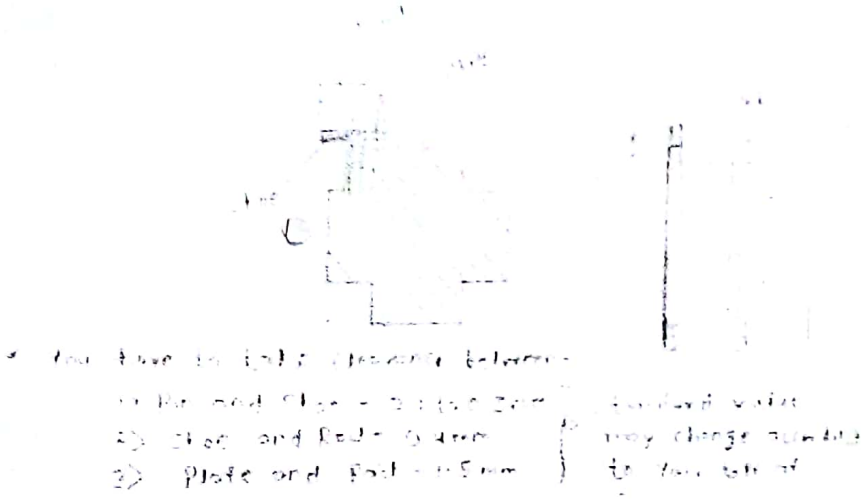


3. Man b&w crosshead pin has 16 times better finishing as compare to main bearing and bottom end bearing pin which help in hydrodynamic lubrication

So these all are the reason that how man b&w can easily cope up with low oil pressure

Q – At what all points you can take the clearances in crosshead bearing (VI)

Ans – See the diagram below –



Q – Different reason of bearing failure and modern technique to detect bearing failure (SA)

Ans – IF any bearing wear down then shoe will come down and get to know out from the proximity switch as shown below –

There could be the number of reason due to which bearing will fail during the operation –

Wiping out – failure of oil film or we can say when no oil film is there

Reasons –

1. The oil is mixed with water (viscosity low)

2. Overloading of the engine so oil film will break down

3. Ovality in the pin or may be in the general

Note – if more than 33 % of the area is wiped out then change the bearing because your overlay layer is already gone out

Fatigue cracking – fatigue cracking means a very fine crack will be there on the surface of the bearing

Reasons –

1.Due to fluctuation of load on the bearing

2.Bearing running at high temperature as we know at high temperature fatigue strength reduces

3.if your material is of poor quality then it will crack

Cavitation – cavitation generally occur when the pressure drop below the vapour pressure of the liquid so due to cavitation small holes will be there on the bearing

Reasons –

1.Water present in the lube oil

2.Diesel oil present in the lube oil

Note – Black spot on the bearing is because of erosion and layer of tin is oxidised because of corrosion

This is mostly occur when sea water enters into the lube oil

Q – Complete procedure to remove the main bearing of the engine (SA)

Ans - Moreover, the main bearing of a ship's main engine must be overhauled when its running hours as stated by the engine maker have been completed. Apart from this, if there is any sign of bearing worn out or if the bearing temperature is going high, it is imperative to open the main bearing for inspection.

The procedure for opening of the main bearing is as follows:

1) Inform company and take permission.

2) Take immobilization certificate from port state Authority stating that the main engine will not be available for a particular period of time.

3) Read the manual and have a toll box meeting with everyone involved in the job. Discuss the procedure.

4) Prepare important tools and spares to be used in operation.

5) Prepare risk assessment with the personnel involved in operation.

6) Shut starting air valve for main engine.

7) Open indicator cocks of all the units.

8) Engage turning gear and put it in remote control. The remote control switch to be operated by in charge of the operation.

9) Stop main lube oil pump.

10) Open crank case doors.

11) Put blower and ventilate it thoroughly.

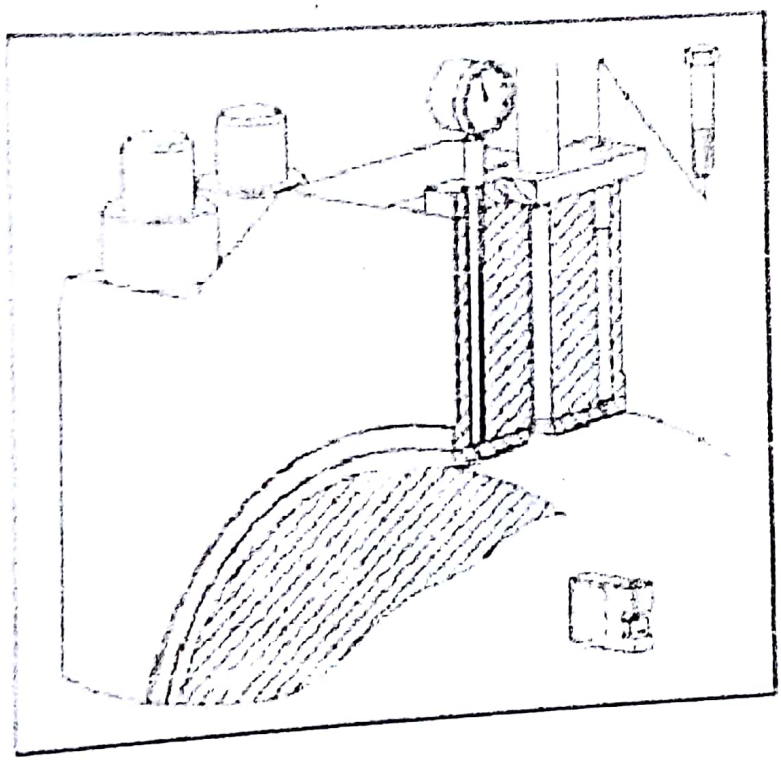
12) Prepare enclosed space entry checklist.

13) After sufficient ventilation, wearing proper PPE enter the C/C.

14) Make sure that the main bearing measuring tool (depth gauge) is calibrate and set to '0'.

15) Open the screws of lube oil pipe connection and insert the depth gauge and measure the clearance between upper bearing keep and journal.

16) Compare this reading with the earlier reading in the record or the new bearing reading.



17) Now disconnect the lube oil pipe line.

18) Turn the crank throw so that it is towards the exhaust side.

19) Now mount the hydraulic jacks and loosen the main bearing stud nuts.

20) Mount the lifting tool for main bearing keep and lift the keep using a pulley and a wire rope.

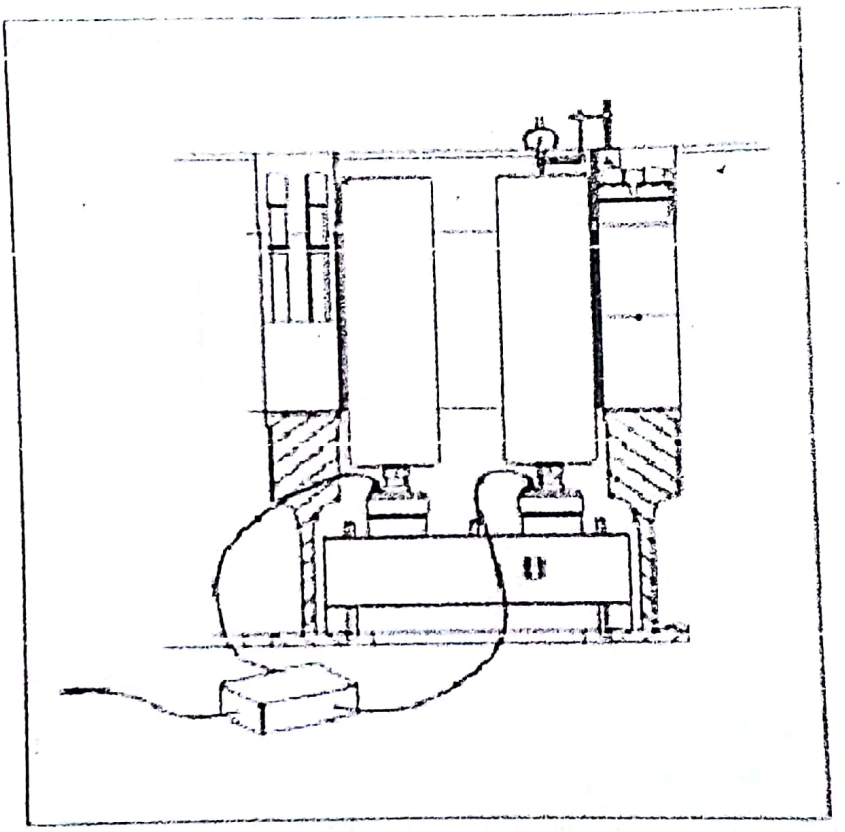
21) Note the marking on the main bearing keep before lifting for correct direction of the keep.

22) Guide the keep safely outside with a help of another chain block and place it on a wooden base once it is out.

23) Mount the tool for lifting the upper bearing shell and place it safely outside.

24) Place the strong back (cross piece) support on the bed plate so that its ends rest on the cross girders.

25) Mount the hydraulic jack on the cross piece placing it such that it lies beneath the crank webs.

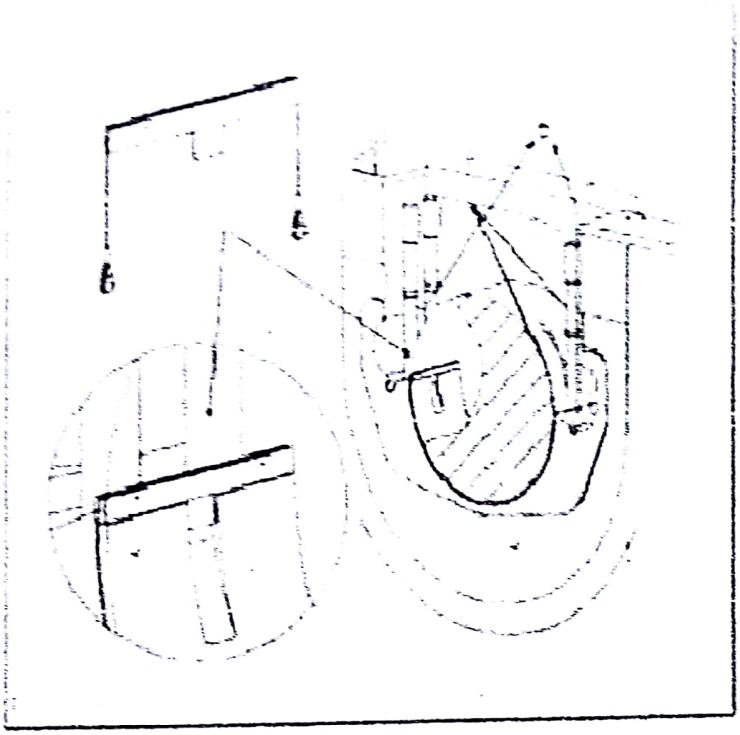


26) Mount a dial gauge on the adjacent main bearing so that the lift of the crank shaft can be recorded.

27) Now with hydraulic pressure (1500-1650 bar) lift the crankshaft corresponding to the main bearing clearance to the adjacent main bearing, and check the lift with the help of a dial gauge.

28) Remove the lock screws from the lower shell.

29) Place the dismantling tool on the lower bearing shell such that the flap enters the oil groove.



30) Pull the bearing shell round and up so that it lies on the journal and take it out safely.

