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T-04

Cargo Hose

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Foreword

China Classification Society (hereinafter referred to as CCS) Product Inspection and Testing Guideline (hereinafter referred to as this Guideline) contains the technical requirements, inspection and testing criteria related to classification and statutory survey of marine products to be applied for CCS approval/inspection.

This Guideline frees the users to adopt other test methods and requirements which are equivalent to or are stricter than this Guideline.

This Guideline is published and updated by CCS, and is released at <http://www.ccs.org.cn>. Your comments or suggestions are welcomed and may be sent to our email addressed service@ccs.org.cn.

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Cargo Hose

1 Application

1.1 The Guidelines apply to cargo hoses for liquefied natural gas, methanol and ammonia fuel.

1.2 The main structural types of cargo hoses for liquefied natural gas include: metal bellows, composite material hoses and hose structures in hoses with annular space. The main structures of the cargo hose for methanol include: inner spiral metal wire, pipe wall composed of sealing layer and tensile layer, outer coating, outer spiral metal wire, etc. The main structures of cargo hose for ammonia include: inner lining, reinforcing layer and outer coating, etc.

1.3 Other equivalent standards may be accepted by CCS for the technical requirements and test methods mentioned in the Guidelines.

2 Normative references

2.1 The basis for approval and inspection used in the Guidelines are as follows:

- (1) Chapter 2, Part 3 of CCS Rules for Classification of Sea-going Steel Ships;
- (2) Chapter 5, Part 3 of CCS Rules for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk;
- (3) Chapter 3 of CCS Rules for Construction and Equipment of Liquefied Natural Gas Floating Storage and Regasification Unit;
- (4) SY/T 6986.2-2 Installation and equipment for liquefied natural gas - Design and testing of marine transfer systems - Part 2: Design and testing of transfer hoses;
- (5) BS EN 1474-2 Installation and equipment for liquefied natural gas - Design and testing of marine transfer systems - Part 2: Design and testing of transfer hoses;

- (6) Chapter 2 of *CCS Guidelines for Preparation of Ship-to-Ship Lightering Operation Plan* (Liquefied Gas Carrier);
- (7) BS EN 13766 Thermoplastic Multilayer (Non-vulcanised) Hoses and Hose Assemblies for the Transfer of Liquefied Petroleum Gases and Liquefied Natural Gas - Specification;
- (8) Chapter 5 of CCS Rules for LNG Bunkering Pontoons;
- (9) Chapter 4 of Current CCS Rules for LNG Bunkering Vessels;
- (10) *Petroleum, Chemical and Liquefied Gas Ship-to-Ship Lightering Guidelines* of the Oil Companies International Marine Forum;
- (11) IACS UR G3 Liquefied gas cargo and process piping;
- (12) Chapter 5 of *CCS Guidelines for Ships Using Methanol Ethanol Fuel*;
- (13) Chapter 4 of *CCS Guidelines for Methanol Bunkering Vessels*;
- (14) Chapter 9 of the Ship Technical Regulations of the People's Republic of China - Interim Rules for Technology and Survey of Alcohol Fuel-powered Ships;
- (15) Chapter 5 of *CCS Guidelines for Ships Using Ammonia Fuel*;
- (16) GB/T 37997 Specification for Multilayer Thermoplastics (Non-vulcanized) Hoses and Hose Assemblies for the Transport of Hydrocarbons, Solvents and Chemicals;
- (17) ISO 27126 Specification for Multilayer Thermoplastics (Non-vulcanized) Hoses and Hose Assemblies for the Transport of Hydrocarbons, Solvents and Chemicals;
- (18) EN 13765 Thermoplastic Multilayer (Non-vulcanised) Hoses and Hose Assemblies for the Transfer of Hydrocarbon Solvents and Chemicals;

- (19) ISO 5771 Rubber Hoses and Hose Assemblies for the Transport of Anhydrous Ammonia - Specification;
- (20) ISO 16904-2 Liquefied Natural Gas Equipment and Installations - Design and Testing of Shipboard Transfer Systems - Part 2: Design and Testing of Transfer Hoses;
- (21) GB/T 16591 Rubber Hoses and Hose Assemblies for the Transport of Anhydrous Ammonia - Specification.

