Guideline No.: T-05(202502)

T-05

Fuel (Natural Gas, Methanol and Ammonia) Valve Unit

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Foreword

The product inspection guideline of China Classification Society (hereinafter referred to as "CCS") specifies the applicable technical requirements and inspection and test requirements for classification products and authorized statutory products of ships to be approved/inspected by CCS.

The Guidelines allow users to adopt alternative test methods and requirements, provided they meet or exceed the standards set by the Guidelines.

The Guidelines are prepared and updated by CCS and published on http://www.ccs.org.cn. In case of any comments and suggestions, please contact CCS via service@ccs.org.cn.

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Main modifications in this version: None

Contents

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1 Scope of Application

1.1 The Guidelines are applicable to the fuel (natural gas, methanol and ammonia) valve units to be surveyed and approved by CCS.

1.2 The fuel (natural gas, methanol and ammonia) valve units in the Guidelines are applicable to natural gas, methanol and ammonia-fueled engines, boilers and other equipment.

1.3 In addition to the Guidelines, the fuel (natural gas, methanol and ammonia) valve units shall meet the requirements of equipment manufacturers.

1.4 The Guidelines are applicable for scenarios where the fuel (natural gas, methanol and ammonia) valve unit manufacturer leads in design and then seeks its application for intended purpose. If the unit subsystem is included in the design approval of dual-fuel engine and the unit manufacturer makes a specific design on the basis of engine type approval, the said subsystem can be considered as an acknowledgement and inheritance of the main engine approval and as the implementation of technical requirements for engine parts. In this case, the manufacturing inspection can be carried out directly according to the approved engine drawings. If necessary, detailed design drawings shall be reviewed and approved. For example, this principle can also be applied if the valve unit of boiler burner and other equipment is an integrated component.

2 Normative References

2.1 The normative references used in the Guidelines are as follows:

(1) Chapter 9 of Part 3, Chapters 1, 2 and 3 of Part 4 and Chapters 1 and 2 of Part 7 of CCS *Rules for Classification of Sea-Going Steel Ships* and its Change Notices;

(2) Chapters 3, 6, 7, 11 and 12 of CCS *Rules for Natural Gas Fuel Used in Ships* and its Change Notices;

(3) Chapters 5 and 16 of CCS *Rules for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk* and its Change Notices;

(4) Chapter 4 of CCS *Guidelines for Design and Installation of Gas Fuel Engine Systems for Liquefied Gas Carriers*;

(5) Chapters 2, 3, 4, 6, 9 and 10 of CCS *Guidelines for Ships Using Methanol/Ethanol Fuel* and its Change Notices;

(6) Chapters 2, 3, 4, 6 and 10 of CCS *Guidelines for Ships Using Ammonia Fuel* and its Change Notices;

(7) Chapter 2, Part 2 and Chapter 7, Part 3 of CCS *Rules for Materials and Welding*.

3 Terms and Definitions

Unless otherwise specified in the Guidelines, the terms and definitions in the *Rules for Natural Gas Fuel Used in Ships*, other rules and guidelines of CCS are applicable to the Guidelines.

Relevant definitions in the Guidelines are as follows:

3.1 Fuel (natural gas, methanol and ammonia) valve unit: It refers to a constituent unit used to control the supply of fuel (natural gas, methanol and ammonia) for each combustion equipment.

It is a part of the supply system of fuel-consuming equipment. It is located between the supply pipeline and the fuel-consuming equipment and consists of mechanical and electrical parts:

(1) The mechanical part includes manual stop valve, control stop valve and vent valve, pressure regulating valve (if any), filter and connecting pipeline. The closed unit shall have a shell equipped with the above equipment;

(2) The electrical part includes pressure/temperature sensor and transmitter, control box or junction box, solenoid valve box or solenoid valve .

Based on different designs and layouts, the fuel (natural gas, methanol and ammonia) valve unit can be classified into two types: open unit and closed unit.

(1) Open unit: After all mechanical equipment is connected through pipelines, they are installed on an open common foundation together with electrical equipment to form an open unit. The open unit shall be installed in a dedicated compartment on the ship, specially designated for the fuel (natural gas, methanol and ammonia) valve unit. This compartment is a dangerous area. The automation and control system of the open unit shall be installed in a safe area on board;

(2) Closed unit: All mechanical equipment is connected through pipelines and installed in a closed shell. The shell and electrical equipment are installed on a common bracket. The area inside the shell is a dangerous area.

3.2 Pipeline system: It refers to the assembly of all pipelines and valves essential for normal functions of fuel (natural gas, methanol and ammonia) valve unit. Generally, it consists of fuel (natural gas, methanol and ammonia) supply pipeline, return pipeline (if any), bleed-off pipeline and inerting pipeline entering the unit.