Note - Top Main bearing clearance: max- 0.58mm, min- 0.40mm

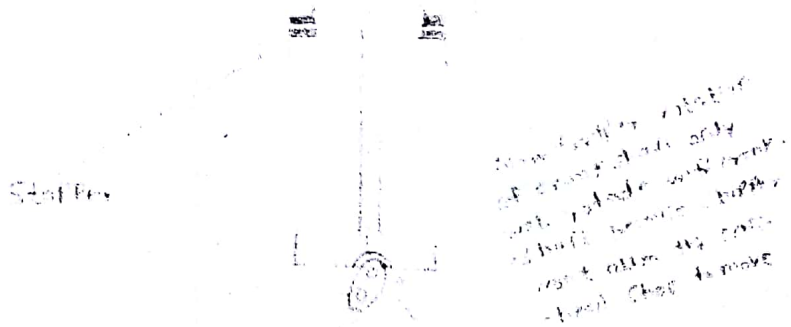
At the time of jacking make sure you will jack very carefully and never cross the reading because excess jacking permanently damage your crankshaft (one of the severe damage)

Q – How to inspect the crankpin bearing of 2-stroke engine (SA)

Ans – To understand this just see the diagram below –

Before doing this just take all the safety precaution and remove the bottom half because I am not going to write the same stuff again and again in relation to permit and safety which I already described above

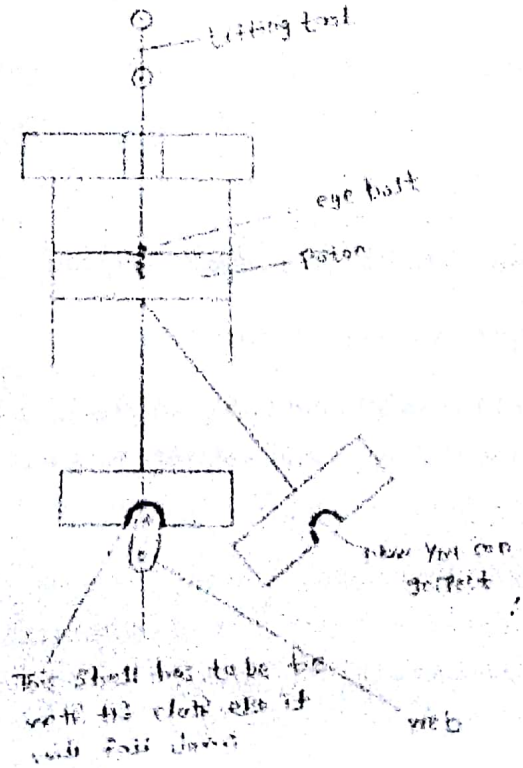
Procedure - We will place two stopper and turn the engine so, one point will come when crosshead shoe will rest on the stopper and no further movement of crankshaft and only web will rotate so you can easily inspect the bottom end bearing top shell with this method



Q – How to inspect the bottom end bearing in 4 stroke engine without taking the piston out from the unit (AA)

Ans – This question is very frequently asked now a days in MMD orals

To understand this just see the diagram below and before doing this just take all safety precautions and permits



1. So if you want to inspect the bottom end bearing in 4 stroke engine without removing the piston so just take out the injector from the cylinder head
2. Now rotate the flywheel and take the piston to TDC
3. After that put the eye bolt on the piston through the passage of injector (internal thread was there on the piston for the purpose of lifting)
4. Now with the lifting tool and chain block take the piston load so that when we rotate the engine the piston and connecting rod should not move (before ding this make sure you remove the bottom shell of the bottom end bearing by removing the hydraulic nut and bolt)
5. Now only crankshaft will move, piston and connecting rod is stationary so one time will come when you can easily take out the upper shell of bottom end bearing

Q – Explain the function of thrust block, working and how thrust has been transferred to hull (VI)

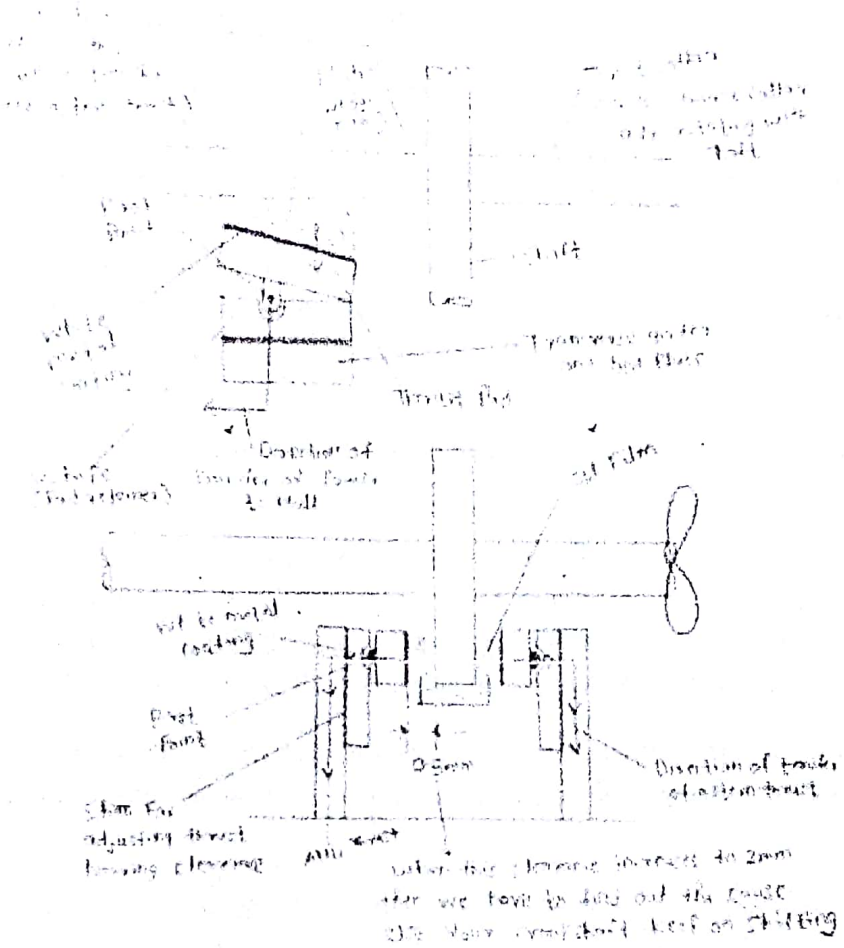
Ans – In all the books you find a very complicated explanation which is very difficult to understand so I start with very basics, as we all know that purpose of thrust block is to take the thrust of forward and aft and transmit to the hull because we don't want that propeller thrust should come on engine else our whole crankshaft will shift towards the other side

Some amount of thrust still transfer to the crankshaft for that reason we fit axial vibration/movement monitor which keep on giving you the reading or some time we use thrust block in the aft also

Note – In earlier days we put the thrust block outside the engine so because of this it wont work efficiently and axial movement of the crankshaft is outside the normal range so that was the reason we change the design now it has been put near to the engine at the aft side and the other reason is we put the thrust block at that place where minimum vibration has been there and it put on that place where strengthening is provided where it is going to rest

1. In thrust block we have the thrust pads (180 degree to 240 degree)
2. This pads automatically tilts and form the oil film which can transfer the thrust (normally wedge oil film is formed)
3. In diagram it is clearly shown the direction of transfer of thrust
4. On thrust pad we have the white metal coating
5. We have U shape pad retainer which further transfer this thrust to transfer girder and bed plate
6. Oil film is form between the thrust pad and thrust collar and a important point to note is that only thrust collar is rotating with the shaft
7. Liquid is incompressible so that was the reason it transfer the trust to thrust pad

8. We have two thrust pad fitted opposite to each other one will transfer the ahead thrust and one will transfer the astern thrust



Note – Maximum clearance allowed is 2mm between the collar and thrust pad if clearance has been increased then you have to find out the reason why clearance has been increased else your shaft keep on shifting and you find out the reading on the axial vibration monitor

In thrust block we have both temperature is fitted which both have alarm and trip of your engine. Alarm set point = 65 degree and Auto shut down of engine = 75 degree (Standard values which may change according to your engine)

Note – Some time surveyor ask that how to check that clearance for that we put the hydraulic jack to shift the crankshaft on one side and reading has been taken by the dial gauge, but this has to be done by the expert only else you may break the internal parts of the engine

Q – How to do the crankcase inspection in 4 stroke engine and what all things you will check in that (AA)

Ans – There could be the number of places which you need to check during the crankcase inspection but before that lets talk about safety aspect first –

1. Stop the engine and wait for the engine to cool down sufficiently
2. After two hours you have to stop the priming pump
3. Put the men at work tag in ECR and at local panel
4. Shut the starting air to the starting air motor
5. Open crankcase door and allow it to cool down
6. Take one torch and small hammer with you
7. If crankcase seems to be cleaned then it is okay but if you find dirty crankcase or you find black carbon it means blow past from the unit
8. Then you have to check the condition of oil, for that you have to take some oil from crankcase and rub that oil with your fingers and check the ingress of water and diesel
9. Check all the hydraulic nut of main bearing, bottom end bearing for that you have to hammer it solid sound should come and also check the locking of all the hydraulic nuts
10. If lube oil is too much sticky or too much slippery then there may be the possibility of bacteria contamination but it mostly happen in 2 stroke engine not in 4 stroke engine because of the high temperature
11. We have to check for any water leakage from the liner if any water leakage is there, then that was the clear indication o-ring of liner has been gone
12. Check the axial or floating movement of the connecting with the help of screw driver
13. Check the lube oil for any white metal, clear indication of bearing worn out (Also check this thing at the time of lube oil filter cleaning also)
14. Check the condition of liner, if you find the blackish liner it means there was the clear indication of blow past from that unit
15. If you have the dry sump then one strainer is there so, just make sure nothing is stuck in that strainer
16. If you remove the complete oil then one strainer is there from where your lube oil pump will take the suction check that also
17. Check the condition of gear which give the drive to camshaft
18. On those gear we have two nozzle which give the lubrication to the gear so check the condition of that by starting the priming pump
19. You also need to check that from all the main bearing equal amount of lube oil has been fall down to the crankcase
20. In some engine nozzle has been there for piston cooling so make sure that adequate quantity of oil has been coming out from the nozzles
21. Generator relief door has to be pressed with hand just to make sure that everything is fine

22. Check the breather of crankcase in which flame arrestor is there which is near to the funnel just make sure that it is not blocked else your complete crankcase has been pressurised
23. Open the cam case cover and check the condition of roller and cam, roller should not stuck over the cam
24. Check the condition of camshaft bearing

Note - Make sure you don't have anything in your pocket at the time of inspection not even any cotton rags

Note – During crankcase inspection we never take any kind of clearance but visually we can check the condition of all

Q – How to check the slippage in 2 stroke engine(RA)

Ans – One mark is there, till the time that mark is coincide with the web there will be no slippage

Q – Why engine is not to run on critical speed for long time (VI)

Ans – To understand this first you need to understand some basic terminology, for that I consider one example when ever you go to temple and you hit the temple bell with your hand so the sound came by hitting is the induced frequency of vibration and sound came after that which last for some time is the natural frequency of vibration

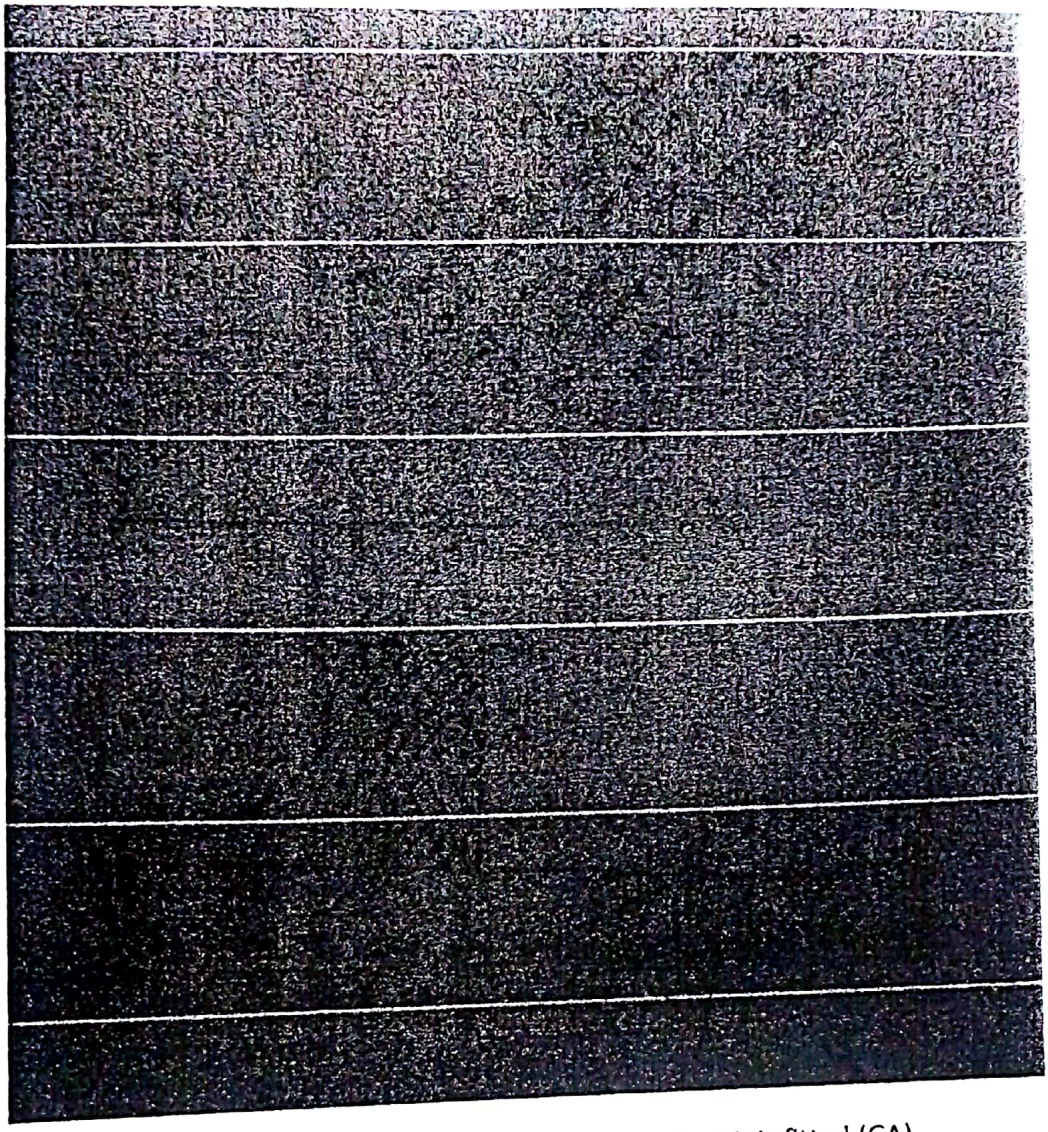
Natural frequency of vibration depends upon – material, thickness and length with which you can change the natural frequency of vibration