3 Terms and definitions

3.1 Cargo hose: Refers to the hose used for transporting liquefied natural gas, methanol and ammonia.

3.2 Hose assembly: It refers to the entire hose composed of hoses, end accessories and other components.

4 Drawings and documents

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

- (1) Main technical parameters of the product, including model, inner and outer diameters, transmission medium, design temperature, minimum bending radius, maximum allowable working pressure, maximum applicable torque, maximum applicable axial load, storage bending radius, maximum allowable impact load/breaking load, conductivity/insulation resistance, etc.;
- (2) General drawing;
- (3) Drawings of main parts and components.

4.2 During product drawing approval, the following drawings and data shall be submitted for information:

- (1) Product instructions, nameplate and factory certificate (sample);
- (2) Document describing the compatibility between hose material and medium.

4.3 During type approval, the following drawings and data shall be submitted for approval:

- (1) Factory overview: factory name, address, production history, production capacity, technical and inspection personnel, main products, affiliation, product trademarks, etc.;
- (2) Details of the product to be approved;
- (3) List of main production equipment;
- (4) List of main testing equipment;
- (5) Brief production process, main process documents, welding process and joint connection process of the products to be accredited;
- (6) Quality management documents or quality system certificates;
- (7) Enterprise registration certificate;
- (8) Qualification certificate and/or production license, if applicable;
- (9) Product quality certificate or sample of certificate;
- (10) Quality control plan, if applicable;
- (11) List of qualified suppliers, if applicable;
- (12) Type accreditation test program.

5 Technical requirements

5.1 The liquid and vapor hoses used for cargo lightering shall be compatible with the cargo and adapt to the temperature of the cargo. Hose end accessories shall be suitable for the working pressure and temperature.

Methanol hoses shall not be made of materials sensitive to methanol, such as metallic aluminum alloy, galvanized steel and lead alloy, non-metallic nitrile rubber and butyl rubber.

Materials susceptible to ammonia corrosion such as copper, alloy containing copper, zinc, alloy containing zinc, cadmium and mercury shall not be used for the ammonia hose.

5.2 The hose shall be in strict accordance with the manufacturer's instructions for testing, storage, temperature and pressure operating cycles.

5.3 Hoses that bear the pressure of liquid cargo hold or the discharge pressure of cargo pumps or vapor compressors shall be designed according to their bursting pressure, which shall not be less than 5 times the maximum pressure that hoses may bear during cargo lightering.

5.4 A prototype test shall be conducted for each new cargo hose with end accessories and the hose used in the prototype test shall not be reused for transporting cargo.

5.5 Hoses shall be marked with the date of test and specified maximum working pressure by stenciling or other means, as applicable. For hoses that are not used at ambient temperature, the maximum and minimum operating temperatures shall also be marked. For LNG and methanol hoses, the specified maximum working pressure shall be not less than 1 MPa (gauge pressure).

5.6 Any LNG hoses intended for use in shipboard cargo systems shall be manufactured from suitable materials having a melting point above 925 °C.

5.7 The welding process qualification shall be carried out in accordance with the requirements of CCS.

6 Materials and components

6.1 Raw materials and parts and components of products shall be controlled in accordance with the relevant requirements of our current specifications.

6.2 The raw materials and parts and components included in the list of qualified suppliers shall not be changed without the approval of the CCS.

7 Type test

7.1 Selection of typical samples

7.1.1 For initial accreditation, the transmission medium, design pressure, diameter, material and other factors shall be considered for selection of typical samples. Type tests shall be carried out on cargo hose assemblies of each model and size. However, for a range of more than 3 different diameters, at least the following sizes shall be selected for type test:

- (1) Minimum diameter;
- (2) Maximum diameter;
- (3) Intermediate diameter selected according to the following: a type test carried out on a hose assembly of diameter D is only valid for hose assemblies with diameter between $0.5D$ and $2D$.

7.1.2 During the accreditation of certificate renewal, the most representative model/specification or that with the largest market demand can be selected from the accredited products as typical samples for testing.

7.2 Type test items

Type test items are detailed in Table 7.2.

Type Test Items Table 7.2

S/N	Test Items	LNG cargo hose	Methanol cargo hose	Ammonia cargo hose
1	Visual and dimension inspection	X	X	X
2	Temperature and pressure cycling test	X	X	X
3	Bursting pressure test	X	X	X
4	Bending cyclic fatigue test	X		
5	Destruction test	X		
6	Impact Test	X		
7	Tensile test	X		
8	Bend test for minimum bend radius	X		
9	Maximum allowable applicable torque test	X		
10	Electrical test	X	X	X
11	Hydraulic test	X	X	X
12	Leakage test	X	X	X
13	Welding inspection	X	X	X
14	Other test items to be carried out according to the product implementation standards	X	X	X

Note: ① The test item marked with "X" means "applicable";

② The implementation standards of LNG cargo hoses mainly include ISO 16904-2, BS EN 1474-2 and SY/T 6986.2;

③ The implementation standards of methanol hose mainly include GB/T 37997, ISO 27126 and EN13765;

④ The implementation standards of ammonia hose mainly include ISO 5771, GB/T 16591, etc.

