Guideline No.: E-21(201501)

E-21 VALVE REMOTE CONTROL SYSTEM

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Foreword:

This Guide is a part of CCS Rules, which contains technical requirements, inspection and testing criteria related to classification and statutory survey of marine products.

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1 Application

1.1 The Guidelines only serve as the general requirements for valve remote control system. The suitability of such system for particular ships is also required to comply with the requirements presented by the ship design department and CCS plan approval department.

1.2 The valve remote control system stated in this chapter means the remote control equipment installed indoors (e.g. control station, hydraulic power source, solenoid valve box) and the locally installed equipment (e.g. hydraulic actuator, electric actuator, electrohydraulic actuator, local hydraulic manual pump).

1.3 This chapter is applicable to valve remote control systems of hydraulic control type, electric control type and electrohydraulic control type. Reference may be made to this chapter for valve remote control systems of other types such as pneumatic control type.

2 Normative references

(1) Rules for Classification of Sea-going Steel Ships (hereinunder referred to as Rules for Steel Ships)

(2) IACS UR E10

(3) SOLAS

(4) IEC60092-504 Electrical Installations in Ships, Part 504: Special Features-Control and Instrumentation

(5)GD01-2006 Guidelines for Type Approval Test of Electric and Electronic Products

3 Terms and definitions

Valve remote control system: devices which use hydraulic oil pressure, pneumatic pressure and/or electricity as the power to achieve remote centralized control and position display of valves in the ship's piping systems from the control console.

Local control: a control mode under which the equipment is manually operated by the operator in the vicinity of the equipment.

Output torque:the torque output by the actuator of the valve remote control system to open and close valves.

Opening/closing time: time used by the actuator of the valve remote control system to drive the

valves into open/closed position.

Accumulator: a device used to store and release hydraulic energy.

4 The following drawings and documentation are to be submitted to CCS for approval:

(1) Technical specifications;

(2) Function description;

(3) Control flow chart;

(4) Outside diagram;

(5) Electrical circuit diagram;

(6) Pneumatic control diagram (if applicable);

(7) Hydraulic control diagram (if applicable);

(8) Manufacturer test program;

(9) Type test plan (to be provided for type test)

The following drawings and documentation to be submitted are to be submitted to CCS for review:

(1) Operation manual (including description of failure treatment);

(2) External wiring diagram;

(3) Components/parts list;

5 Design and functional requirements for the product

5.1 Ambient and working conditions

5.1.1 The valve remote control system is to be capable of working properly under the following ambient and working conditions:

(1) Ambient air temperature: +5 ~+55 ℃ (for electronic devices of valve remote control system installed in enclosed spaces).

-25 ~ +45 ℃ (for devices of valve remote control system installed on open decks).

(2) Relative humidity:95%±3% when the temperature reaches +45 ℃; 70%±3% when the temperature is higher than +45 ℃.

(3) Vibration: frequency: 2.0Hz~13.2Hz, vibration amplitude: ±1mm; frequency: 13.2Hz~100Hz, acceleration: ±0.7g.

(4) Inclining and swaying: inclining and swaying angle in varying directions:22.5 ℃(period:10s) linear acceleration in vertical direction: ±9.8m/s2.

(5) Power fluctuation rate: for alternating current power supply, the steady state voltage: +6%~-10% of the rated value, frequency: ±5% of the rated value; transient voltage: ±20% of the rated value, recovery time: 1.5s, frequency: ±10% of the rated value, recovery time: 5s. When power is supplied by an accumulator battery, the voltage of systems connected to the accumulator battery during charging is +30%~-25% of the rated value; and the voltage of systems not connected to the accumulator battery during charging is +20%~-25% of the rated value. Voltage stabilizing device is to be used if the systems are not capable of working within abovementioned power fluctuation range.

(6) Harmonic component: not more than 5%.

(7) Electromagnetic compatibility: the system is have necessary electromagnetic compatibility and comply with the test requirements specified in Table 3.1.2 (Product category: internal communication and signal processing equipment), Chapter 3 of CCS GD01-2006 Guidelines for Type Approval Test of Electric and Electronic Products.

(8) The pneumatic and hydraulic equipment of valve remote control system is to be capable of operating properly within ±20% of the rated value of the power source voltage fluctuation without being damaged at 1.5 times of the design pressure.

5.2 Design and functional requirements for valve remote control system

5.2.1 Control of valves is to be completed from the remote control station and valves are to act correctly;

5.2.2 The remote control station is to be provided with arrangements indicating full opening/closure of valves or opening degree of valves. In general, red light denotes full closure of valves while green light denotes full opening of valves. For remote indirect indication of valve positions, the valve opening/closing signals are sent by the pressure switch on hydraulic piping and the valve position signals are sent by the positive displacement valve position indicator or flowmeter.