Now lets talk about our engine, firing in the engine is the induced frequency of vibration and whatever happens on the crankshaft due to the firing inside the cylinder is the natural frequency of vibration but at one rpm resonance will take place so due to which this natural frequency of vibration will last for long time

So that was the reason we have to quickly cross that rpm so that resonance should not take place under any circumstances

Note – If you run the engine on critical speed so the stresses induced on the crankshaft could even break it

Note – In generator we have the critical rpm somewhere around 100-110, but we always run the generator at 890-900 rpm so that's why we don't worry that much



Q – With sketch explain main engine stuffing box and where it is fitted (GA)

Ans – Stuffing box is fitted on the diaphragm and piston rod is passing through it

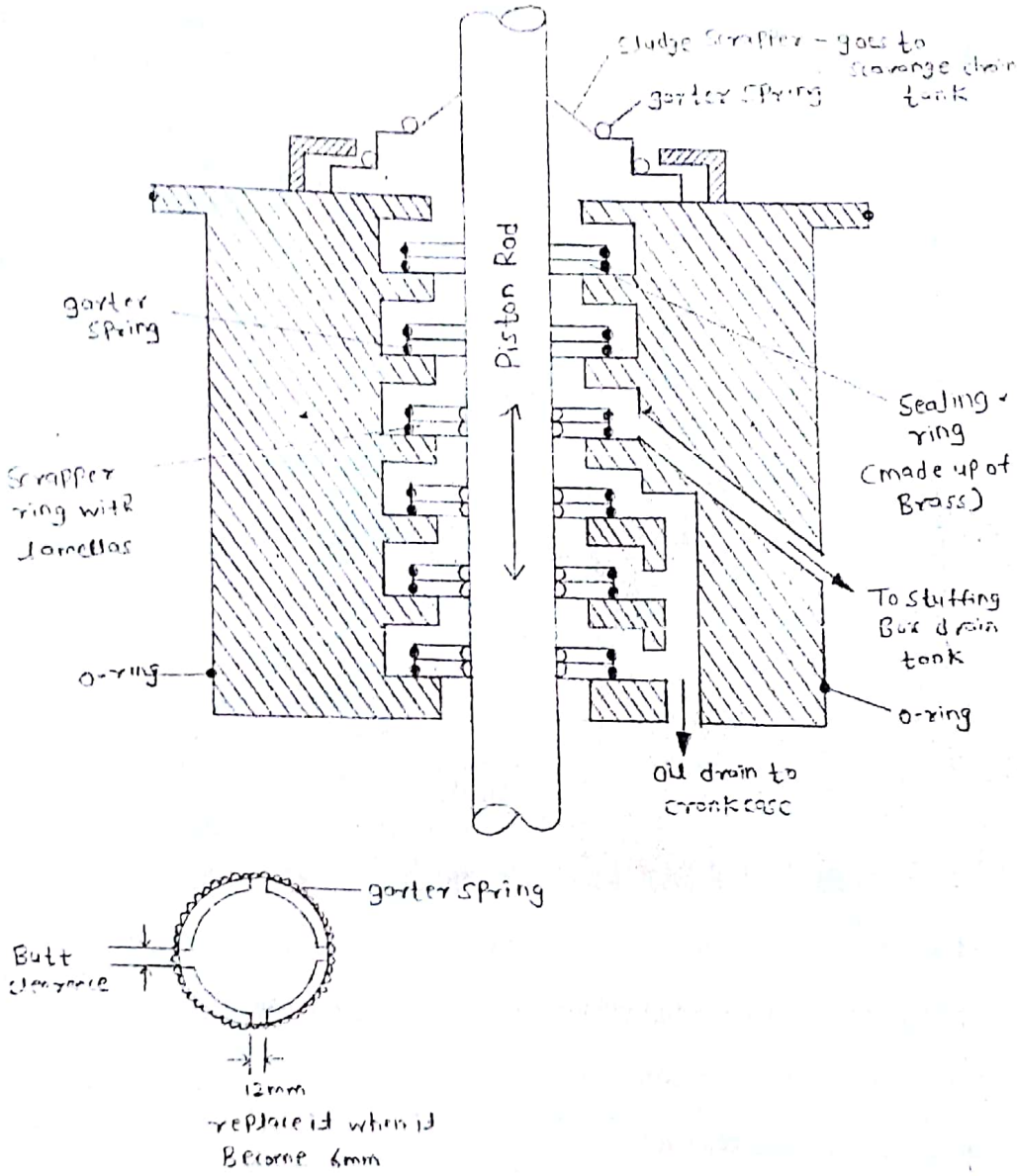
Purpose – Prevent oil not to go into crankcase

Prevent scavenge air not to go into crankcase

Prevent exhaust gas not to go into crankcase (act as a barrier if anything goes wrong above this so it wont allow that effect to come on to the main engine crankcase side)

Note – If too much oil is coming in the drain of stuffing box it means your scrapper ring wont work properly

If too much air is coming out from the drain of stuffing box it means your sealing ring wont work properly



Note – Garter spring push the sealing and scrapper ring towards the piston rod so that it can effectively scrap and seal the surface

This was the only part in engine room which can be replaced when butt clearance reduced to the replaceable value

Sealing ring and scrapper ring continuously make contact with the piston rod so due to this wear down of these two part will take place and one point will come when there was no sealing and scrapping effect and then we have to replace the sealing and scrapper ring

Note – First scrapper ring drain goes to the stuffing box drain tank because it has a mixture of oil and sludge

Lamella is made up of cast iron and mostly this will worn out inside the sealing and scrapper ring, so sometime we only change the lamella's

Note – If any of the outside o-ring of the stuffing box was not sealing properly then scavenge air will go to the crankcase and pressurise it so there may be the possibility that oil start coming out from the labyrinth seal which is fitted on the aft side of the crankshaft

Q – Explain the basic functioning of fuel pump with diagram (AA)

Ans – The function of the fuel pump is to meter the quantity of fuel as per the load with the help of rack

So the basic function of the fuel pump is –

1. Increase the pressure
2. Meter the quantity of fuel
3. Timing the fuel injection

At TDC and BDC these are the two places where piston movement is normally zero

Fuel burn at TDC because no volume is going to increase and tremendous pressure has been generated

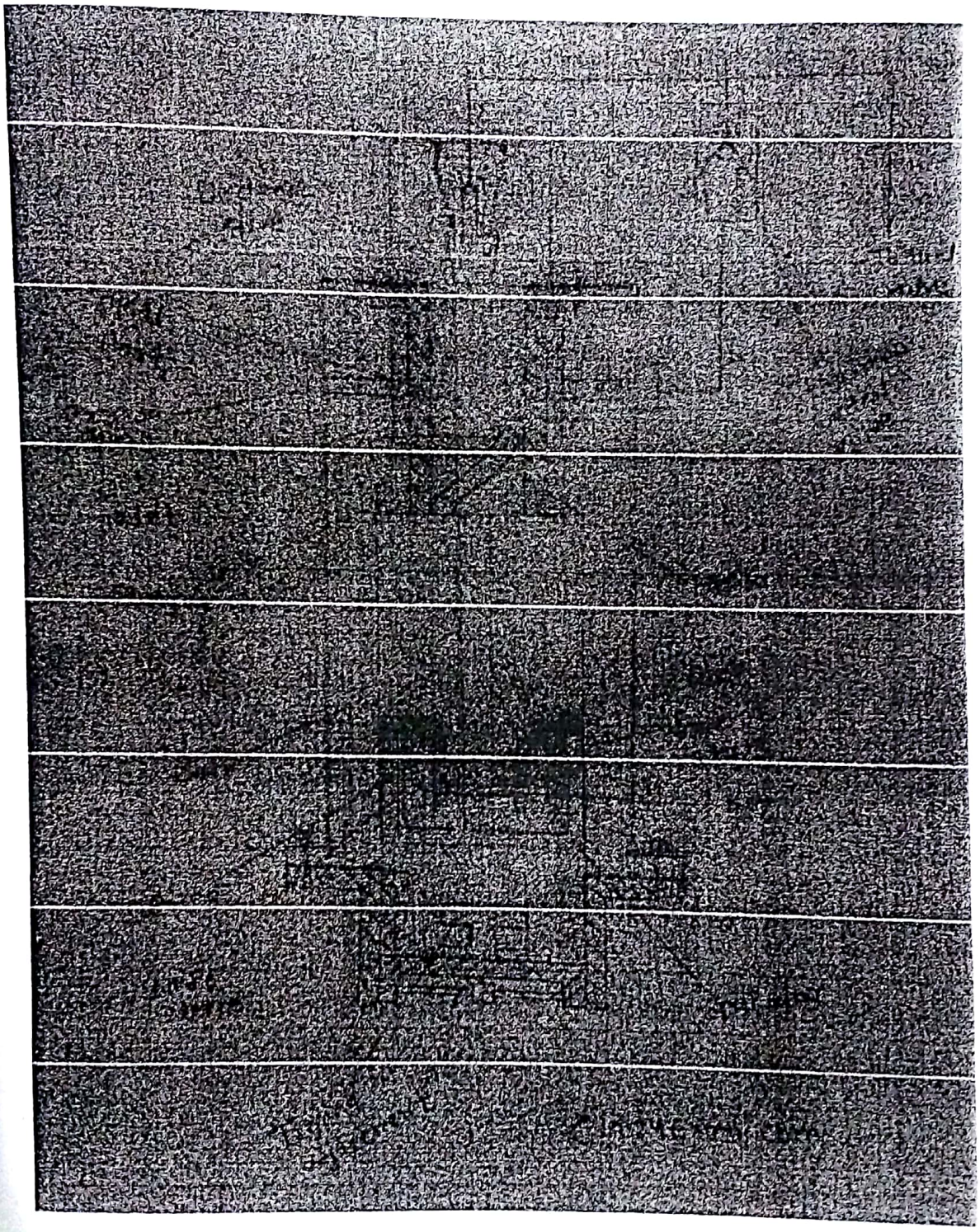
The combustion of the fuel has to occur near TDC and try to avoid the combustion when piston going downward because volume is going to increase so efficiency of the engine has been dropped (thermal efficiency)

Note – Surveyor mostly ask that why all fuel pump are called jerk type fuel pump so the reason is that when plunger of the fuel pump start moving upward so it will try to compress the fuel and due to which pressure keep on increasing as we know liquid are incompressible; due to this increase in pressure needle valve of the fuel injector lift up and fuel will be injected inside the engine but due to this action pressure in the line drops and next injection will take place when again sufficient pressure will be there in the high pressure line so it simply means that injection is not continuous so that was reason we try to give the jerk to the roller with the help of fuel cam so that pressure should not drop even after opening of the needle valve of the fuel injector for that reason we design the fuel cam

in such a manner that it should give the jerk to the fuel pump plunger that was the only reason why all fuel pumps are called jerk type fuel pump

Different types of fuel pump

1. **Helix control type – Man b&w**
2. **Valve control type – Sulzer**



1.**Helix control type** – Fuel pump plunger and barrel can be replaced together, made up of nitrite steel (highly polished) and clearance of 2-3 microns in between of that.

First we will discuss in detail about helix control type of fuel pump and before starting with the working of this pump I would like to tell you the basic terminology related to valve control type fuel pump

1. Spill port name is given because fuel come from it and when the plunger moves up some of the oil goes out from the spill port itself

2. Plunger moves inside the barrel

3. As the plunger keep on moving upward so one point of time will come when it will cover the spill port that point is the beginning of injection because remaining oil start compressing inside the chamber and we know liquid is incompressible so in a fraction of microseconds sudden rise in pressure will be there

4. Beginning of injection when plunger cover the spill port

5. When cam push the roller so it will push the guide sleeve and guide sleeve further push the plunger upward

6. The time plunger move upward and beginning of injection take place when plunger cover the spill port and after that one time will come when helix of the plunger come in contact with the spill port so that high pressure oil automatically goes back to the spill port and that point is called the end of injection

7. When the helix come in contact with the spill port so the time when this take place the high pressure oil from the spill port hit the body of the fuel pump so to save the body of the fuel pump erosion plug is fitted

8. As shown in the diagram the key is moving up and down with the movement of the plunger up and down

9. Rack is connected to the pinion to meter the quantity of fuel oil by turning the helix of the fuel pump

10. Normally we cut off the fuel supply when the position of the rack is on +2 or +3 because we always take the safer side

11. Helix will change your end of injection point but the turning of helix has been controlled by the governor, so according to load governor automatically set the end of injection

12. When spill port cover by the plunger that point is called the beginning of injection and when helix come in contact with the spill port so that point is the end of injection, so

ultimately fuel has been injected in between of these two that's why it is called effective delivery stroke

13. Lubrication has been provided by the fuel oil only

14. So effective delivery stroke normally depend upon the load that when we have to stop the injection

15. So timing can be checked from the cam, not from the rack of the fuel pump

16. When plunger of the fuel pump moving upward so pressure of the fuel keep on increasing and the time when it cover the spill port the injection commences, but the time when short circuit takes place means helix come in contact with the spill port so sudden pressure will drop above the fuel pump plunger so due to this drop in pressure what ever high pressure oil was present in the high pressure line it will try to come back to the fuel pump but it was not possible because of the drop in pressure inside the fuel pump closes the discharge valve (this discharge valve as shown in the diagram act as the non return valve) so that high pressure oil in the high pressure line act on the fuel injector and again lift up the needle valve and injection will take place but this injection is called the secondary injection which is not required at all so, for that reason we provide the Stagnation Control Valve as shown in the diagram

