

# Study on Technology of Valve Remote Control and Level Gauging System for Liquid Cargo Vessels

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**Abstract:** Valve remote control system (VRC) and level gauging system (LGS) are important equipments on liquid cargo vessels. This paper introduces the technology and the selection of VRC and LGS especially for liquid cargo vessels. It also shows the integration among VRC, LGS and ship automation system. The solutions introduced in this paper can be references for ship designers.

**Keywords:** Liquid cargo vessel, Valve remote control, Level gauging

## Introduction

All along, the main products of China's shipbuilding industry are dry bulk carriers, the proportion of new bulk carriers and container ships up to 70% to 80%, relatively few cargo ships. With the recent changes in the shipping market, dry bulk carriers to create new orders to reduce the increase in cargo ships. Since 2015, the global dry bulk cargo ship into a trough, dry bulk cargo ship made a new order. On the contrary, the cargo ship shipping market has maintained a steady development momentum. Today, China's major shipyards pay more attention to the development of liquid cargo ships, including oil tankers, chemical tankers, asphalt ships, liquefied gas carriers. For many ship equipment, tanker ship configuration is different with the bulk carrier, one of the most important aspect is the valve remote control and liquid level telemetry system.

It can be seen that the cargo control system of the tanker is more complicated than the dry bulk carrier, and the equipment involved is more and the form is different. And cargo ships loaded with cargo is often flammable and explosive liquid, so its cargo control system security requirements are quite high. In addition, the tanker remote control and liquid level telemetry system at least in the ship's cargo control room and centralized control room to achieve remote control and monitoring. With the increase in the degree of automation, some tanker ships even in the cab can also be valve control and liquid level system display and control. This requires the ship automation system to fully and efficiently control the valve remote control and liquid level telemetry system.

Valve remote control system configuration

Tanker requirements in the cargo control room and the control room can operate the valve switch and display the status of the valve position. At present, commonly used ship valve remote control system mainly electrohydraulic and hydraulic two. Dry bulk ship with more electro-hydraulic, and liquid cargo ships are basically using hydraulic.

Electro-hydraulic valve remote control system is generally used only for dry bulk carriers and container ships, mainly by the drive and automated computer systems, each drive and automation between the computer through the cable connection. The actuator of the electro-hydraulic valve remote control system integrates the hydraulic fuel tank, the motor, the valve position indicator and the control module, and controls the control module by the automation computer. The control module receives the valve switch signal output from the automatic computer and executes the action of the switch valve. When the switch is in place, the valve position is indicated. The valve position feedback to the control module, and then by the control module will valve position. The signal is transmitted to the automation computer for display. As shown in Figure 1.

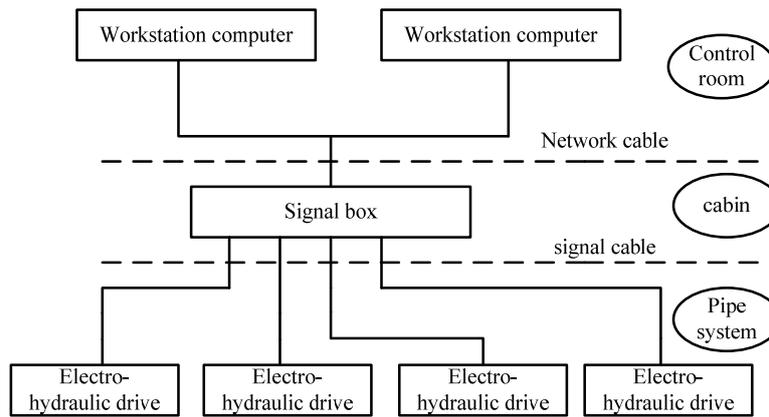


Figure 1 Schematic diagram of electro-hydraulic valve control system

### Brief Introduction of Hydraulic Valve Control System

The hydraulic valve remote control system (Figure 2) is suitable for all types of ship, mainly by the drive, hydraulic power pump station, solenoid valve box (including electrical control module) and automated computer system composed of solenoid valve box and drive, power pump station between Hydraulic pipe connection. The solenoid valve box is connected to the automation computer via cable.