3.3 Shell: It refers to a removable closed container used for installing and storing the pipeline system, pressure/temperature sensor and transmitter of fuel (natural gas, methanol and ammonia) valve unit. The area inside the shell is a dangerous area.

3.4 Design pressure and design temperature: They refer to the maximum pressure and minimum temperature meeting the equipment requirements, which are used for the design of fuel (natural gas, methanol and ammonia) valve unit.

3.5 Integrated Gas Pressure Regulator (IGPR): It is a type of integrated device used to control the gas fuel supply of each gas-consuming equipment. Generally, it is directly installed on the gas-consuming equipment. For the requirements for IGPR, please refer to the inspection requirements for the fuel (natural gas, methanol and

ammonia) valve unit.

4 Drawings and Documents

4.1 During product drawing approval, the following drawings and documents shall be submitted for approval:

(1) List of product main performance specifications (design pressure, design temperature, power supply parameters, etc.);

(2) General assembly drawing;

(3) System P&ID, including inerting and scavenging diagrams (if applicable);

(4) Drawing of parts and list of materials for pressure-bearing equipment (welding details shall be described for welding connection);

(5) Electrical schematic diagram;

(6) External communication interface table (Modbus/TCP);

(7) Design calculations of pressure-bearing shell (if applicable) and pipeline;

(8) Risk analysis report (if applicable).

5 Technical Requirements

5.1 Marine environmental conditions

The product design and technical requirements shall meet the requirements in CCS *Rules for Natural Gas Fuel Used in Ships*, CCS *Guidelines for Ships Using Methanol/Ethanol Fuel*, and in Chapter 6 and other chapters of CCS *Guidelines for Ships Using Ammonia Fuel*. Mechanical and electrical equipment shall meet the requirements for environmental conditions in CCS *Rules for Classification of Sea-Going Steel Ships*.

5.2 Technical requirements

5.2.1 The main functions of the fuel (natural gas, methanol and ammonia) valve unit include:

(1) Pressure adjustment: Adjust the fuel (natural gas) pressure according to the load of fuel-consuming equipment, e.g., the engine;

(2) Leakage detection: Implement leakage detection of the unit before startup to ensure that all valves on the supply pipeline can be opened and closed normally and orderly without internal leakage;

(3) Inerting and scavenging: Have the inerting and scavenging functions to ensure no residual fuel (natural gas, methanol and ammonia) in the equipment, so as to meet the safety and maintenance requirements of fuel (natural gas, methanol and ammonia);

(4) Manual or automatic cut-off of fuel (natural gas, methanol and ammonia) supply: Support this function to meet the operation requirements of fuel-consuming equipment;

(5) Filtering: Filter the fuel (natural gas, methanol and ammonia) entering the fuel-consuming equipment.

5.2.2 Technical requirements for pipeline and shell

(1) Generally, Class I pipelines should be used for the fuel (natural gas, methanol and ammonia) valve unit. If safety measures are taken to prevent leakage and its consequences, Class II pipelines can also be used. The layout of pipelines and valves shall meet the requirements in CCS *Rules for Natural Gas Fuel Used in Ships*, CCS *Guidelines for Ships Using Methanol/Ethanol Fuel*, and in Chapter 6 of CCS *Guidelines for Ships Using Ammonia Fuel*;

(2) The size, connection form and layout of fuel (natural gas, methanol and ammonia) inlet and outlet, exhaust port and inerting and purging inlet shall meet the requirements of equipment manufacturers;

(3) The minimum wall thickness and the minimum design pressure of pipelines shall meet the requirements in CCS *Rules for Natural Gas Fuel Used in Ships*, CCS *Guidelines for Ships Using Methanol/Ethanol Fuel*, and in Section 2, Chapter 3 of CCS *Guidelines for Ships Using Ammonia Fuel*;

(4) Flange connections should be minimized in the pipeline system. Threaded connections conforming to recognized standards can only be used for minor pipelines and instrument pipelines with an outer diameter less than or equal to 25mm. If the above-mentioned pipes are used, the requirements in Chapter 2, Part 3 shall be met;

(5) The pipelines shall be processed in compliance with the CCS-approved drawings. There shall be no burrs or sundries inside the pipelines, at threaded connections and flange sealing surfaces. The pipelines shall be so arranged that the fuel in them can be drained during standby or maintenance of the fuel valve unit;

(6) The shell may be considered as a part of the ventilation duct if it is connected to the ventilation duct and the internal space is not more than $2m^3$. In this case, the design pressure of shell and outer tube of double-walled pipe shall meet the requirements in CCS *Rules for Natural Gas Fuel Used in Ships*, CCS *Guidelines for Ships Using Methanol/Ethanol Fuel*, and in Chapter 6 of CCS *Guidelines for Ships Using Ammonia Fuel*;

(7) The shell shall be designed with reference to the pressure vessel, and its ventilation shall meet the requirements in CCS *Rules for Natural Gas Fuel Used in Ships*, CCS *Guidelines for Ships Using Methanol/Ethanol Fuel*, and in Chapter 6 of CCS *Guidelines for Ships Using Ammonia Fuel*, without any space not ventilated as required;

(8) In the methanol fuel valve unit, gas and liquid leakage detectors shall be installed to detect any possible leakage. The unit shall be connected to a collection tank to collect the leaked gas and liquid.