17. But a very interesting point to note is that why stagnation control valve will not open during normal injection, it is because of the area difference because pressure above the valve is same and pressure below the valve is same but due to difference in area it will not open during normal injection

18. In previous design we have helix on the plunger in one side only so when short circuit takes place so high pressure oil hit the body in one side which generate the side thrust in one side only so to compensate this we give the dual helix on the plunger

19. After injection or effective delivery stroke when plunger of fuel pump is coming down, so for some time helix is attached to the spill port but after a fraction of second condition changes and there will be no more contact so fuel stop coming from the spill port to the upper side of the plunger, but plunger still moving downward so whatever oil is present on the upper side of the plunger it starts boiling because vaccum is created on top of the plunger because it continuously moving downward and nothing is coming on top of it so cavitation will be there which will damage the plunger so in this case again stagnation control valve helps and give oil from the high pressure line to the upper side of the plunger so that the space above the plunger should not go to the vaccum

So this was all about the fuel pump

How to check beginning of injection in fuel pump – This was the question that surveyor mostly ask that how will you check the beginning of injection in fuel pump, so to check this there will be the number of methods which is described below –

Method – 1

1. Remove the discharge valve from the fuel pump and directly connect the high pressure fuel line to the fuel pump without discharge valve
2. On the other side of high pressure pipe put one bucket just below the h.p pipe
3. Now start the fuel pump and oil will start coming into the bucket
4. Now start turning the engine with the help of turning gear
5. The time oil stop coming from the h.p pipe to the bucket that was the beginning of injection for that fuel pump
6. You can mark on the flywheel

Note – We can adjust the injection timing of starting by adjusting the timing adjustment as shown in the diagram, with its upward movement we can open the injection early and vice versa

Method - 2

1. With light method you can check the beginning of injection, we put the the light from spill port and other side light will come the time light stop coming on the other side that was the beginning of injection it simply means that you spill port is fully covered by the plunger

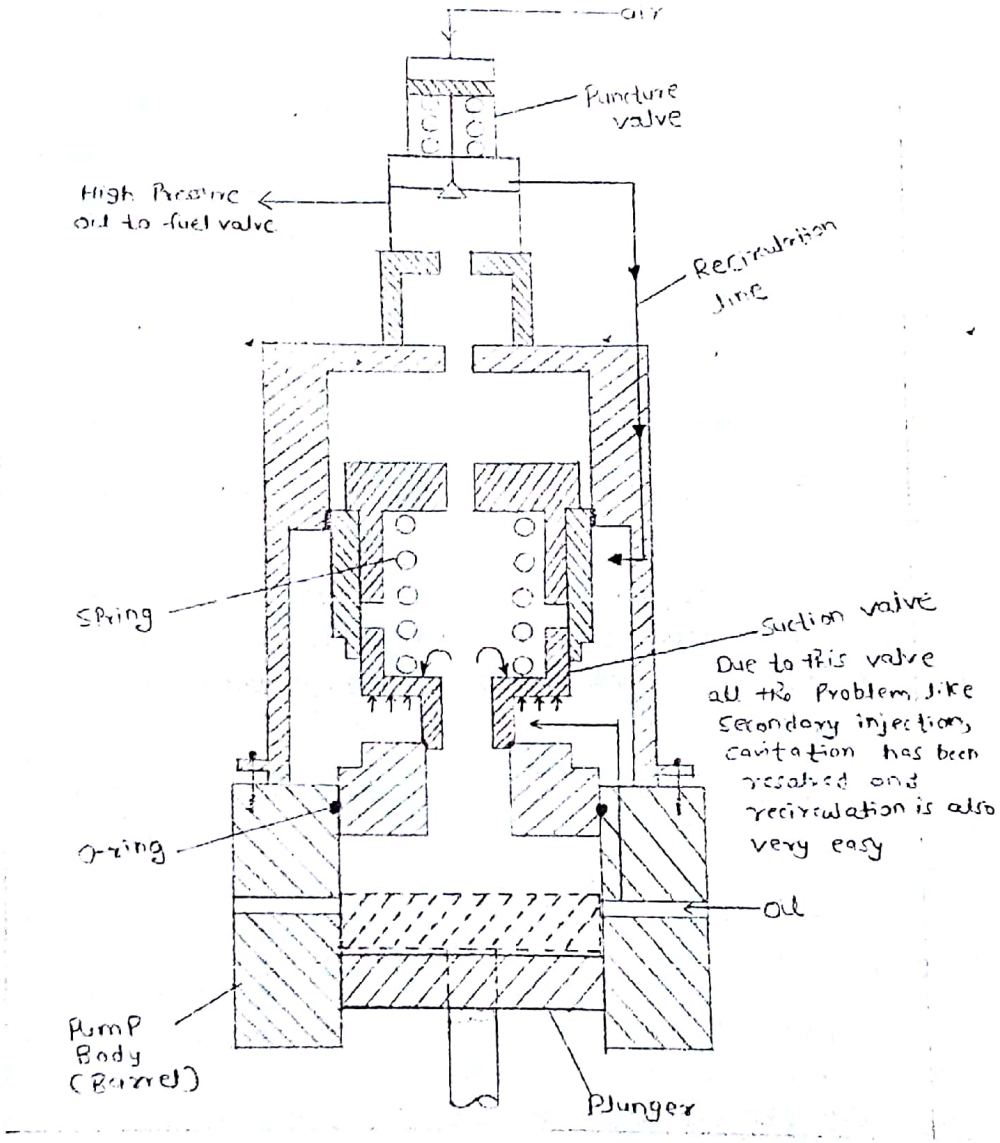
Note – If our fuel quality is bad then the chance of ignition lag is on the higher side so we early the beginning of fuel injection

MAN B&W FUEL PUMP – Now lets talk about latest man b&w fuel pump

The pump is basically a jerk type with a plunger moving in a matched barrel, using two helical grooves machined in the plunger to control the end of injection by uncovering spill ports and causing the discharge pressure to drop rapidly, thus causing the needle valve in the injector to close.

Oil is supplied to the barrel via the spill ports and a suction valve. The suction valve, situated at the top of the barrel opens when the pressure in the barrel falls below the supply pump pressure; i.e. during downward stroke of plunger, while spill ports are covered by plunger.

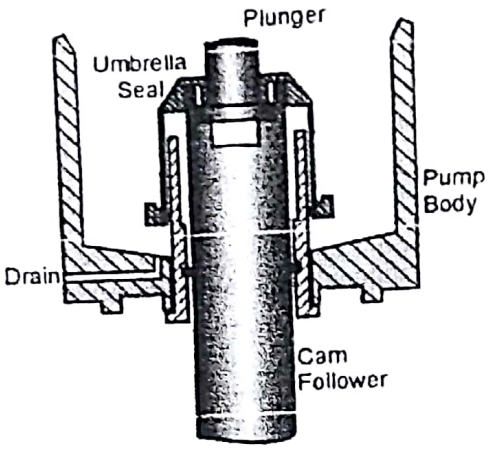
Replaceable erosion plugs are fitted in the pump housing opposite the spill ports. The high pressure oil, spilling back, as the edge of the helix uncovers the spill ports at the end of injection, hit the plugs, which prevent damage to the pump casing



1. In this type of fuel pump there will not be the problem of cavitation because the time when plunger is moving downward so oil will come from the suction valve because all the time 9 bar pressure is available over there because of the booster pump
2. If your engine stop at that point so that your spill port is completely cover by the plunger so how recirculation will take place this was the frequently asked question in MMD so in this type of fuel pump there will not be the any problem because in that case oil will come from the suction valve

Puncture valve - A puncture valve is fitted in the top cover of the pump. It is opened when compressed air from the control air system acts on top of a piston fitted in the top cover. Fuel oil from the discharge side is then returned to the suction side of the pump and no injection takes place. The puncture valve is operated in the event of actuation of the shut down system (all units), during the air start sequence or when excessive leakage is detected from the double skinned fuel pipes.

Fuel oil leakage past the plunger to the cam case is prevented by the use of an "umbrella" seal



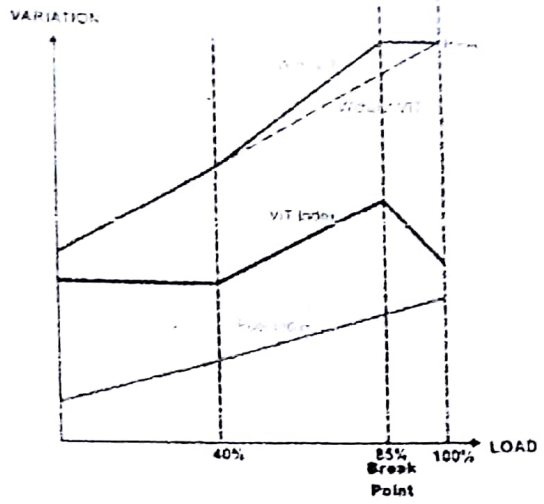
FUEL PUMP UMBRELLA SEAL

Note – Some time question asked that pressure below the puncture valve is normally 300 bar so how 7 bar air can open the valve inside the fuel pump, so again the concept is same that was the area difference

Note – In sulzer and man b&w fuel pump cam profile is different in man b&w roller all the time was on the top profile and only at the time of injection it comes down and give the jerk and remain it was there only but in case of sulzer cam profile is totally different as shown below

Q – What is the reason of using variable injection timing (VI)

Ans –



The reason for using VIT is to achieve greater fuel economy. This is achieved by advancing the injection timing so that maximum combustion pressure (pmax) is achieved at about 85% MCR (maximum continuous rating).

The system is set up so that there is no change in injection timing at low loads (40%MCR). This is to avoid frequent changes of pump lead during manoeuvring.

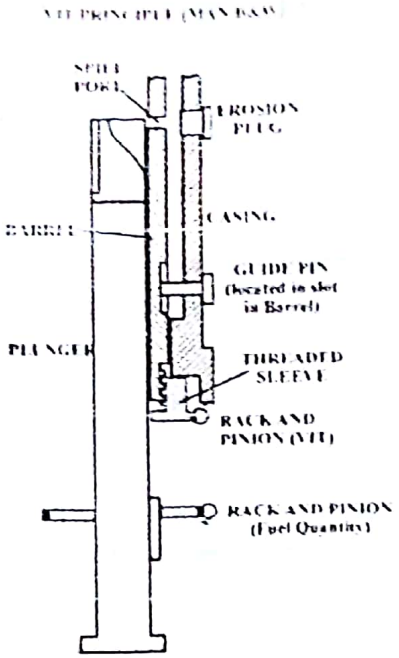
As the engine load is increased above 40%, the start of injection advances. When the engine has reached approximately 85% MCR at which the engine is designed to have reached pmax, the servos retard the injection timing so that the maximum combustion pressure is kept constant between 85% and 100%MCR.

At 90% MCR a fuel saving of 4-5g/h.p.hour is claimed to be achieved.

Variable Injection timing also allows for small adjustments to the fuel pump timing to be made to allow for fuels of varying ignition qualities. Wear on the fuel pumps can also be compensated for as can changes in the camshaft timing due to chain elongation (up to 2 degrees)

Note – The diagram shown below is clearly tell you that how linear movement can be converted into axial movement of the barrel

So with the up and down movement of the barrel we can vary the injection timing



Q – How VIT actually work and how break point is been decided and normally when we change the VIT settings (SA)

Ans – This question very rarely ask from 4th engineers because it belongs to 2nd engineers, because actually working is little difficult to understand but still I try to give you some brief idea about the working of VIT

The air signal to the fuel pump VIT actuators which operate the VIT racks is implemented within the electronic governor as an electrical signal between 4 and 20 milliamps. This signal is sent to an IP converter which generates the pneumatic control signal between 0.5 bar (min VIT setting) and 5 bar (Max VIT setting).

The essential difference between the mechanical and electrical system is the use of the breakpoint and how the pressure rise is controlled. With the mechanical system the breakpoint is fixed, with the electrical VIT system the breakpoint is variable depending on the scavenge pressure.

If the scavenge pressure is high, then the resulting compression pressure within the cylinder will be higher: This means that unless adjustments are made, the maximum pressure in the cylinder could rise above the design point. By altering the breakpoint to a lower percentage point of engine load, Pmax is reached earlier and maintained at that point until 100% load.

Similarly, if scavenge pressure is low, then the breakpoint moves closer to 100% engine load, so that Pmax is still reached.

The electronic control is only active when running ahead when the engine is in bridge control or ECR control. When running astern or in local engine side control, the manoeuvring system delivers a preset pressure to the VIT actuators.

Adjustments during running are simpler, as correction values are entered directly into the governor. Change in fuel quality or wear in the fuel pumps may make it necessary to adjust the VIT.

The correct method of doing this is as follows:

1. Take a set of indicator cards with engine load just above the breakpoint.
2. Adjust the Pmax by altering the governor Poffset value. (this is the value by which the Pmax can be raised or lowered)
3. Take a further set of indicator cards to verify adjustments.

