







jammed plungers are removed with the cover on the high-pressure pump, and it is difficult to remove the plunger from the upper cover of the pump due to jamming.

After removing, cleaning, replacing the necessary parts, the engine starts and operates back regular.

### 3.1.4 Causes

Through checking the surface of plunger and cylinder surface on high-pressure pump cap, no scratches, roughness, mechanical edges are detected. Signs of scale on the plunger body on the lower and top part of the hydraulic piston show that the fuel leaks down, grips and traps. Leakage position can be from sealing gaskets or from the plunger work surface itself.



Figure 7: Plunger status is stuck and new[23]

Apart from being able to cause plunger jam, some other causes can lead to loss of fuel supply as above:

- The suction valve on the high-pressure pump body is jammed, fuel is not supplied into the pump.
- Fuel pressure is so low that it is not enough to push the plunger back to its dead, dead spot or cannot move the plunger.

### 3.1.5 The essence

On the ME-B / C engine, the stroke of the high-pressure pump is proportional to the engine load (the amount of fuel supplied to the cylinder), so the plunger does not always move to the top dead point (like the engine MC). If the engine operates for a long time in low load mode, the plunger does not work on the entire journey. If leakage occurs as a problem on the fuel, deposits on the surface will cause plunger stuck on the loading of the engine increases (journey of the plunger rise through deposits).

### 3.1.6 Corrective and preventive

Maintain fuel pressure according to manufacturer's instructions (~ 10 bar)

When operating at low load, the daily load should increase the load more than the prescribed time, increase the load slowly and up to 75-85% load.

Maintenance and replacement of sealing seals according to the plan are shown in the instruction manual.

Check fuel quality to ensure components are harmful to plunger's working surface.

Fuel pressure monitoring if detecting any fluctuation, attention should be paid to leakage, especially when running at high load and when operating with LS MGO.

## 3.2 Solution for the exhaust valve

Incomplete statistics show that the incident occurred at least on 4 34000 DWT series ships of different ship owners, based in China and Japan. The engine is made in DMC (China), HITACHI (Japan) have in common is the same version of the engine used MAN B&W 6S ME-B8.5

### 3.2.1 Phenomena

When the main machine runs in small load in the cruise mode, in the time of increasing the load for the engine to the value of normal mining at least 1 hour of operation to wash the turbine. Blowing black boiler, at the loading stage increased up to 60-80%, suddenly the engine speed fluctuated strongly, load indicator surged, indicating the level of fuel supply increased even to 100%.

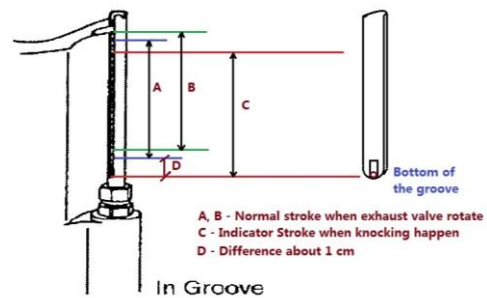


Figure 8: Journey of the exhaust valve when a problem occurs[24]

Distance A: The movement of exhaust valve (from the closed position to fully open)

Distance B (A = B): Regarding meaning B is similar to A but because the indicator bar rests on the high end of the winding cylinder.

Distance C: The distance from the position completely closed to the position where the indicator bar is limited due to the slot.

About a few seconds or later, a powerful impact is heard on the engine discharge side, after which the engine speed returns to normal, but the phenomenon can be repeated continuously, or the motor speed is ceaseless.

In typical load mode (65-80%) when the sea voyage does not occur.

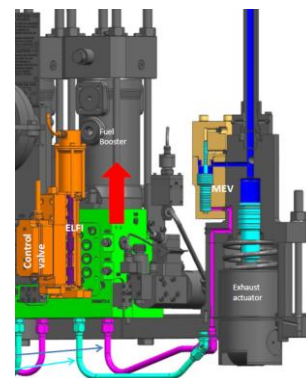


Figure 9: Arrangement of ELFI valve and MEV piston to support for exhaust valve control [25]

### 3.2.2 Instant handling

When the speed of change is detected, immediately ask for the cockpit's opinion to reduce the engine speed. When permitted, reduce the speed to the value at which the speed is no longer fluctuating, the speed decreases in many cases, it is possible to move to the HALF speed. Maintain this speed for 5-10 minutes then increase the speed of the engine again, if the problem repeats, it must slow down and maintain at a lower speed for longer.

### 3.2.3 Explain the phenomenon

For some reason, a discharge valve does not close all on the closed journey, resulting in that cylinder does not burn, does not give birth. Only five cylinders are left, causing the engine speed to fluctuate strongly, the amount of fuel supplied to the cylinder increases to ensure maintaining the set speed.

The deafening impact in the inner cylinder is caused by a collision between the seat face and the valve seat due to the impact of a tremendous force when closed again.

### 3.2.4 Harm

Overload for the remaining cylinders; Power imbalance between cylinders; Imbalance in torque on the shaft; Risk of fire and explosion on exhaust manifolds and turbochargers. When there is no other adjustment, the fuel is still supplied to the cylinder which has trouble but does not burn, goes to the exhaust manifold, if this amount of fuel accumulates or the content is large enough, it can cause fire and explosion causing try more serious. Safety loss in the case of a ship or a moving area is restricted.

### 3.2.5 Causes

Until now, manufacturers have not identified the cause of the phenomenon. The manufacturer makes some assumptions:

Due to air mixed in the hydraulic system controls

Because carbon dioxide enters the gap between the stem and guide pipe, it is jammed.