5. 2. 3 The valve remote control system is to be designed by fail-safe principle. Alarm signals are to be sent out in the event of a system failure, in which case the valves are to remain in the positions required by the system, unless otherwise deemed impracticable. And particularly, when the power source (electric, pneumatic, hydraulic) is interrupted, change of valve open/closed

positions is not to be incurred. Valves that are allowed to be opened only during operation are to automatically return to the closed position in the event of abovementioned failure.

5.2.4 The valve remote control system is to be independent from other safety systems and alarm systems and in the event of its own failure, is not to affect the normal operation of other systems.

5.2.5 The valve remote control system is to be so designed that a single failure occurring during its operation will not lead to occurrence of other failures and that the risks created thereby are reduced to as low levels as possible.

5.2.6 Failure (power failure, pneumatic or hydraulic failure, low liquid level, low pressure, etc.) monitoring and alarm functions are to be provided.

(1) All alarms are to give audible and visual alarm signals simultaneously. The color of alarm light for major failure is normally red and that for ordinary failures is normally yellow. Audible signals are to have adequate loudness.

(2) The valve remote control system is to be capable of sending alarm signals of all failures occurring simultaneously. The alarming of a certain failure and/or the answer to an alarm is not to impede the alarming of and/or answer to other concurrent failures.

(3) The audible alarm signal clearing (silencing) devices are to be provided to allow for silencing after the alarm signal has been answered (e.g. by pressing the silencing button of the device). When an audible signal is being silenced, the visual alarm signal should not be closed but may be changed (for instance, from flashing light to flat light), and such changed visual signal is still to be clearly visible and to be kept on until the failure has been eliminated. This alarm channel is to be capable of being automatically restored to its normal working conditions upon elimination of the failure.

(4) The indicating and alarming equipment of the valve remote control system is to be provided with self-check function, by fitting light testing button for example, i.e. be capable of performing alarm (or indication) test for its own failures to prevent omitted alarm or false alarm (false indication).

(5) Electric and electrohydraulic valve remote control systems are to be fitted with limit switches so that the actuator will be automatically stopped when the valve is opened/closed to position.

(6) Under emergency control mode, the valve remote control system is to be provided with valve position indicating device, which is usually a mechanical pointer.

(7) Hydraulic control system is to be provided with an accumulator, which is used as the auxiliary source of power to the hydraulic system to maintain system pressure or serve as an emergency energy source.

(8) The output torque of the actuator is to be sufficient to satisfy the need of opening/closing the

controlled valves and is to be at least 1.2 times of the valve opening/closing torque at minimum pressure.

(9) The number of valves controlled by the system and the valve opening/closing time are to comply with the requirements of ship design.

(10) For valve remote control systems used in hazardous areas or spaces on oil tankers, product oil tankers, chemical tankers and ship-type offshore platforms, qualified explosion-proof electrical apparatuses furnished with the conformity certificates of explosion protection issued by competent explosion protection testing agency approved by CCS are to be used.

(11) The valve remote control system is to be capable of opening and closing the valves via local hydraulic manual pump or other manual devices. All actuators are to be installed at locations readily convenient for connection of fixed manual pump or portable manual pump for manual emergency operations. Provided that the requirements of relevant rules are complied with, the fixed manual pump is to be installed in the vicinity of the actuator as far as practicable to facilitate manual operation.

(12) The hydraulic or electrohydraulic control system is to give alarms when the pressure of the operating pump or system pressure is lower than 20% of the normal working pressure.

(13) The system is to be capable of automatically changing over to the backup source of power in the event of loss of the normal source of power supply. A battery bank may be used as the backup source of power and its capacity is to be sufficient to supply power continuously for 30 minutes.

(14) The computer/PLC control system and software design are to comply with the requirements of Section 6, PART SEVEN of the Rules for Steel Ships.

5.2.7 Power source and control circuit

(1) The pneumatic piping and hydraulic piping are to be fitted with safety valves. The opening pressure of safety valves is to be 1.2 times of the rated working pressure.

(2) The air supply piping is to be fitted with pressure reducing valve, filter, oil-water separator and drier to keep the air dry and free from impurity and oil content. In general, at least two pressure reducing valves, two filters and two driers are to be provided respectively and connected in parallel. Installation of one filter and one drier may be allowed provided that appropriate means has been provided to ensure prompt maintenance and replacement of abovementioned devices without affecting the normal operation of the pneumatic control system.

(3) Hydraulic control systems are normally fitted with pressure reducing valves, in which case the requirements of 2.8.5.4, PART THREE of the Rules for Steel Ships are to be complied with.

(4) The selection of pneumatic and hydraulic piping is to be subject to strength calculations and comply with the requirements of Chapter 2, PART THREE of the Rules for Steel Ships.

6 Type test

6.1 Where type approval is being applied for by the applicant for products with different control modes, one most representative product is to be selected from products of each control mode for type test.

6.2 Environmental and working conditions for type test

6.2.1 The test site is to be maintained under atmospheric conditions within the following ranges:

(1) Ambient temperature: 15 ℃ ~ 35 ℃;

(2) Relative humidity: 30%~90%;

(3) Atmospheric pressure: 86~106 kPa.

