

## A case of ship rescue boat engine failure analysis and repair

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### Abstract

**Introduce a case of a ship rescue boat engine start failure, analysis the cause of the boat engine failure and adopt proper maintenance methods to repair the boat engine, propose investigation methods and ship management measures to avoid the failure of the rescue boat engine, emphasize the importance of maintaining a good condition of life saving equipment for human life safety and legal inspection.**

### Keywords

**Rescue boat; boat engine; carburetor; cooling water pump; spark plug; port state control.**

### 1. Introduction

One ship was a 187,000 tons ocean bulk freighter, built by China Shanghai Waigaoqiao Shipbuilding Co., Ltd. Delivered to the owner on December 11, 2019. Fixed route, sailing between the northern port of China and the southern port of Australia, the type of rescue boat engine: Mercury 25HP. On June 15, 2022, during the sea voyage, when the crews do daily inspection of emergency and life-saving equipment, found that the rescue boat engine could not start normally and the crew reported that the boat engine cooling water pump indicator hole no water come out for a long time.

The rescue boat is an important equipment for emergency escape on board. Its working state is related to the life safety of the crew on board during emergency escape. At the same time, if the working state of the rescue boat engine cannot meet the requirements of stands of the maritime convention, during port state control (PSC) inspection, the ship's detention defect will be issued. Since June-October is the high typhoon season in the northern hemisphere, ships are vulnerable to dangerous situations, and the port state control inspection of this ship has already entered the inspection window. In order to ensure the safety of life on board and avoid the shipowner's economic loss caused by the ship being detained, the company's supervise department, after receiving the report from the ship, took proactive measures to give the crew professional guidance, and solved the malfunction of rescue boat engine start failure and cooling water pump indicator hole no water come out problem.

### 2. Requirements of the maritime Convention

In order to ensure the safety of the ship and the safe escape of the crew in the event of an emergency on the ship, the Port State Control Organization (PSC) and major classification societies of various countries have paid great attention to the working status of the emergency equipment and life-saving equipment of the ship. Critical equipment such as ship lifeboats, rescue boats, emergency fire pumps and emergency generators are subject and mandatory items in every port state inspection and ship survey. According to the statistics of the PSC detention project of domestic sailing ships in 2020, the proportion of defective life-saving

equipment reached 12.5%, and a large part of it was due to the failure of the davit and engine of the rescue boat.

The content of chapter 5 of the "International Life-Saving Appliance Code" (LSA Code) sets out specific requirements for ship rescue boats. The rules require that ship rescue boats should be able to maneuver at a speed of 6 knots and maintain this speed for at least 4 hours and be able to rescue people from the water. This requires the rescue boat to have certain maneuverability and maneuverability, and the state of the boat engine directly affects the maneuverability and maneuverability of the rescue boat. Australia's Port State Control (AMSA) clearly states that if a ship's rescue boat uses the form of an external hitch, it must be ensured that the boat engine can be sufficiently cooled. This requires that the cooling water of the boat engine cooling water pump indicator hole must flow out of the continuous water flow, otherwise it will cause defects in the rescue boat and even stranded the ship.

### **3. Malfunction analysis and repair**

#### **3.1. The boat engine cannot be started, the following points should be checked:**

##### **3.1.1. Boat engine fuel oil circuit inspection**

The Mercury 25HP is equipped with a 25L external fuel tank. Before starting, check whether the oil level in the fuel tank is normal. The fuel tank to the boat engine is connected by a section of fuel transfer hose. An oil primer valve is installed on the hose. The function of the oil primer valve is to prevent air in the fuel pipeline or gasoline in the pipeline from vaporizing into steam packs when the boat is first started or the boat is not running for a long time, affecting the normal delivery of fuel. Before starting the boat, press and pinch the oil primer valve repeatedly to remove the air from the pipeline to ensure that fuel can enter the carburetor for combustion use when the boat engine starts.

During the inspection, it is necessary to ensure that the oil level of the external fuel tank is normal, that the fuel pipeline is intact and there is no leakage, and that the pilot valve is in good working condition.

##### **3.1.2. Starter check**

There are two ways to start a rescue boat engine: electric start and manual start. Electric start is a way to start with electric energy stored in a battery. The Mercury 25HP boat engine is equipped with a recyclable rechargeable battery with a rated voltage of 12V and a battery capacity of not less than 70 amp-hours. This battery is in a floating state. After starting the boat, the charger will charge the battery to full charge again; manual start is to use a starting pull rope to ensure the starting gear and boat engine gear are engaged, uses manpower to pull the starting rope to drive the rescue boat engine to the speed of ignition.

During the inspection, it should be confirmed that the starting battery voltage of the boat is within the normal value range, the electrical wire connectors are in good condition, and there is no phenomenon of low battery voltage and poor contact with the wire; the manual start pull rope runs freely and does not get stuck.

##### **3.1.3. Spark plug inspection**

The Mercury 25HP boat engine is a gasoline internal combustion engine, and the gas mixed with gasoline and air is ignited by a spark plug inside the cylinder. If the spark plug itself is not in good working condition or is not assembled according to the technical specifications of the manual, it will cause the boat engine to fail to fire and affect the normal start-up. This model of boat is equipped with two NGK B7HS-10 or Champion L82C-NGK BPR7HS-10 spark plugs. The connection state between spark plug and wire, spark plug gap and spark plug tightening torque are the key points. The spark plug gap value is equal to 1.0 mm and the tightening torque is 27NM.