In the case of badly worn liners giving poor compression, or excessively worn fuel pumps, it is recommended that the VIT function is disabled in the governor settings.

Q – Difference between VIT and Super VIT (GA)

Ans - To start with, variable injection timing. In this method the injection timing is varied so as to have maximum combustion pressures, Pmax, at low loads.

VIT is used in Sulzer Engines.

VIT= Variable beginning of injection + Variable ending of injection = Adjustable timing of injection.

Thereby helps in achieving maximum combustion pressure at 75-100 % load range.

Super VIT

Super VIT = Adjustable Timings + Adjustable Break Point

Break Point

Is that load point where the maximum cylinder pressure has been reached and injection timing has been advanced the most.

Above break point injection timing is gradually retarded back until it reaches its original setting at 100% MCR load.

Generally it is 85% MCR load.

SUPER VIT OVER VIT

In VIT, adjustable timings are obtained by means of a special profile on fuel pump plunger. Hence there is a fixed relation between fuel injection timing and fuel index. Thus, in VIT it is not possible to adjust injection timing without altering fuel index.

How increase in efficiency?

Increase in efficiency is due to ability of engine to operate with the maximum designed firing pressure and giving a higher ratio of expansion over a wider range of load. Thus increasing thermal efficiency and lowering specific fuel oil consumption at part loads on engine.

Expansion Ratio: is Ratio of maximum combustion pressure to pressure at commencement of exhaust blow down.

So increase in efficiency is due to increase in expansion ratio, when the engine is operating under light loads right up to full load.

Q – Explain the basic function of fuel injector/fuel valve and how it works (AA)

Ans – Penetration and atomization is been done by the needle valve

Atomization – Breaking of big droplet of oil into small drops, due to which surface area increases and better mixing will take place

1. To atomize fuel oil properly – viscosity should not be high, else it is difficult to break so better to heat the oil
2. Normally we take oil either 380cst/180cst @ 50 degree but at the time of injection your viscosity is to be 12 cst (viscotherm will automatically take care of it just set the viscotherm to 12 cst)
3. Atomization has been done by passing the oil through small openings

Penetration – As soon as oil droplets leave the nozzle so whatever distance that droplets cover after that inside the cylinder that is called penetration

Penetration is very important to know because complete combustion area is available to utilize but penetration should not be too high else it will hit the cold liner and combustion will take place on liner which is not good for liner

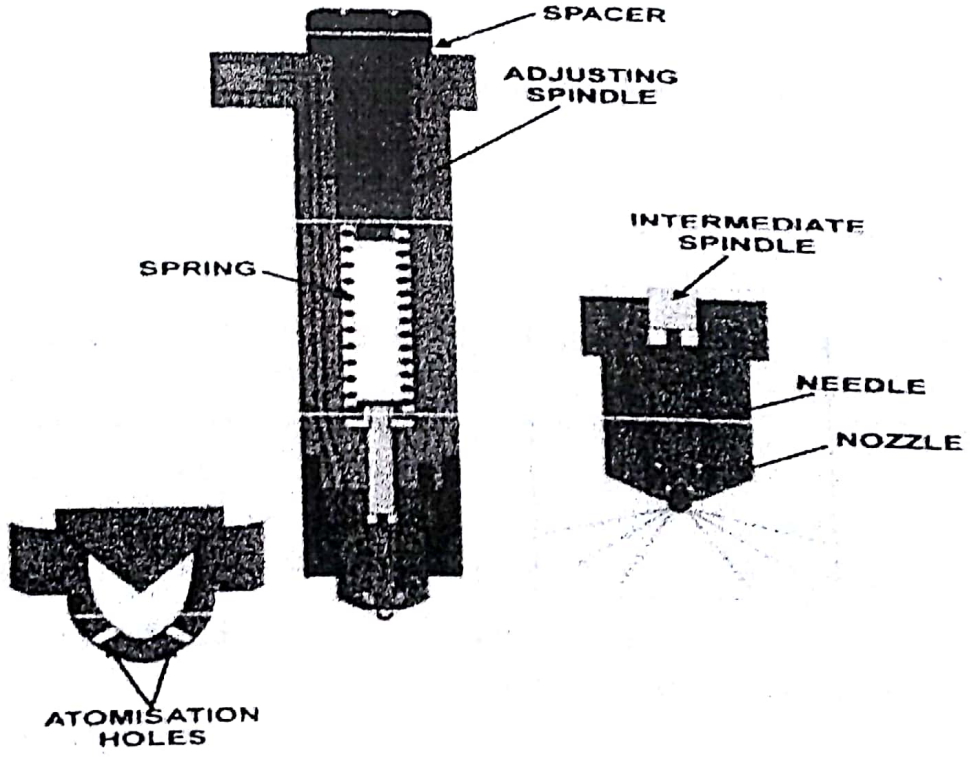
But even penetration should not be too low else complete fuel droplets just burn near to the nozzle and we cannot effectively use the full combustion space

Note – If penetration is high then atomization is low or vice versa, so we need to maintain a balance between of these two because both of these are important for efficient burning of the fuel inside the combustion space

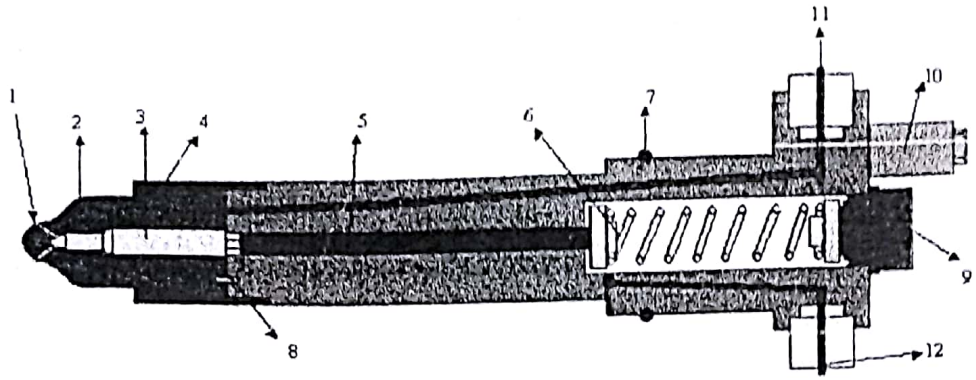
Note – Now lets talk about the third parameter which is equally important that was air, when air will swirl it properly mix with the fuel and that swirling action is been done by the scavenge ports (they are design tangentially so that air come with the swirling action)

Working - Fuel injectors achieve atomization and penetration by making use of a spring loaded needle valve. The fuel under pressure from the fuel pump is fed down the injector body to a chamber in the nozzle just above where the needle valve is held hard against its seat by a strong spring. As the fuel pump plunger rises in the barrel, pressure builds up in the chamber, acting on the underside of the needle as shown. When this force overcomes the downward force exerted by the spring, the needle valve starts to open. The fuel now acts on the seating area of the valve, and increases the lift.

As this happens fuel flows into the space under the needle and is forced through the small holes in the nozzle where it emerges as an "atomised spray".



PARTS NAME



	PART NAME		
1.	ATOMIZATION HOLE	7	'O' RING
2.	NOZZLE BODY	8.	DOWEL PIN
3.	NEEDLE VALVE	9.	ADJUSTING NUT AND WASHER
4.	NOZZLE CAP NUT	10.	RETAINING NUT
5.	INTERMEDIATE SPINDLE	11.	INLET CONNECTOR
6.	SPRING	12.	LEAK OFF CONNECTOR

Note – In this type of fuel injector recirculation takes place in a different way like small quantity of oil keep on leaking from the side of the needle valve and from there it come to the side of the intermediate spindle and from there it finally goes out from point 12 as shown in the figure above

At the end of delivery, the pressure drops sharply and the spring closes the needle valve smartly.

Older loop scavenged engines may have a single injector mounted centrally in the cylinder head. Because the exhaust valve is in the centre of the cylinder head on modern uniflow scavenged engines the fuel valves (2 or 3) are arranged around the periphery of the head.

The pressure at which the injector operates can be adjusted by adjusting the loading on the spring. The pressure at which the injectors operate vary depending on the engine, but can be as high as 600 – 800 bar

Note – At the time of hydraulic testing of injector on the testing machine it normally opens at 350 bar (approx. value may change according to the specification and design) but during the injection of fuel inside the combustion chamber it normally opens at 800 -1000 bar (approx. value may change according to the engine) because testing we done at atmospheric pressure while it mount on the cylinder head, there no longer be the atmospheric pressure because injector normally inject fuel when piston about to reach at

TDC at that time pressure inside the combustion space is too high. This was one of the important point to understand which surveyor mostly ask during your orals

Note – Needle and guide is same piece and it has to be replaced in pair

Testing of fuel injectors – There could be the number of test that we normally perform on the fuel injector to make sure that it should work efficiently inside the engine

After the parts are cleaned and inspected the fuel valve is assembled as per the manufacturer's instructions and thereafter tested for function and performance.

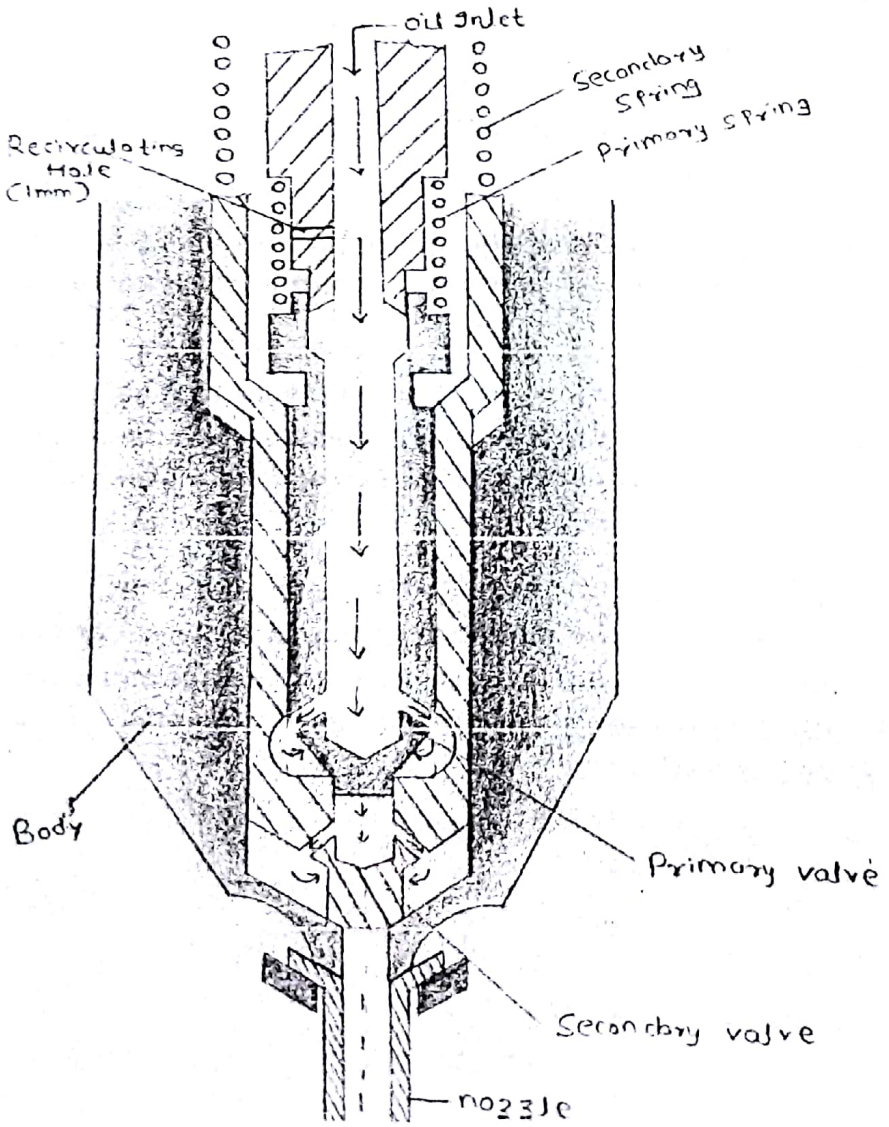
1. **Spray pattern test –** To check the spray pattern just put one paper below the injector and give a jerk (spray pattern basically tell you about the condition of holes in the injector)
2. **Leak test -** To test for tightness between needle and guide, operate the hand pump to increase pressure until it is just below opening pressure. See how long it takes the pressure to fall off. If the pressure falls quickly the needle and guide should be replaced.
3. **Drip test -** To test for the tightness between the nozzle needle and seat, operate the hand pump slowly to gradually increase the pressure until it is just below opening pressure. Maintain the pressure for a few seconds and ensure injector is not dripping.
4. **Opening pressure test -** The assembled fuel valve is installed on the test stand and after purging the pipe line the manual handle is operated in quick succession. The nozzle should start discharging with a sharp crackling noise at the set pressure. The pressure at which the injector is supposed to fire depends upon the manufacturer's engine design but normally is between 280 to 380 kg/cm2 with an allowance of plus or minus 10 kg/cm2. If opening is early so you can adjust the opening by tightening the screw on the top of the injector
5. **Hole diameter in injector** – You can check the hole diameter with the help of go and no go gauges (go gauge should go inside the hole and no go gauge should not go inside the hole if it goes then you have to replace or check with the instruction booklet)

Following points to be remembered while testing of fuel injector:

1. Visually examine the injector just after taken from cylinder head. Pressure test and find opening pressure in service.
2. Check injector setting pressure, formation of trumpets and carbon accumulation, corrosion at the nozzle, etc.