*Other assumptions according to the operator's assessment:*

The main reason is that the closing force of the "gas spring" acting on the piston (from the bottom to the top) is not enough to win a specific resistance from the top down.

Low pressure "gas spring" pressure or leakage;

The check valve on the "gas spring" line is stuck or the circulation section is restricted, leading to the air pressure of the "spring" is not enough to close up;

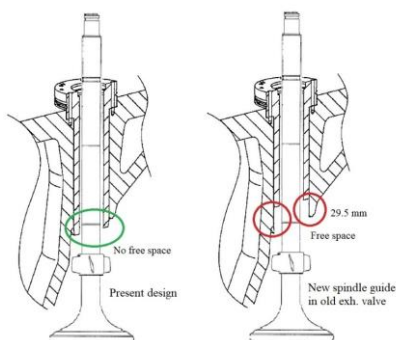
Errors of ELFI control valves lead to the constant use of high-pressure oil acting on the ME-V piston, making the exhaust valve not fully closed.

The cylinder is in the piston at the top of the valve.

Reciprocating piston in pumped oil due to the hybrid camshaft (exhaust valve actuator).

### 3.2.6 Measures from manufacturer

- Replace hydraulic hose connectors to increase sealing and loosening capabilities
- Replace hydraulic hoses with larger diameters
- Replace the conduit guide pipe to increase heat transfer capability. The essential feature of the new design is the shorter guide pipe, the larger inner diameter.



**Figure 10:** Space when changing the guide pipe according to the new design[26]

### 3.2.7 Proposed measures

Discharge of air thoroughly at lubricating oil locations, self-discharge filter, fine filter before hydraulic pump intake.

Enhance the hydraulic oil leakage test in pipelines from HCU to MEV piston.

Periodically check the pressure of the energy tank in the stop engine state, if necessary. For accurate results, it is necessary to fully discharge the remaining hydraulic oil pressure in the system and have the temperature adjusted.

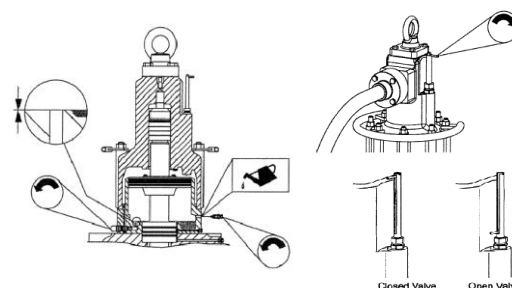
Strengthen the leakage test of the spring wind in the air cylinder, the check valve on the supply (check in the engine stop state), recommend every 3 months. Abrasion on the cuff on the air cylinder or may result in the possibility of spring gas leakage, resulting in a change in the time of opening or opening of the cylinder, or a non-flammable cylinder due to incomplete closure, causing fungal damage, rolling valve because the valve does not close.

Enhance leakage test in "gas spring," the check valve on the exhaust valve (check-in engine stop state), recommend every 3 months. Abrasion on the seal on "air cylinder" or may lead to leakage of "gas springs," resulting in

the time of closing, opening the valve is changed, or the cylinder does not burn due to the incomplete valve, causing fungal damage, rolling valve due to the valve does not close.

The process of checking the tightness of the "air cylinder" on the valve in the engine stop state (no need to remove the cylinder) as follows:

- Check that the "gas spring" is being supplied to the exhaust valve at the specified pressure value. If not need to adjust again. This value is included in the manufacturer's manual.
- Stop pumping engine lubricant (oil level to valve)
- Set the indicator bar of valves in the free position, mark this position.
- Close the air supply valve for the "gas spring" to the valve, exhaust the pipe. Calculate the time from the exhaust on the pipeline until the indicator bar of the valve starts to go down, meaning that the discharge starts to open.
- If the measuring time is greater than 15 minutes, the sealing capacity of the "air cylinder" and the check valve is still functional.
- If this time is less than 15 minutes, the valve should be cured as soon as possible, replacing damaged parts (such as shoots of cylinders, one-way valves, valve seals or safety valves).



**Figure 11:** Some attention when maintaining exhaust valve[27]

Check the surface state of the tip, the working part with the maintenance guide pipe to see the level of fouling, soot, fire, and wear (if any).

Check the condition of the seal and throttle holes on the top of the valve during maintenance.

Monitor the impact of MEV-piston on the display screen and the position of the ELFI control valve.

The valve replacement process should take into account the "air spring" level before running the lubricant pump. Otherwise, the value of the closed and open corners of the valve may be changed.

## 4. CONCLUSION

The mode operates at low load when the sea voyage of the engine driving the propeller is used quite recently in various reasons. With the characteristic of electric-electronic fuel injection engine, but still using camshaft to control exhaust valve, in addition because it was newly put into use shortly, during operation at low load, engine 6S46ME -B8.5 in particular and ME-B / C line, in general, have generated some problems that significantly affect the operation of the ship.

This study investigated and identified the structural and operating characteristics of Hitachi 6S46 ME-B8.5 engines. From that point on, the influence on the process of the motor operating at low load when sailing. At the same time, the effects of the continuous low-load operation on the associated equipment and the details on the engine from which the measures and adjustments were determined.

In particular, the article has deeply explored, analyzed and determined the causes of incidents on discharge cylinders on Hitachi 6S46 ME-B8.5 engines during operation at low load but not yet specified by the manufacturer to get the exact cause, thereby giving recommendations and measures in the process of harnessing the engine (next to the manufacturer's instructions). The paper analyzed and investigated the cause of the plunger problem of high-pressure pumps based on the design characteristics and operation mode of the engine, thereby giving necessary recommendations.

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