

# Research on Technical Condition Evaluation Indexes System of Marine Diesel Engine

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**Abstract:** The technical condition of marine diesel engine is very important to the operation of ship. The scientific evaluation indexes system of technical condition of marine diesel engine is helpful to evaluate the technical condition of marine diesel engine and ensure the normal operation of ship's power system. According to the basic function and structure of marine diesel engine, on the basis of discussing the selection principle of technical condition evaluation index, this paper puts forward the maximum power, maximum speed, exhaust temperature, cooling water temperature, oil pressure, oil temperature, vibration information and quality of lubricating oil as evaluation indexes of marine diesel engine's technical condition, which provides reference for marine diesel engine's technical condition evaluation.

**Keywords:** marine diesel engine; technical condition evaluation; indexes system

## 1. Introduction

Marine diesel engine is widely used as a main engine and auxiliary machine in ships because it has the highest thermal efficiency, wide power range, quick start, convenient maintenance, safe operation and long service life. It is not available in marine power systems. The missing component. The operating environment of the ship is relatively harsh. During the sea going out, the normal operation of the diesel engine directly affects the safety of the ship. Therefore, it is also important to evaluate the technical status of the ship's diesel engine. There are many methods for equipment technology status assessment, and it is generally necessary to construct an evaluation index system [1]. The technical status evaluation of marine diesel engine refers to the research literature. The literature [2] uses the rough set to construct the internal combustion engine state evaluation index, which mainly includes vibration information, oil quality, fuel consumption rate, supercharger information, exhaust temperature, and cooling. The water outlet pressure difference and the oil cooler outlet temperature difference can basically be used for the technical state evaluation of the diesel engine. However, since the literature does not give a clear meaning of each indicator, it is necessary to improve the indicator system.

In this paper, based on the basic structure and basic functions of marine diesel engine, the technical evaluation

index system of marine diesel engine will be constructed. Secondly, the selection principle of technical state evaluation index will be introduced. Finally, the technical evaluation indicators of eight marine diesel engines will be constructed.

## 2. Basic functions and structure of marine diesel engines

The main function of the marine diesel engine is to use less volatile diesel or inferior fuel oil as fuel, convert the chemical energy of combustion into heat energy, and then convert the thermal energy into mechanical energy through the expansion of the mass, to provide the ship with the necessary navigation. power. The main components of the diesel engine include: combustion chamber, crank linkage mechanism, gas distribution mechanism, lubrication system, cooling system, speed control system, starting system, reversing system and control system [3]. Among them, the normal operation of the combustion chamber components, the gas distribution mechanism, the lubrication system and the cooling system plays an important role in the normal operation of the diesel engine and the safe navigation of the ship.

## 3. Technical status assessment indicator selection principle

From the definition, content and result requirements of the technical state assessment, the technical state assessment should reflect the technical state requirements of the equipment in the actual use process in a timely, accurate and dynamic manner. Therefore, the establishment of the indicator system should refer to the characteristics of each subsystem indicator and the weight coefficient of different indicators in the overall evaluation system. The selection and evaluation of specific technical status indicators should follow the following principles [4, 5]:

### 3.1. Principle of objectivity

The technical state assessment indicators must follow objective laws. Everything starts from reality, and the theory is linked to reality. It cannot be subjectively created, and it is even more difficult to judge. The establishment of a scientifically based technical status indicator system can reflect both objective reality and the main factors affecting the state of marine equipment technology.

### 3.2. System comprehensiveness principle

The technical status indicator system should reflect the performance of the equipment operating status as fully as possible. The establishment of the entire technical status assessment indicator system needs to be systematically linked according to the weighting factors of the evaluation indicators.

### 3.3. Principle of comparability

The same level of indicators in the technical status indicator system should meet the principle of comparability. Since different indicators have different measurement ranges and cannot be directly compared, when performing technical state assessment, different indicators need to be normalized to meet the principle of comparability.

### 3.4. Reliability principle

It can be seen from the definition of the technical state evaluation index that the indicators describing the physical and functional characteristics of the device have both qualitative and quantitative requirements. The indicators describing the quantitative requirements of the equipment need to be supported by specific numerical calculations, and the data of the evaluation indicators should be true and reliable.

### 3.5. Principle of simplicity

There are many indicators that affect the state of the equipment technology, and it is unrealistic to take all the indicators into consideration. Therefore, it is necessary to make a comprehensive judgment based on the difference in the importance of different indicators and the difficulty level of different indicator parameters. At the same time, it is necessary to meet the principle of simple, efficient and practical indicator system.