6.2.2 The valve remote control system is to operate at rated working voltage and frequency.

6.3 Type test items and methods

6.3.1 For valve remote control systems under type test, the electrical components are to be correspondingly tested as per the requirements of Table 6.3.1.

6.3.2 Regarding the various test methods and standards quoted in this section, other equivalent standards or standards acceptable to CCS may be adopted as appropriate.

Table 6.3.1

No.	Test item	Test method and results
1	Visual inspection	2.1 of GD01-2006
2	Function test	Refer to 21.7.2.5 of the Guidelines for details.
3	Voltage withstanding test	2.14 of GD01-2006
4	Energy source fluctuation test	2.4 of GD01-2006
5	Energy source failure test	2.5 of GD01-2006
6	Insulation resistance measurement	2.3 of GD01-2006

Continued Table 6.3.1

7	Low temperature test	2.9 of GD01-2006
8	High temperature test	2.8 of GD01-2006
9	Alternate humid and heat test	2.10 of GD01-2006
10	Vibration test	2.7 of GD01-2006
11	Inclining and swaying tests	2.6 of GD01-2006

No.	Test item	Test method and results
12	Test of degree of protection	2.15 of GD01-2006
13	Electrostatic discharge immunity test	3.4 of GD01-2006
14	Radiated, radio-frequency, electromagnetic field immunity test	3.5 of GD01-2006
15	Low-frequency transduction immunity test	3.8 of GD01-2006
16	Test of immunity to conducted disturbances, induced by radio-frequency fields	3.9 of GD01-2006
17	Electric fast transient/burst immunity test	3.6 of GD01-2006
18	Surge immunity test	3.7 of GD01-2006
19	Measurement of shell port radiated emission	3.3 of GD01-2006
20	Measurement of conducted emission	3.2 of GD01-2006
22	Pressure test of piping system pressure components	2.7.1.1 and 2.7.1.2, PART THREE of the Rules for Steel Ships
23	Tightness test of piping system pressure components	2.7.3.1, PART THREE of the Rules for Steel Ships

7 Unit/batch inspection

7.1 Each batch of valve remote control system is to be subject to unit/batch inspection after type test/approval.

7.2 Unit/batch inspection is to include at least the following items:

7.2.1 The plans of valve remote control system for which inspection is being requested are to be submitted to CCS for review and approval.

7.2.2 Visual inspection: the external structure, materials used, internal wiring, selection and installation of elements and devices, manufacturing process and marks of the product are to be inspected for compliance with relevant CCS requirements, drawings and documentation to be submitted approved by the owner, technical specifications provided by the manufacturer, etc.

7.2.3 Voltage withstanding test is to be carried out at the test voltage specified in Table 21.7.2.2 and at a test voltage frequency of 50Hz or 60Hz. The product is to be tested for 1min without electric breakdown. Printed circuit board with electric elements, which is likely to be damaged at the test voltage during the test, may be removed prior to the test.

Table 7.2.2

Rated voltage (V)	Test voltage (V)
$U_n \leq 65$	$2 \times U_n + 500$
$66 < U_n \leq 250$	1500
$250 < U_n \leq 500$	2000

7.2.4 Insulation resistance measurement: immediately following the voltage withstanding test, the insulation resistance between energized parts and the insulation resistance of energized parts to ground (shell) are to be measured at the test voltages defined in Table 21.7.2.3 (1) and the measured insulation resistance is to be no less than the values specified inTable 21.7.2.3(2). Printed circuit board with electric elements, which is likely to be damaged at the test voltage during the test, may be removed prior to the test.

Table 7.2.3(1)

Rated voltage (V)	Test voltage (V)
$U_n \leq 65$	$2 \times U_n$, 24 at minimum
$U_n > 65$	500

Table 7.2.3(2)

Rated voltage (V)	Minimum insulation resistance(MΩ)	
	Before test	After test
$U_n \leq 65$	10	1
$U_n > 65$	100	10

7.2.5 Function test: various functions of the equipment, including at least but not limited to the following items, are to be verified for compliance with the requirements of drawings and documentation to be submitted approved by the owner and product technical specifications:

(1) Remote control opening and closing test (including valve position indication test);

(2) Emergency (local control) opening and closing test;

(3) Power loss protection test (including test of the valve's ability to maintain its original position or be operated to the preset open/closed position in the event of failure of the electric, pneumatic or hydraulic power source);

(4) Alarm function test (Electric/power source pressure and temperature, oil filter blockage, etc.).

7.2.6 Pressure test of piping system pressure components: the pressure components of piping systems (including connecting parts), upon completion of manufacturing (fabrication), are to be hydraulically tested to a pressure not less than 1.5 times of the design pressure.

7.2.7 Tightness test of piping system pressure components: the pressure components of piping systems, upon completion of assembly, are to be examined for leakage under working conditions.

It is recommended that the pressure components of hydraulic piping systems be tightness tested to 1.25 times design pressure and that the pressure components of pneumatic piping systems be tightness tested to 1.1 times design pressure.