7.3 Test requirements and test methods

(1) Appearance and dimension inspection

The appearance and dimensions of the product shall meet the requirements in the drawings approved by CCS.

(2) Temperature and pressure cycling test

The hose assembly shall be subjected to a pressure cycling test at normal ambient temperature, which shall be carried out for 200 times from zero to at least twice the specified maximum working pressure.

(3) Bursting pressure test

After the above temperature and pressure cycling tests, a bursting pressure test shall be carried out to confirm that the bursting pressure is at least 5 times higher than the specified maximum working pressure under the highest and lowest extreme operating temperatures.

(4) Bending cyclic fatigue test

The hose assembly shall be subjected to a bending cyclic fatigue test at the design temperature for a minimum of 400000 cycles without failure.

The fatigue bending radius shall be in accordance with the recommendations of the design.

(5) Destruction test

Hose assemblies shall be capable of withstanding, without damage, a destruction test at ambient and design temperatures. The hose assembly is fixed between two rigid plates (an area corresponding to the diameter of the hose) and a force of 1000 N is applied 10 times at the same position in the middle of each flexible hose.

(6) Impact test

Hose assemblies shall be subjected to an impact test to confirm that the hose can withstand specified loads without damage at ambient and design temperatures. The load specified for the test is the maximum impact pressure to which the hose may be subjected during transfer operations.

(7) Tensile test

Hose assemblies shall be subjected to a tensile test at ambient and design temperatures to confirm that the hose can withstand the maximum working load .

(8) Bend test for minimum bend radius

Hose assemblies shall be subjected to bend test at ambient and design temperatures to confirm that the hose can withstand the maximum working pressure at the minimum bend radius.

The hose shall be gradually bent to the minimum bend radius, and then the pressure shall be increased to the maximum working pressure. When the minimum bend radius is maintained for 15 mins, the hose shall be inspected and there shall be no damage when it returns to the state before test.

(9) Maximum allowable applicable torque test

Hose assemblies shall be subjected to a torsional test at ambient and design temperatures to confirm that the hose can sustain its maximum working load during the maximum allowable applicable torque.

The hose assemblies shall be progressively torqued to the maximum allowable applicable torque and then applied to the maximum working pressure. When the maximum allowable applicable torque is maintained for 15 mins, check whether the hose leaks and has no damage when it returns to the state before test.

(10) Electrical test

Confirm that the hose is conductive or insulated, and its resistance value meets the design requirements. The resistance of the continuous conductive hose shall be less than 10 Ω and the insulating hose shall have a resistance of not less than 25000 Ω .

The hose shall be drained of water and placed on the ground in an insulated manner, and the resistance between the fittings at both ends shall be measured.

(11) Hydraulic test

The hose assemblies shall be subjected to hydraulic test to verify that the hose can withstand the test pressure without leakage. The test pressure shall be less than 1.5 times of the design pressure and the holding time shall be 15 mins.

(12) Leakage test

The hose assemblies shall be subjected to air pressure test at ambient temperature, and the pressure shall not be less than 1.1 times of the design pressure, so as to confirm that the hose assembly can withstand its pressure without leakage.

(13) Welding inspection

Appearance inspection and nondestructive testing shall be carried out for welds of hose assemblies. Where applicable, all butt welds of hose assemblies with connection systems shall be 100% radiographed.

8 Unit/batch inspection

8.1 The manufacturer can apply for a survey of marine products only after successfully completing and passing the specified delivery inspection/test.

8.2 The test items to be witnessed by the surveyor are as follows:

All cargo hoses applied for survey shall be tested one by one as follows:

- (1) Visual and dimension inspection;
- (2) Hydraulic test;
- (3) Leakage test;
- (4) Welding inspection.

8.3 The test items for which the test reports should be submitted to CCS for review are as follows:

- (1) Test reports of all products applied for survey in accordance with Article 8.2;
- (2) Verification certificate or verification list of test instruments and meters.