## 4. Marine diesel engine technical status assessment index

According to the basic structure, basic functions and working environment of the diesel engine, the technical status evaluation indicators of the marine diesel engine mainly include the following aspects:

#### 4.1. Maximum power maximum power

The main function of the diesel engine is to provide power. Therefore, the maximum power of the diesel engine will directly reflect the maximum working capacity that the diesel engine can provide. It is a key indicator to determine whether the diesel engine can complete its assigned work tasks.

#### 4.2. Maximum speed maximum speed

The main function of the marine diesel engine as the main engine is to drive the propeller. According to the knowledge of the ship's power plant, the power, torque and speed required by the propeller are roughly equal to those provided by the diesel engine. Therefore, the maximum speed of the propeller can be used to indirectly

characterize the power, torque and speed of the diesel engine.

#### 4.3. Exhaust temperature

Exhaust gas temperature is the most direct evaluation indicator to determine whether the diesel engine thermal process is normal. Under normal circumstances, as the load increases, the exhaust temperature increases, but the exhaust temperature is within a specified range. If the exhaust temperature is much higher than the normal value, there may be a problem with the injector of the diesel engine.

#### 4.4. Cooling water temperature

The cooling water temperature can reflect the information of the exhaust gas temperature and the technical state of the cooling system. Therefore, the temperature of the cooling water is an important evaluation index for evaluating the overall technical state of the diesel engine. The high temperature of the cooling water may be caused by excessive diesel engine load, gas flowing into the cooling water system, insufficient cooling water, or symptoms of cracking of the cylinder or cylinder pulling of the diesel engine. Therefore, the high temperature of the cooling water can be used to characterize the degree of degradation of the state of the diesel engine technology.

#### 4.5. Pressure of lubricating oil

The pressure of the oil is a basic parameter for understanding the working state of the oil system and a key indicator for evaluating the technical status of the diesel oil system. By understanding the oil pressure, not only can you understand the technical state of the oil system itself, but also the state of the clearance of the moving parts of the diesel engine. A sudden increase or decrease in the pressure of the oil may be a precursor to the degradation of the state of the art of certain moving parts.

#### 4.6. Temperature of lubricating oil

The oil temperature is a key parameter reflecting the load of the diesel engine, the cooling effect of the cooling water, the heat load of the diesel engine running parts, and the lubrication effect of the running parts. Once the oil temperature rises abnormally during the operation, it needs to be shut down. In order to find out the cause, otherwise, it may cause major failures such as pulling cylinders and bearing burnout. In the long-term operation of the diesel engine, if the temperature of the oil continues to rise slowly, it also needs to pay close attention, which may be caused by deterioration of the technical state such as increased wear of the parts. Therefore, the temperature of the oil is one of the key parameters for the evaluation of the state of the art.

#### 4.7. Vibration information

Vibration information generated during the operation of a diesel engine is often an effective method for early fault diagnosis. Vibration can be mainly divided into two categories, one is aerodynamic vibration, such as intake

and exhaust, gas vibration information; the other is mechanical vibration, such as the impact of the valve, gear engagement, bearing rotation, piston movement, etc.. Under normal circumstances, the greater the load, the greater the vibration intensity, but the vibration information not only includes the vibration amplitude information, but also the vibration frequency and other information. It can be used to construct some fault phenomena and vibration information features through the feature extraction of vibration information. The relationship between the motor and the technical state of the diesel engine can be judged by vibration information. At present, there are many vibrometers to assist in the analysis of vibration information. However, the on-site operators of diesel engines listen carefully to the ear and often find some signs of failure in advance. It can be seen that vibration information is a relatively important indicator of technical state assessment.

#### 4.8. Quality of lubricating oil

From the impurities, moisture and diesel oil that appear in the oil, you can find faults or malfunctions. Therefore, you need to clean the oil filter regularly to check the quality of the oil. Metal powder appears in the lubricating oil. On the one hand, it indicates that the diesel engine has a large wear, on the other hand, it also indicates that the technical state is degraded, and there may be a large wear. The quality of the oil is mainly determined by the type, size and concentration of the metal particles. The appearance of new metal particles, the increase in the volume of metal particles and the large increase in the concentration of metal particles may be caused by excessive wear of some parts or other causes. Therefore, it is necessary to find out the cause to judge the technical state of the diesel engine. Therefore, the quality of the oil

is one of the key parameters for the assessment of the state of the art.

### 5. Summary

The technical state of the marine diesel engine is directly related to the operation and maintenance management of the ship. Based on the basic structure and function of the diesel engine, this paper proposes eight indexes of maximum power, maximum speed, exhaust temperature, cooling water temperature, oil pressure, oil temperature, vibration information and oil quality as evaluation of diesel engine. The technical status assessment index provides reference for further constructing the technical evaluation technology of marine diesel engine, which is worthy of reference in marine power engineering.

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