3. Spray pattern assessment and prompt re-seating.
4. Drip proof. No droplet formation at set pressure minus 10 bar, held steady and also upon closing.
5. Injector lift diagram may be taken.
6. Recommended assembly procedure to be followed (Like tightening torque, etc.) and handle parts carefully.

Now Lets about the MAN B&W fuel injector –



At the time when engine is stopped so from the booster pump 9 bar fuel oil is coming and going out from the recirculation hole

But some time surveyor ask that why to keep the recirculation pressure so high (like 8-9 bar) so the reason for this is to prevent vapour formation (if we keep on increasing the pressure the temperature at which vapour formation will take place will also increased)

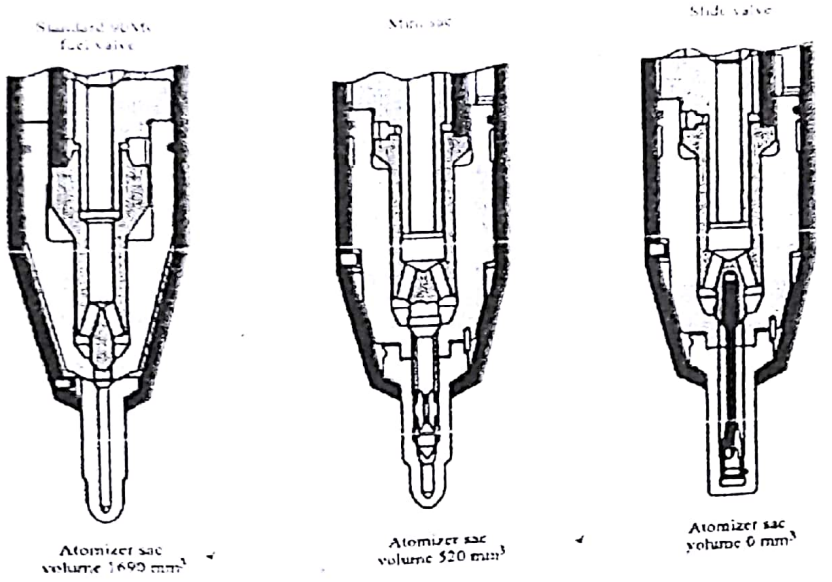
1. During normal running of the engine fuel start coming from the fuel pump at high pressure which act on the primary valve and due to this primary valve lifts up against the primary spring and due to its lifting it will close the recirculation hole
2. After the recirculation valve closes there will be the sudden rise in pressure due to which secondary valve lifts up against the secondary spring and oil finally come to the injector nozzle hole
3. Primary valve normally lift at 10 bar pressure
4. Secondary valve normally lift at 300 bar pressure against the tension of the secondary spring

Q – Different types of fuel valve and why we are using slide valve type fuel valve now a days (AA)

Ans – Evolution of fuel injection valve design for MAN B&W Diesel MC two-stroke engines; smoke and NOx emissions were lowered by reducing or eliminating the sac volume

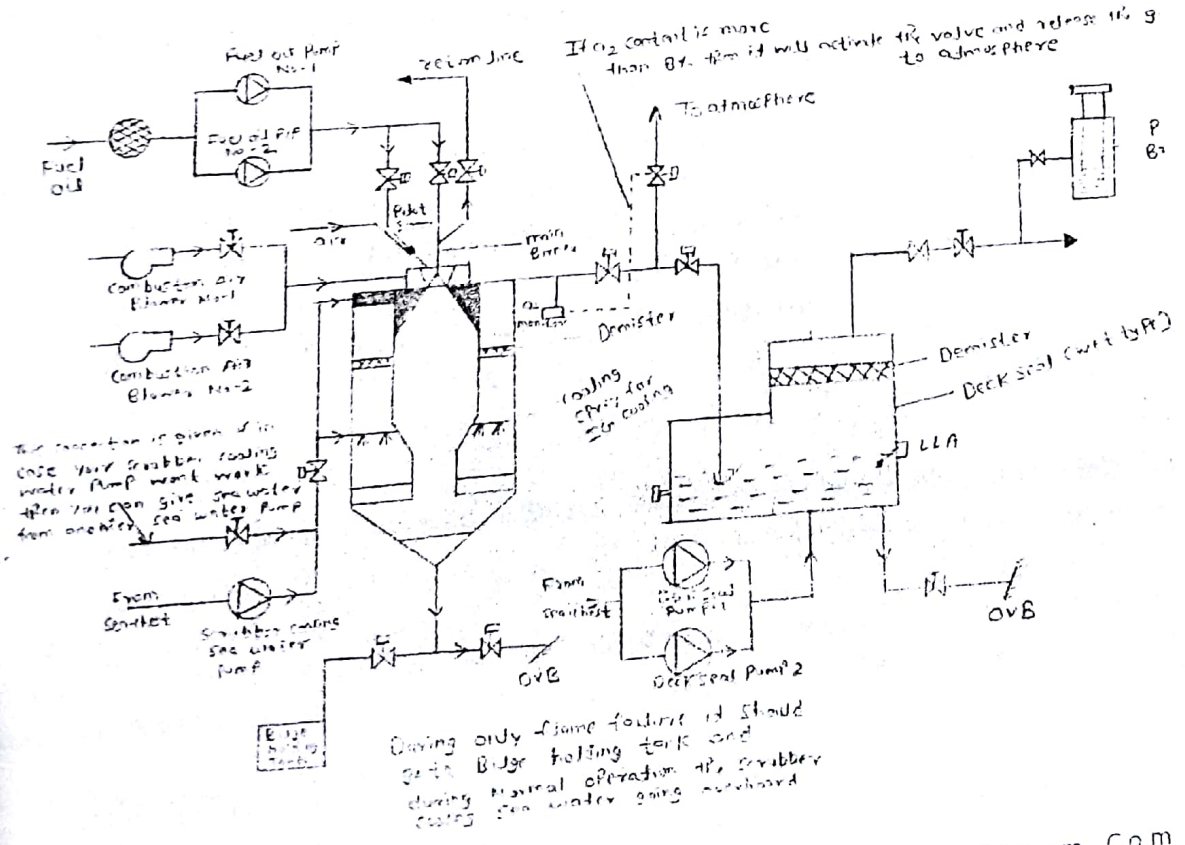
Due to this sac volume continuous dripping of fuel will be there after the effective injection so due to this black smoke and Nox will be increased and continuous dripping of fuel also the waste of money so that was the reason we are using zero sac volume type of fuel valve now a days which you can find out in slide valve type of fuel injector as shown below in the diagram

Note – The slide is lubricated by the oil only but at the time of testing the injector on the testing machine in workshop, we cannot able to provide the enough lubrication to slide valve type of fuel valve so just test once and remove from the testing machine because if you keep on testing then definitely you are going to effect the slide in the injector and again the problem of dripping will start



Q – Draw inert gas generator diagram and what are the alarms and trip in IGG (AA)

Ans – The diagram of the inert gas generator is shown below



Alarms in Inert gas generator

1. Combustion air pressure low
2. Instrument low air pressure
3. Scrubber cooling sea water pump low pressure
4. Deck seal water pump low pressure
5. Fuel oil low pressure
6. High/low oxygen content
7. IG line pressure high
8. IG line pressure low

Trips in Inert gas generator

1. Inert gas temperature high – the temperature sensor is fitted on the blower
2. Scrubber cooling tower high water level alarm
3. Deck seal water low level alarm
4. Failure of water supply to scrubber tower
5. Failure of IG blower
6. Instrumentation power failure –There will be 24 volt dc supply will come if this power fails then you cannot able to control or monitor anything

Q – If you are the in charge of watch keeping and you have to start the generator which was not started from a long time then how you will proceed to start and take on load (SA)

Ans - **Starting of generator engine**

Starting of an engine from "stop" state is something which needs to be done with care, especially if the interval of starting is sufficiently long. The following is a checklist of all the checks which ideally need to be carried out before starting the generator. In actual practice sometimes the engineers might take some of these for granted and skip, but it is advisable not to indulge in such a practice. Infact these checks are generic for any four stroke engine starting process

1. Check the turbocharger sump oil level, governor, alternator, forward and aft lube oil levels, and diesel oil level in service tank
2. Open the indicator cock
3. Prime the lube oil to all parts by hand pump or by motor driven priming pump
4. Ensure that all jacket cooler valves, lube oil cooler valves, air cooler valves should be in open position
5. With use of the Turning bar turn the fly wheel and check for any resistance on the bottom end bearing and check any water / fuel coming out through indicator cocks

6. While turning engine, check all visible lube oil points are lubricated
7. Remove the turning bar from fly wheel and put in the place
8. Drain the auxiliary air bottle
9. Blow through engine (ie: by turning engine with air). In order to ensure that no water is inside combustion chamber if it is present it may cause water hammering
10. Close the indicator cocks and pull lever from stop to start
11. When the needle in RPM indicator deflects to some value of (0-25 rpm) put the lever in run condition
12. The engine will run on fuel oil once the generator picks up the rated speed
13. Put generator on load by closing air circuit breaker
14. For checking the alternator fore and aft bearing lube oil level by opening oil plug in the alternator and the ring bearing while rotating splash lube oil from the sump can be seen
15. In order to synchronize the incoming generator with running generator syncroscope method/dark lamp method is used

Starting of generator

Checks to be made while running

Once the generator has actually started to run, there are several checks which must be performed before it is left on its own to continue running. These checks pertain to verifying various parameters related to lube oil levels, temperatures and so forth. Given below is a brief checklist related to the same.

Lube oil checks

1. Sump lube oil level
2. Governor lube oil level
3. Rocker arm lube oil level
4. Alternator forward and aft bearing lube oil level
5. Lube oil in turbine & blower side of turbo charger

Temperature checks

1. Exhaust gas temperature
2. Turbocharger (inlet-outlet) temperature
3. Booster air inlet temperature

Cooler temperatures

1. Cooling sea water (inlet - out let) temperature in cooler
2. Jacket cooling water (inlet - outlet) temperature

3. Air cooler (inlet -outlet) temperature

Q – What all trips and alarms are present in auxillary engine (RA)

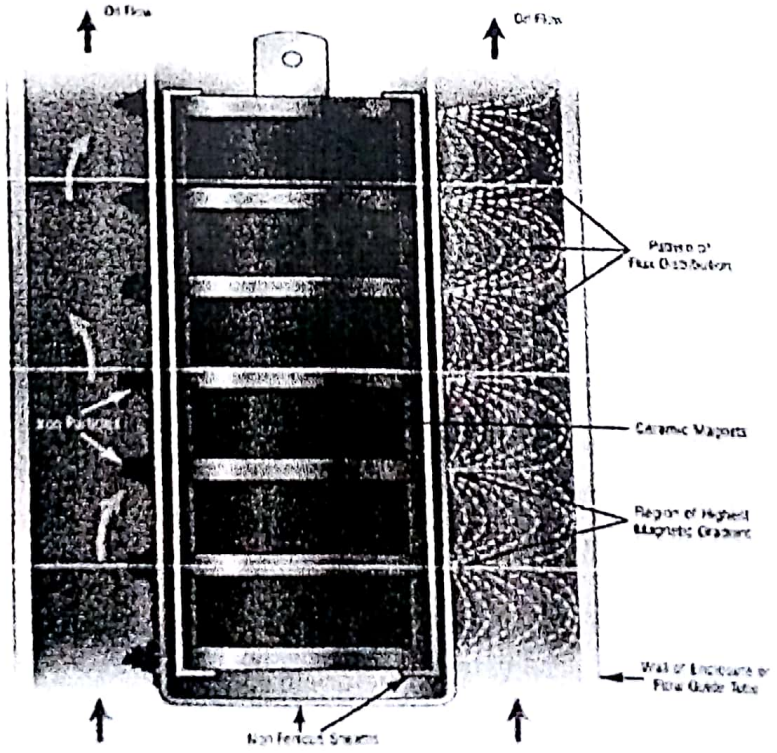
Ans - The various trips and alarms are mentioned as follows

1. Alternator bearing low oil level alarm & trip
2. Alternator bearing high temperature lube oil alarm &trip
3. Low sump oil level alarm and trip
4. Lube low oil pressure alarm and trip
5. Reverse current trip
6. Over speed trip
7. Over load trip
8. High and low frequency trip
9. Jacket cooling water low pressure alarm

Q – What do you understand by the term magnetic filters (GA)

Ans – This normally consists of filter elements which are magnetic in nature and which help in catching fine metal or ferrous particles that run in the system. These elements are surrounded by a basket screen which also act as a filter and simplifies the cleaning of the filter. Magnetic filters mostly used in lube oil systems

