

# CHARACTERISTICS AND THEIR CORRECT SELECTION IN THE FAULTS DIAGNOSIS OF HYDRAULIC

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**ABSTRACT** The condition characteristics of hydraulic systems reflect running condition for the hydraulic equipment directly. It is the key for condition monitoring and early fault diagnosis to select characteristics reasonably. In this paper, the types, properties of characteristics in hydraulic equipment are analysed, and some considerations in their selection are presented.

**KEY WORDS** hydraulic equipment, fault diagnosis, condition characteristics

The stability and reliability of hydraulic systems are emphasized with the wide use of hydraulic transmission and control in engineering machinery, and the traditional method to detect the failures by maintenance workers' sense organs and their experience could not meet the needs of the development in modern hydraulic industry.

The maintenance system of hydraulic equipment, like other equipment, has gone through two phases of "run to failure" maintenance and regular maintenance, and is in transition to predictive maintenance which is considered one of the most effective means to increase equipment utilization ratio and decrease the maintenance costs. The condition monitoring and failure diagnosis based on the condition monitoring guarantee the predictive maintenance.

Since each hydraulic component works in the closed pipelines, it is not easy to measure and to judge, which causes many technical problems for the operation and maintenance in hydraulic system. It appears important specially, therefore, to strengthen condition monitoring of the hydraulic system, which makes us keep understanding the system conditions in time, and judge the faults location and their causes, then forecast the technical condition of the system in future. It is the key of the condition monitoring effectively to select, gather and process the condition characteristic parameters correctly.

## 1 TYPES OF THE CONDITION PARAMETERS IN HYDRAULIC SYSTEMS

The information of physical and chemical parameters, such as energy, medium, force and heat of hydraulic system in motion, must be gathered. There is also much characteristic information of the hydraulic system by which we can judge its technical condition. The

information of condition parameters could be divided into three types:

(1) The output parameters of the hydraulic system or equipment such as the rotational speed and torque of hydraulic motors, the pushing and pulling forces of hydraulic cylinders. It is easy to determine the condition of the equipment according to the output characteristics of the executive body.

(2) The direct information, such as the wear, deformation and rust of hydraulic components. They are possibly direct causes for failure of the equipment. Since it is difficult to get information by measuring the key components of the hydraulic equipment after it is installed and put in motion. We usually adopt indirect or second-hand information as the condition characteristics in such cases.

(3) The indirect information, such as the pressure, flow, temperature and debris in the hydraulic system. It reflects the change in work capacity for the equipment whose condition could be checked and evaluated without disassembling the equipment while it is in motion. Therefore, indirect information is widely used as the condition characteristic one.

## 2 SELECTION OF THE CHARACTERISTIC PARAMETERS

As a rule, the following characteristic parameters could be considered:

(1) The characteristic that reflects precisely the objective condition of the equipment should be selected, because different characteristic contains different quantity of information.

(2) Those characteristics which are conducive to discover the failures of the system with the least delay should be adopted.

(3) The characteristics selected should appear monotropic relationship with the condition of the equipment, and avoid ambiguous phenomenon.

(4) The indicated value of the characteristic signals should have higher accuracy and credibility which are even more important in the situation on which the reliability of the equipment is laid emphasis on.

(5) Such characteristics which could be measured without dismantling the equipment must be adopted whenever possible, and in some cases it is required not disturbing the operation of the system.

(6) The characteristics selected should be easy to measure and analyse, and save the cost needed.

(7) As the work capacity of complicated equipment is often described by many parameters, those which are most sensitive to the change in the condition of the equipment should be chosen, then the technical state for the equipment can be judged comprehensively.

Though it is hard to meet every item above, the rule still be a guidance in our selecting characteristics. The characteristics selected in the condition for the hydraulic system should satisfy these items as many as possible.

### 3 THE CHARACTERISTICS IN COMMON USE FOR THE CONDITION MONITORING OF HYDRAULIC SYSTEMS

(1) Pressure signal. Hydraulic transmission is static-pressure one based on Pascal Principle. The pressure reflects the working state of the hydraulic system directly, and dynamic pressure signal (especially for the pulse one) carries much information in the state. This signal is easy to pick up and higher in the ratio of "signal to noise", therefore, the pressure is mostly used characteristic signal in faults diagnosis for the hydraulic equipment.

(2) The debris composition in oil samples. It is the most valuable monitoring technique for wearing states of hydraulic elements and the faults in hydraulic system to analyse the oil samples since about eighty per cent of the faults in hydraulic system result from the oil contamination and is getting worse. The technique of Ferrum Spectrum is widely used in the analysis of the degree, location and causes of wearing in elements.

(3) The vibration signal. There exists much information which has wide range of frequency during the vibration in hydraulic equipment. The vibration signals which reflect the condition changes fast and fully in running units could be changed into electrical signals easily, and they are commonly used characteristics in monitoring on hydraulic equipment.

(4) The flowrate. It guarantees to have expectant speed and precision for hydraulic cylinders and motors to keep certain flowrates. The state of hydraulic elements by analysing the flowrates, leakages and the efficiencies in volume can be judged.

(5) Rise in temperature. The oil temperature affects the velocity, leakages and the properties of sealing rubbers. Unusual rise in temperature of hydraulic fluid and elements' crusts can be adopted to determine the conditions of the hydraulic elements and the whole system too.

## 液压设备故障诊断的状态特征及其正确选取

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**摘要** 液压系统的状态特征是液压设备运行工况的直接反映, 而状态特征的合理选取是开展设备状态监测与故障早期诊断的先决条件. 本文分析了液压设备的状态特征种类、特点及选择时应考虑的几个问题.

**关键词** 液压设备, 故障诊断, 状态特征