5.3 Materials

The materials of main parts and components for the fuel valve unit shall be selected with consideration given to working medium, temperature, pressure and other conditions. The materials of products shall be selected according to relevant requirements in CCS *Rules for Natural Gas Fuel Used in Ships*, CCS *Guidelines for Ships Using Methanol/Ethanol Fuel*, Chapter 3 of CCS *Guidelines for Ships Using Ammonia Fuel* and CCS *Rules for Materials and Welding*.

5.4 Welding requirements

To ensure the welding quality of pipelines and pressure-bearing parts in fuel (natural gas, methanol and ammonia) valve unit, manufacturers shall complete the preparation of the welding procedure qualification report (WPQR) and the welding procedure specification (WPS) for corresponding materials and weld joints, and obtain the welding procedure approval from CCS related to product welding in accordance with CCS *Rules for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk* and *Rules for Materials and Welding*.

5.5 Installation

5.5.1 The pipeline system shall be carefully cleaned after installation to ensure no burrs or sundries.

5.5.2 Splash prevention shall be considered at flange connections.

5.5.3 All pipe joints and hose joints with sealing gaskets shall be electrically connected. The resistance at each joint or connection shall be proven to be less than 1MΩ, except in cases where bonding jumpers are used.

5.6 Electronic control system

5.6.1 The design, manufacture and inspection of electronic equipment of the electronic control system, including software design, shall meet the relevant requirements in Part 7 of CCS *Rules for Classification of Sea-going Steel Ships* and in CCS *Guidelines for Type Approval Test of Electrical and Electronic Equipment*.

5.6.2 The electronic control system of fuel (natural gas, methanol and ammonia) valve unit mainly has two forms: control box and junction box. The control box is equipped with PLC, which can control the operation of fuel (natural gas, methanol and ammonia) valve unit based on the external signal received. The junction box provides wiring terminals and does not have the function of controlling the operation of the electronic control system. It must be connected to an external control system to control the operation of the unit.

5.6.3 The design of the monitoring and control functions of the electronic control system for the fuel (natural gas, methanol, ammonia) valve unit shall meet relevant requirements in 5.7 of the Guidelines.

5.7 Control, monitoring and safety protection

5.7.1 The control system of the fuel (natural gas, methanol and ammonia) valve unit shall be designed to realize the control of valves and the processing of alarms. Measures shall be taken to remove unburnt combustible mixtures in the exhaust system for pipelines between the fuel valve unit and the engine and other equipment. Therefore, the control system shall be able to realize:

(1) Orderly action of valve (fuel (natural gas, methanol and ammonia) leakage detection, valve closing, ventilation, inerting and maintenance inspection);

(2) Process monitoring and local display of real-time status;

(3) Hardware interface with the supply system of equipment (e.g., engine);

(4) Signal communication interface with the integrated automatic ship-wide monitoring and alarm system.

5.7.2 Monitoring and safety protection

(1) The fuel (natural gas, methanol and ammonia) valve unit shall be able to monitor fuel temperature, fuel pressure and differential pressure before and after the fuel filter;

(2) The fuel (natural gas, methanol and ammonia) valve unit shall have the leakage detection function to ensure safe and reliable supply of the fuel valve unit;

(3) In addition to their own safety and functional requirements, the function and program control of the electronic control system shall also meet the safety and functional requirements for the equipment.

6 Raw Materials, Parts and Components

6.1 Important parts and components mainly include: shell, pipeline, manual stop valve, control stop valve and vent valve, pressure regulating valve (if any) and flowmeter (if any), fuel (natural gas, methanol, ammonia) filter, electrical control box or junction box.

6.2 Manual stop valves, control stop valves and vent valves, pressure regulating valves, electrical control boxes, fuel (natural gas, methanol and ammonia) filters, shells and pipes shall be inspected by CCS or have the product certificates issued by CCS. If necessary, flowmeters shall be approved by CCS.

7 Type Test

N/A

8 Unit/Batch Inspection

8.1 The inspection for issuing the marine product certificate shall be conducted after the manufacturer has completed the required inspections/tests and the product has passed inspections/tests, reaching a deliverable state.