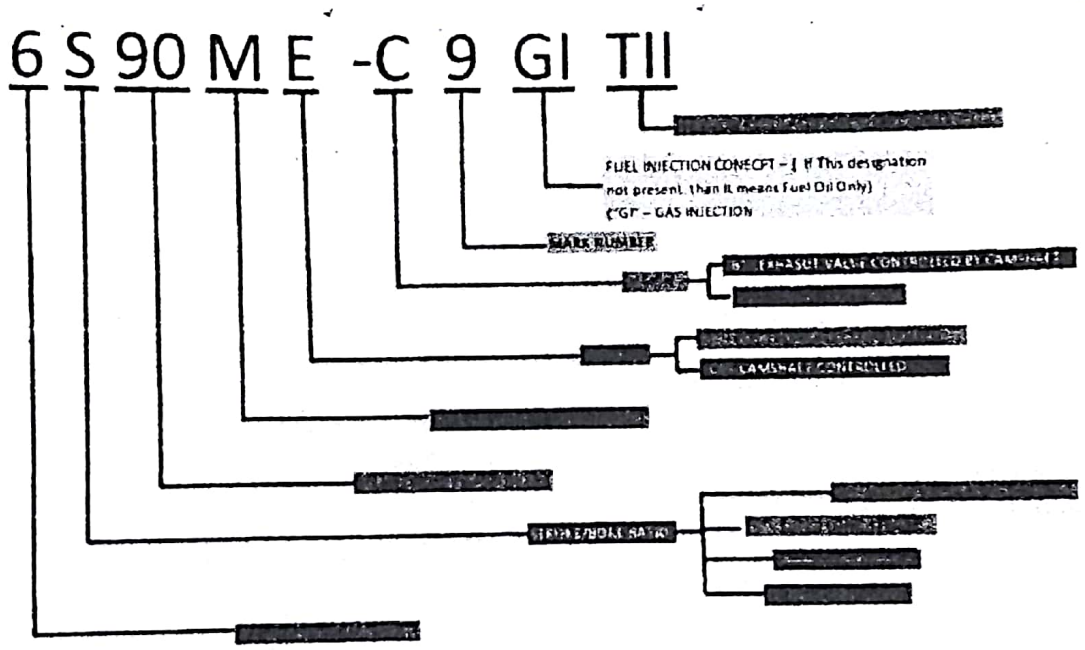
The diagram of one type of magnetic filter is shown below –



Q – What you the understand by the term 6S90ME- C9 Engine (AA)

Ans – Different people have different type of engines so we try to cover all the specification with the meaning which is given below –

In the last 9 indicates to the mark number of the engine which surveyor mostly asked in your orals that what is the significance of mark number so complete illustration about mark number is given below -



The mark version has largely followed the mean effective pressure (MEP) of the engine, that is 18 bar = Mark 6, 19 bar = Mark 7, 20 bar = Mark 8

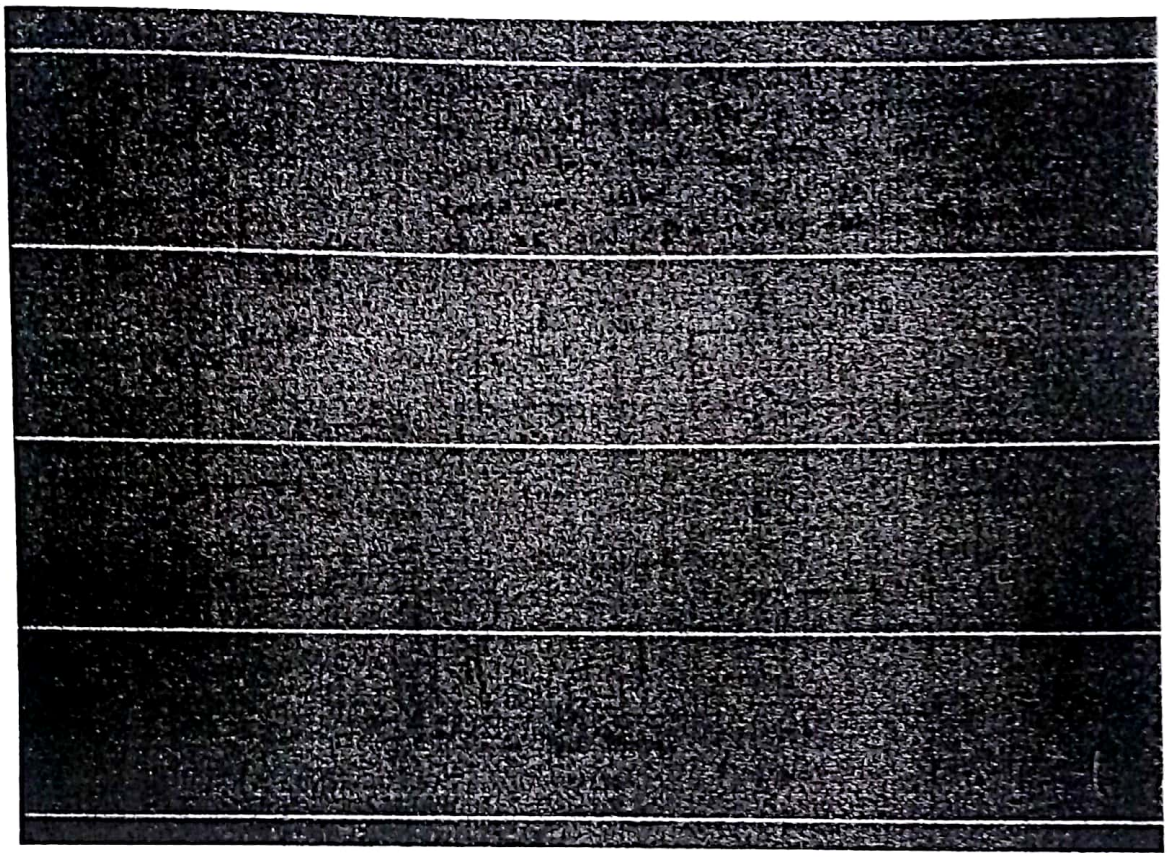
Read as follows Mark number / Pmean bar /Pmax bar

1. 6 / 18.2 / 140
2. 7 / 19 / 150
3. 9 / 20-21.4 / 160

As mentioned above mark number closely follows the Pmean of a particular series and hence Pmax too.

Q – Draw the fuel oil transfer system for the main engine of the ship (AA)

Ans – This diagram tell you the general arrangement for the fuel oil system actual system may vary depending upon the type of ship you sailed on



Q – Draw the valve timing diagram for 2 stroke and 4 stroke engine (MA)

Ans – The numbers are already marked on the diagram –

Scavenge port are open – (0)

Air is sucked in, which pushes out the residual exhaust gases - (0-1)

Piston is at BDC – (1)

Completion of scavenge process and filling with fresh air for combustion – (1-2)

Scavenge ports are closed – (2)

Post scavenging takes place – (2-3)

Exhaust valve closes – (3)

Compression of air – (3-4)

Fuel injection commences – (4)

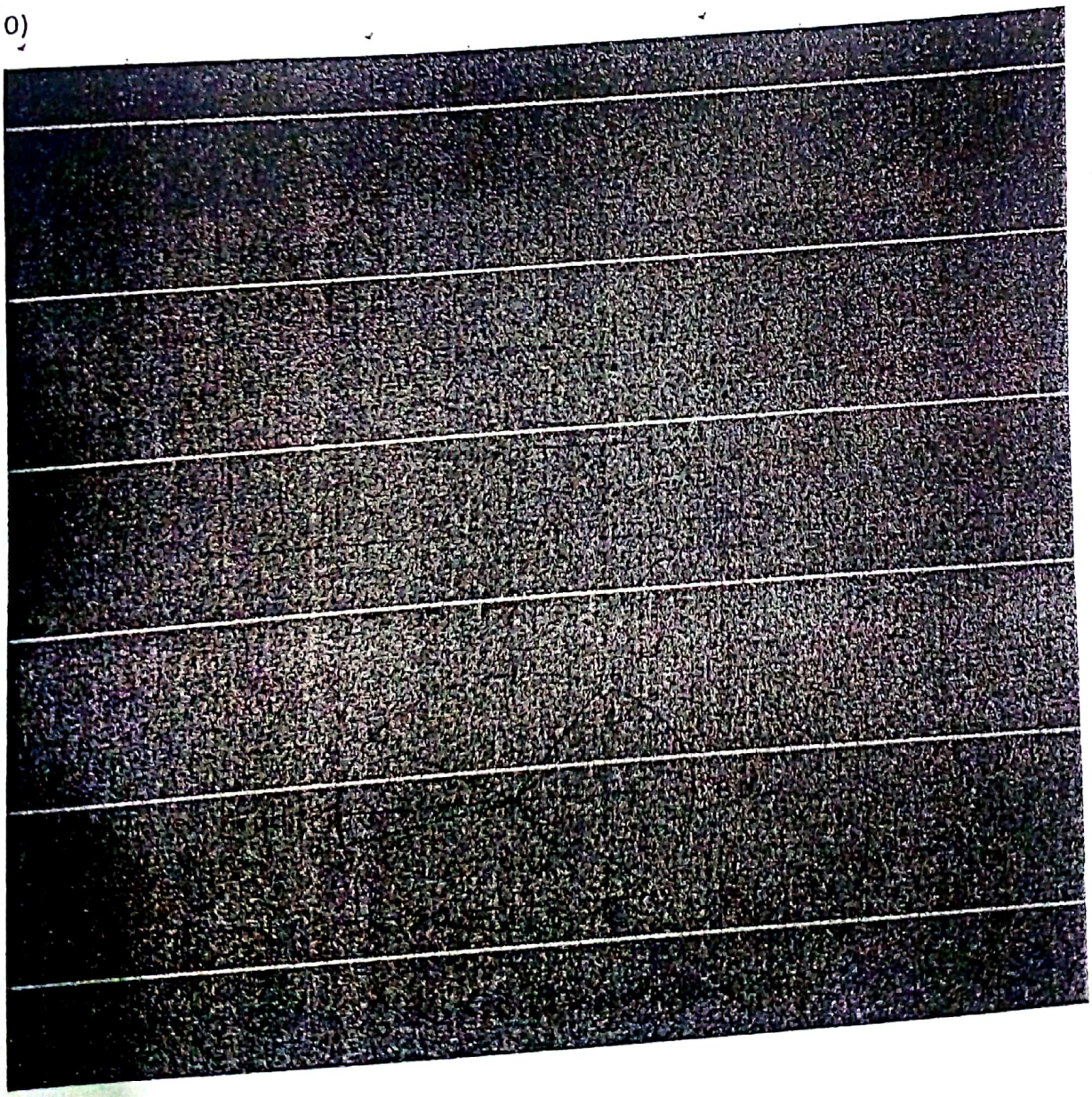
Fuel ignition commences, near TDC – (5)

Fuel injection and combustion completion – (6)

Expansion of the heat energy from combustion, being converted into work energy to push the piston downward – (6-7)

Exhaust valve open –(7)

Blow down of exhaust gases seen as a sudden rapid pressure drop on the P-V diagram – (7-0)



Valve timing angles –

1. Inlet scavenge opens – 42 degree before BDC
2. Inlet closes – 42 degree after BDC
3. Exhaust opens – 75 degree before BDC
4. Exhaust closes – 60 degree after BDC
5. Injection starts – 16 degree before TDC
6. Injection ends – 15 degree after TDC (it depends upon load may vary from 10 degree to 20 degree)

Now lets talk about 4 stroke valve timing diagram

Inlet valve opens –(1)

Suction stroke – (1-2)

Inlet valve close –(2)

Compression stroke –(2-3)

Injection begins –(3)

Injection ends –(4)

Expansion stroke – (4-5)

Exhaust valve opens –(5)

Exhaust stroke –(5-6)