During inspection, ensure that the gap of spark plugs meets the technical specifications, otherwise the spark cannot be generated and the boat engine cannot ignite; If the tightening torque exceeds the limit value, the spark plug may be damaged and cannot work normally.

In addition to checking the spark plug clearance and tightening torque, confirm the condition of the ignition coil. The inspection method is to remove the spark plug from the boat engine, connect the ignition coil wire, put it in a visible safety container, and observe whether there is a spark in the spark plug. If there is a spark, it means that the ignition coil works well.

#### **3.1.4. Carburetor inspection**

Carburetors have two functions: one is to provide a place for fuel vaporization. When the filtered air passes through the throat of the carburetor, it produces the same working principle as the jet pump, sucking the fuel into the carburetor to make it vaporize; the second is to make the vaporized fuel and air form a fuel for combustion in a certain proportion. Mixed gas, the concentration of air is determined by the throttle, and the concentration of fuel is determined by the throttle of the rescue boat engine.

When the carburetor is disassembled and inspected, special attention should be paid to whether the air damper and the internal fuel float can move freely. If these two parts do not work properly, it will directly affect the mixing of fuel and air, causing the boat to not start properly.

#### **3.2. The cooling water pump indicator hole without water come out, the following points should be investigated:**

Mercury 25HP boat engine adopts water cooling method. Its cooling water pump is composed of rubber impeller, suction and drain outlet, and cooling water pump gland. Its power comes from the drive shaft of the boat engine. When the boat engine is running, the cooling water pump starts to work. Therefore, no matter whether the rescue boat is running at sea or testing the boat engine on board, it must be ensured that the cooling water pump can absorb the cooling water, otherwise it will cause the overheating of the boat engine parts and cause damage to the equipment. In particular, the impeller of the cooling water pump is made of rubber material and has poor heat resistance. If it runs without cooling water for too long time, the temperature of the impeller will rise abnormally, causing damage to the cooling water pump impeller. On the vessel, in order to satisfy the ability of the rescue boat to absorb cooling water during trial operation, the crew often makes a cooling water bucket, which is specially used to provide cooling water for the boat during trial operation and inspection. In order to confirm the working status of the cooling water pump, the cooling water indicator hole is designed on the boat machine. Under normal circumstances, the water indicator hole should have a continuous water column flowing out when the boat machine is running.

#### **3.3. Fixed the malfunction**

After the investigation of the above steps, the crew found that the failure of the rescue boat engine was caused by problems with the carburetor and cooling water pump. With the efforts of the crew, the failure was eliminated before the ship berthing port, and the boat machine returned to normal and ready-to-use. The specific methods of the crew troubleshooting are as follows:

#### **3.1.5. Carburetor troubleshooting**

After dismantling the carburetor (Fig.1), it was found that the movement of the fuel float in the carburetor that controls the fuel intake was blocked. The reason why the boat engine could not start was that the float was stuck in the closed position, and the fuel could not enter the carburetor through the fuel delivery hose. Internal vaporization mixes with air. After adjusting the tightness of the float installation shaft and the opening of the oil inlet valve, the boat engine can start normally.

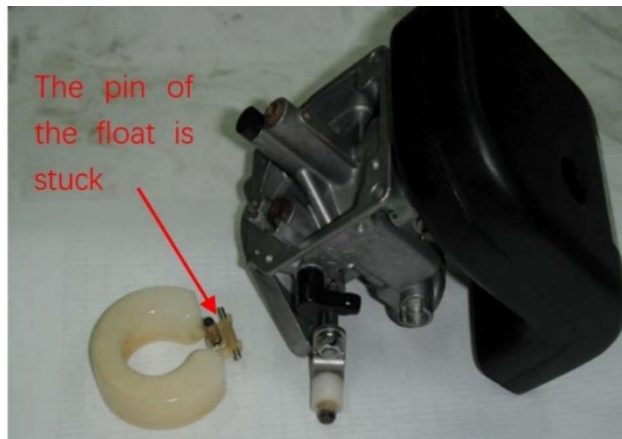


Fig.1 Carburetor

### 3.1.6. Cooling water pump troubleshooting

The reason why the cooling water indicator hole does not produce water is that the impeller of the cooling water pump is seriously wear. After replacing the spare parts, the cooling water indicator hole flows out water continuously and uninterruptedly. The renew procedure of the cooling water pump impeller are as Fig.2:



Fig.2 Cooling water pump impeller renewed

## 4. Conclusion

In order to avoid the failure of important emergency equipment such as rescue boats on the ship, it is necessary not only to improve the safety awareness and responsibility awareness of the crew from the management level, but also to continuously improve the professional business ability and lifelong learning ability of the crew from the technical level.

To strengthen on-board management, management-level crew members should hold regular safety management meetings, reflect on the shortcomings of ship management, periodically self-check the potential failures and safety hazards of ship equipment, summarize experience and lessons, and prevent ship emergencies and ship detention incidents. The ship management company should formulate a complete planed maintenance system, cooperate with the continuous survey to ensure that all equipment of the ship should be inspected and maintained within a certain period. The ship's maintenance department timely pushes new ship technical specifications and professional update knowledge, instructs and urges the crew to continuously learn and improve their own business level.

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