8.2 Factory documents and test reports before the unit/batch inspection of fuel (natural gas, methanol and ammonia) valve unit shall include:

(1) Confirmation for both completion of drawing approval and the closure of drawing approval comments;

(2) Product certificates of parts and components and quality certificate of

flowmeter;

(3) Completed WPS & WPQR;

(4) Qualification certificates of welders and NDT personnel;

(5) NDT reports of shell and pipeline.

8.3 The unit/batch inspection items shall include:

(1) Dimension and visual inspection;

(2) Hydraulic test for strength of pressure-bearing parts;

(3) Sealing test of pipeline system;

(4) Valve action test;

(5) Sensor function test;

(6) Function test (for the first machine);

(7) NDT.

8.4 The test methods and technical requirements shall meet the following requirements:

8.4.1 Dimension and visual inspection: Check that the connection and arrangement of pipelines, the position and size of flanges, the wiring and fixation of cables, the labels, paint and nameplates of important parts and components meet the requirements.

8.4.2 The pressure test of pressure-bearing parts, including pipelines and shells, shall be carried out in the presence of a surveyor. The test shall be carried out as required in Table 8.4.2. The manufacturer shall keep the test report.

Table 8.4.2 Requirements for Hydraulic Test

Content / Description	Test Pressure Pm	Pressure Holding Time min	Acceptance Criteria
Pipeline	1.5 times the design pressure	30	No leakage No deformation
Shell	1.5 times the design pressure	30	No leakage No deformation

8.4.3 The sealing test of the pipeline system shall be carried out in the presence of a surveyor and must only proceed after the system has successfully passed the hydraulic test. The test medium should be air or nitrogen. During the test, the pressure shall be gradually increased to the specified value, and bubble water shall be used for detection. The sealing test shall be carried out as required in Table 8.4.3. The manufacturer shall keep the test report.

Table 8.4.3 Requirements for Sealing Test

Content / Description	Test Pressure Pm	Pressure Holding Time min	Acceptance Criteria
Fuel (natural gas, methanol, ammonia) supply pipeline	1.0 times the design pressure	10	No leakage
Exhaust pipeline	1.0 times the design pressure	10	No leakage
Inerting pipeline	1.0 times the design pressure	10	No leakage

8.4.4 The insulation resistance shall be measured before and after the withstand

voltage test. The DC test voltage should be 48V. The insulation resistance measured before and after the test shall not be less than 10MΩ and 1MΩ, respectively.

The test voltage of 50Hz and 548V shall be applied for the withstand voltage test, with a duration of 1min. The test results shall show no breakdown or flicker, and the insulation resistance shall be measured immediately after the test.

8.4.5 The valve action test shall be carried out to confirm that the manual stop valve, control stop valve, vent valve and pressure regulating valve can be opened and closed normally. The response time for closing the control stop valve on the fuel (natural gas, methanol and ammonia) supply pipeline shall meet the requirements of equipment manufacturer.

8.4.6 The sensor function test shall be carried out after the equipment is powered on. Signals such as valve position feedback, temperature and pressure sensors shall be checked one by one, and there shall be no fault alarm.

8.4.7 The function test shall meet the requirements of CCS *Rules for Natural Gas Fuel Used in Ships*, *Guidelines for Ships Using Methanol/Ethanol Fuel* and *Guidelines for Ships Using Ammonia Fuel* and of engine manufacturers. The specific test items are as follows, and applicable items shall be selected according to different products:

(1) Fuel (natural gas, methanol and ammonia) leakage test;

(2) Maintenance of main engine and fuel (natural gas, methanol and ammonia) valve unit;

(3) Inerting and scavenging test;

(4) Operation in fuel (natural gas, methanol and ammonia) mode;

(5) Stop supply;

(6) Emergency gas cut-off;

(7) Safety test.

8.5 During the initial unit/batch inspection of various types of fuel (natural gas, methanol and ammonia) valve units, all applicable test items in 8.3 above shall generally be carried out, and products without control functions may be exempt from functional test. After the inspection of the first set of products of the same model, a written application can be submitted to CCS for reduction or exemption of some test items. The surveyor shall evaluate the application based on the production situation and use records of the manufacturer and submit the opinions together with the manufacturer's written application to the Product Department of the Headquarters. Any reduction or exemption may only be implemented after approval by the Product Department.

8.6 Certificates

8.6.1 When applying for unit/batch inspection, please provide the following information for the surveyor's review:

(1) Delivery test program;

(2) Raw material quality report;

(3) Inspection certificates of important parts and components, including valve and fuel (natural gas, methanol, ammonia) filter;

(4) Self-inspection and sampling inspection reports;

(5) Product quality certificate of fuel (natural gas, methanol and ammonia) valve unit;

(6) Asbestos-free declaration;

(7) List of measuring instruments.

8.6.2 After completion of unit/batch inspection, CCS issues marine product certificate.