Four stroke valve timing –

Inlet valve opens 20 degree before TDC

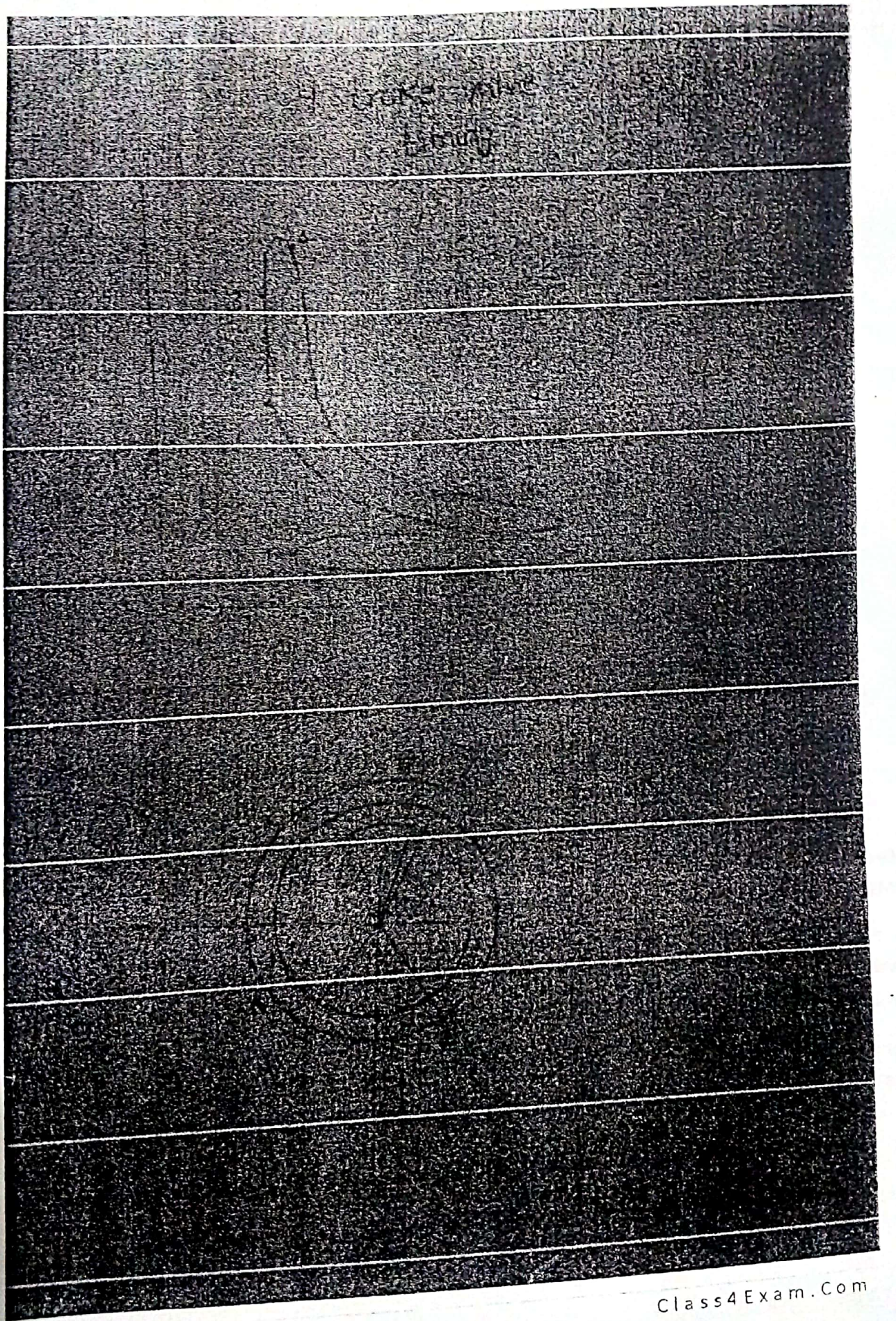
Inlet valve close 60 degree after BDC

Injection begins 10 degree before TDC

Injection end 12 degree after TDC

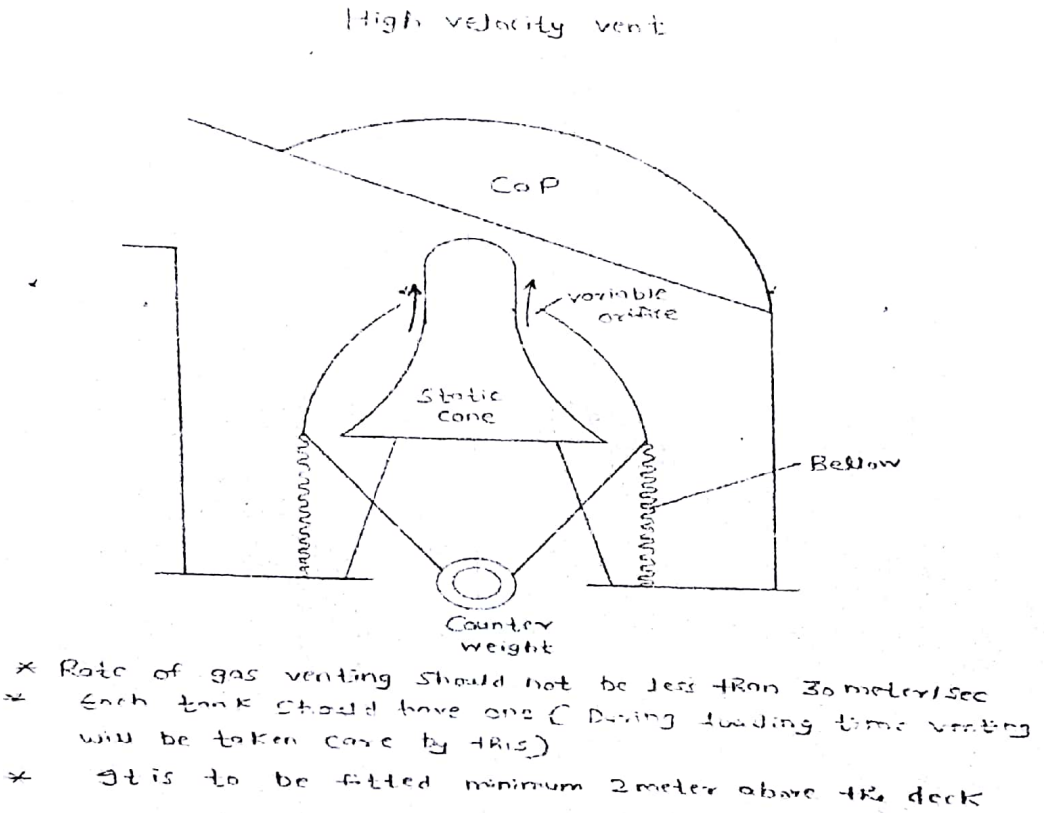
Exhaust open 42 degree before BDC

Exhaust close 60 degree after TDC



Q – Draw the diagram of high velocity vent which was used on the tankers (RA)

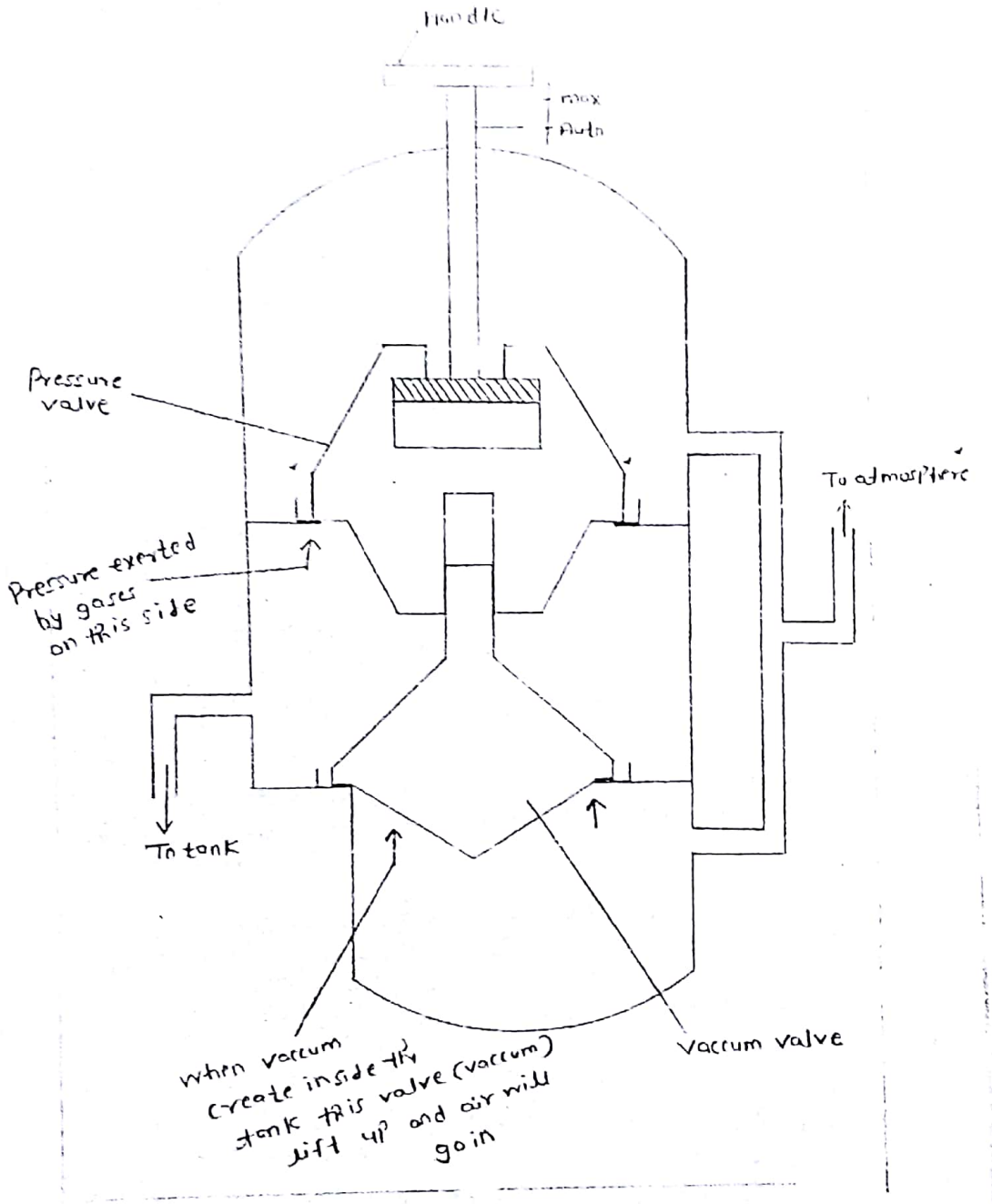
Ans –



Q – Draw PV valve which is normally used on tankers and on what setting normally it will operate(SA)

Ans – Pressure side normally operate 1400 mm of water gauge above atmospheric pressure and vaccum side normally operate -350 mm of water gauge below atmospheric pressure this was the setting normally we see on oil tankers

But in case of chemical tankers the pressure side normally operate 2000 mm of water gauge above atmospheric pressure and vaccum side it is same



Q – What are the main differences between sulzer and man b&w (GA)

Ans - COMPARISON BETWEEN SULZER AND MAN

Technology/ System	Wartsila SULZER	MAN Diesel Turbo	Who gets the EDGE?
Intelligent Engine	RT Flex- A complete electronically controlled engine with common rail system	ME Engine- Complete electronically controlled engine integrated with hydraulic control.	Wartsila- For installing an Intelligent engine technology in 2001 Prior to MAN (2003).
Fuel Injection System	Common rail Electronic control with Delta Injection System	Hydraulic actuated Electronic Control Injection system	Wartsila- For integrating Delta control with 3 injectors controlled independently for different load.
Exhaust Valve Control	Electronically controlled variable exhaust valve timing	Camshaft operated Exhaust valve for reliable operation	MAN- For integrating a smart mechanical exhaust valve operation in Intelligent engine for reliable operation.
Fuel Injectors	Conventional fuel injectors	Zero Sac Volume type fuel injectors with slide valve	MAN- Slide type fuel injector reduces after burning and hence NOx emission
Fuel Pump	Spill, suction valve controlled pump with VIT	Jerk type plunger barrel controlled pump with Super VIT	MAN- Super VIT with independent injection timing control w.r.t fuel index.
Starting Air system	Starting air valve opened by 30 bar air and a closing supply for positive shut along with spring. A relief valve in air manifold to avoid overpressure during starting airline explosion.	Starting air valve open by 30 bar air and shut by spring. Bursting disc provided to avoid overpressure during explosion	Wartsila- Additional safety provided in positive closing and relief valve for reliability during manoeuvring.
Piston and Rings	Convex shaped piston with Jet Shaker cooling. Chromium coated Piston ring.	OROS type Piston for better combustion area and reduction in piston temperature. Controlled Pressure Relief type top piston ring.	MAN-With OROS piston, the Maximum piston temperature reduces by 90°C. With CPR ring, better pressure distribution on liner and lower ring.
Cylinder Liner	Fine honed and bore cooled Liner with mid	Bore cooled liner.	Wartsila- Better cooling and insulation increases Cylinder

Technology/ System	Wartsila SULZER	MAN Diesel Turbo	Who gets the EDGE ?
	layer insulation.		liner Life
Main Bearing	White metal bearing lined on thin back.	Tri metal bearing with high load carrying capacity.	MAN-Tri metal bearing with long life and better embed ability.
Crosshead	12-15 bar pressure from separate pump supplied to bigger size plain bearing.	Small size bearing with oil wedges to retain oil which is supplied by normal system pressure.	Wartsila-Elevated pressure ensures better lubrication at high load. A back up line is provided in case of failure of crosshead pump.
Cylinder Lubrication	Electronically controlled Pulse Lubrication System with metered quantity injection	Alpha Adaptive Cylinder Lubrication control system allowing blending of cylinder oil for different grade of sulphur in fuel	MAN- ACC with different inputs like sulphur content and load index provide better neutralizing features.
Drive	Gear driven with timing gear driving the camshaft	Chain driven with 2 chains driving a camshaft	MAN- Chain drives are cheaper, lighter and easier to maintain and duplication provides backup.
Turbocharging	Prefers Axial turbocharger with constant pulse system.	Variable Turbine Angle turbocharger provides better operation at all load range	MAN-VTA allows engine to run without auxiliary blower at low load operation.
Exhaust Valve	Cobentional Valve seat with Nimonic and Stellite coating	W seat for better operation and increased time between overhaul. Dura spindle with better heat resistant property.	MAN- W seat allows cooling of exhaust valve during combustion stroke
Miscellaneous	Tribo pack allows increased time between overhaul of cylinder component up to 3 years. Electronic monitoring system for safe operation	Electronic monitoring system for safe operation.	Wartsila- With Tribo pack which is a package of design measures increases the TBO to 3 years.