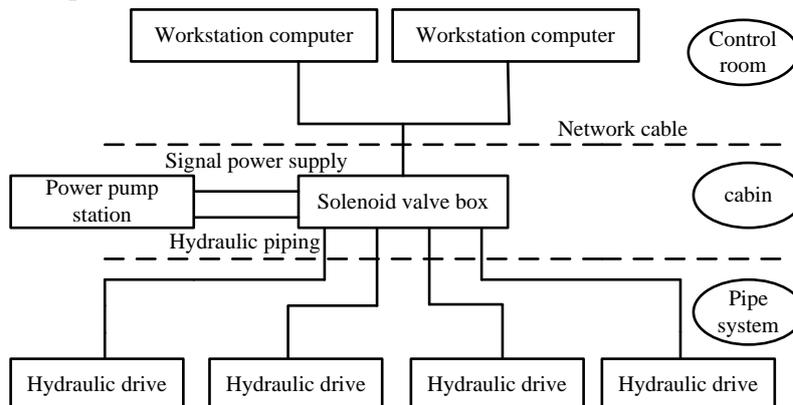


Figure 2 Schematic diagram of hydraulic valve control system

Different from the electro-hydraulic valve remote control system, hydraulic valve control system power pump station and solenoid valve box is for the entire system services. Power pump station is the hydraulic control system of the hydraulic power source. The solenoid valve box consists of a hydraulic part (solenoid and hydraulic circuit) and an electrical part

(control module), which is the center of the hydraulic power and electrical signal processing. In the hydraulic section, the hydraulic power station delivers all the hydraulic fluid required for all the drives to the solenoid valve. There are many solenoid valves in the solenoid valve, one to one corresponding to each drive. The commutation solenoid valve distributes the hydraulic oil to the actuators in each direction and performs the operation of the switch valve.

In the electrical part, the control of the solenoid valve to operate the electrical signal, are from the solenoid valve box within the control module. The control module receives the signal of the switch valve output from the automation computer. Valve position feedback is divided into direct and indirect, two feedback forms and the application is shown in Table 1.

Table 1 Type and application of valve position feedback

Valve position feedback	Switch valve	Switch valve
Direct type	The limit switch on the drive	The potentiometer on the drive
Indirect type	Hydraulic switch on hydraulic line	A positive displacement indicator or flowmeter on a hydraulic line

### Valve selection

Dry bulk carriers and container ships remote control valves are mainly used for ballast water and fuel systems, in the form of a central type. Ballast valve body material is generally cast iron, the use of NBR Dingqing rubber seal; fuel valve body material is generally cast steel, the use of FPM fluorine rubber seal. In addition to the ballast and fuel valves, there are cargo valves. The oil valve is in the form of eccentric. Oil tanker valve body material is generally cast steel, the use of FPM fluorine rubber seal. Asphalt cargo valve is characterized by high temperature, the body of the material is generally cast steel, the use of metal seals. Chemical cargo valve is characterized by corrosive, the body of the material is generally stainless steel, PTFE Teflon sealed. Liquefied gas cargo valve is characterized by ultra-low temperature, the body of the material is generally stainless steel, the use of metal seal. As shown in Table 2.

Another advantage of integrating with the automation system is the ability to use the ship's shore network on the ship's shore communications software and ship satellite devices, the loading of liquid cargo information sent to the shore of the ship management personnel, so that ship managers more convenient and quick to grasp the dynamic and device status.

Table2 remote control valve material selection

Valve medium	Body material	Sealing material	Features
Ballast water	cast iron	NBR	
Fuel	Cast steel or ductile iron	FPM	
Crude oil / refined oil	Cast steel	FPM	
asphalt	Cast steel	Metal seal	High temperature 200°C
Chemicals	stainless steel	PTFE	preservative
Liquefied gas	stainless steel	Metal seal	Low temperature -163°C

## **Conclusion**

The remote control system and the liquid level telemetry system of the tanker are directly related to the economic income of the ship operation and are the equipment most concerned by the shipowner. The selection, design, installation and commissioning of the two systems are also carefully studied by the shipyard. Modern ships are moving towards a high degree of automation and require greater reliability, efficiency and convenience in valve control and liquid level systems. In the future, more and more chemical ship, tanker, asphalt ship, liquefied gas ship and other liquid cargo ships will be configured with a higher degree of automation Valve remote control and liquid level telemetry system.

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