

Guideline No.M-16(201510)



M-16

TRANSVERSE PROPULSION

ARRANGEMENT

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Foreword

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 mp@ccs.org.cn.

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TRANSVERSE PROPULSION ARRANGEMENT

1 Application

1.1 This Guideline applies to the product inspection of transverse propulsion arrangements providing enough thrust for ships travelling at low speed or working alongside or off docks.

1.2 This Guideline is to be complied with when the product is associated with the dynamic positioning system.

1.3 The prime mover and electrical control device associated with the product are not included.

2 Basis for approval and inspection

2.1 *CCS Rules for Classification of Sea-Going Steel Ships*

2.2 *CCS Rules for the Construction of Inland Waterways Steel Ships*

2.3 *CCS Rules for Materials and Welding*

3 Definitions

3.1 For the purpose of this Guideline, the relevant definitions given in *CCS Rules for Classification of Sea-going Steel Ships* apply.

4 Plans and technical documents

4.1 The following plans and technical documents are to be submitted for approval:

- (1) Main product performance specification table (unnecessary to be individually submitted if included in the plans);
- (2) General assembly plan of transverse propulsion arrangement;
- (3) Plans of main parts and components:
 - ① Plan of propeller (plan of controllable-pitch propeller in case of transverse propulsion arrangement with controllable pitch propeller, including propeller hub housing, crank pin ring, yoke, hydraulic cylinder, propeller blade, blade fastening bolt)
 - ② Propeller shaft
 - ③ Driven gear
 - ④ Drive shaft/gear

⑤ Gearbox

⑥ Tunnel

- (4) Schematic diagram of hydraulic system (where applicable);
- (5) Calculation books (including shafting strength and gear strength calculation books, blade strength calculation book, etc.);
- (6) List of physicochemical properties of main parts materials (unnecessary to be submitted if the chemical composition and mechanical properties of materials are described in the main parts plans);
- (7) Test program (where applicable).

4.2 The following plans and technical documents are to be submitted for information:

- (1) Product instructions

5 Materials and components

5.1 The materials and components of the product are to be controlled according to relevant requirements of the CCS Rules currently in effect.

5.2 Couplings, keys and shafting connecting bolts for dynamic positioning system are to be inspected by CCS. For the couplings not for main propulsion, the supporting documents from the manufacturing works may be acceptable provided that the product is type-approved by CCS. A report of the physicochemical properties of materials is required to be provided and sampling inspection may be conducted if necessary when couplings, keys and shafting connecting bolts are standard parts. The part R of connecting bolt is to be subjected to a magnetic particle test.

5.3 The forgings for propeller shaft, drive shaft and gear pair are to be attached with CCS certificates or be inspected by CCS.

5.4 The sealing device, bearing and hydraulic pump are to be attached with supporting documents from the manufacturing works.

5.5 The tunnel and the hydraulic power pack of controllable-pitch propeller are to be inspected by CCS or be attached with CCS certificates. (The hydraulic power pack of controllable-pitch propeller may also be inspected along with the complete transverse propulsion arrangement by CCS.)

6 Welding procedures qualification, non-destructive test and heat treatment

6.1 The welding procedures for welded components such as gearbox and tunnel of transverse propulsion arrangement are to be subjected to the welding procedures qualification according to relevant requirements of *CCS Rules for Materials and Welding* before application.

6.2 Non-destructive test

6.2.1 On completion of fabrication, the propeller shaft and the drive shaft with a diameter of more than 250 mm are to be subjected to an ultrasonic test before machining.

6.2.2 See the requirements of Section 4, Chapter 8, Part Three of *CCS Rules for Materials and Welding* for the non-destructive test of propeller hub and blade.

6.3 Heat treatment

6.3.1 Heat treatment is to comply with relevant provisions of Chapter 5, Part One of *CCS Rules for Materials and Welding*.

7 Design and technical requirements

7.1 Material requirements

7.1.1 The propeller shaft and the drive shaft are to be made of forged steels. The forgings are to comply with relevant provisions of 11.1.2.2, Chapter 11, Part Three of *CCS Rules for Classification of Sea-going Steel Ships* and Section 3, Chapter 5, Part One of *CCS Rules for Materials and Welding*.

7.1.2 The wheel and pinion with a power of more than 100 kW are to be steel forgings. The forgings are to comply with relevant provisions of Section 5, Chapter 5, Part One of *CCS Rules for Materials and Welding*.

7.1.3 See the requirements of CCS guideline *Copper Alloy Propeller* for the materials of propeller.

7.1.4 The materials of tunnel are to comply with the provisions of Chapter 3, Part One of *CCS Rules for Materials and Welding* on the steels used for the hull.

7.2 Construction and strength requirements

7.2.1 The construction and strength of propeller shaft and drive shaft are to comply with the requirements of Section 2, Chapter 11, Part Three of *CCS Rules for Classification of Sea-going Steel Ships*.

7.2.2 The strength of shafting couplings, keys and connecting bolts is to comply with the requirements of Articles 11.3.2 and 11.3.3, Chapter 11, Part Three of *CCS Rules for Classification of Sea-going Steel Ships*.

7.2.3 The strength of propeller blade is to comply with relevant provisions of Section 4, Chapter 11, Part Three of *CCS Rules for Classification of Sea-going Steel Ships*.

7.2.4 The installation of fixed propeller and controllable-pitch propeller is to comply with relevant provisions of Section 4, Chapter 11, Part Three of *CCS Rules for Classification of Sea-going Steel Ships*.

7.2.5 The installed shaft seal is to be able to prevent the steel shaft from being corroded by sea water;

7.2.6 The thickness of tunnel is to be not less than that of the adjacent hull part.

7.3 Anti-corrosion of tunnel

Measures such as cathodic protection and anticorrosive coating may be taken.

7.4 System arrangement and safety alarm device

7.4.1 Hydraulic system (and the propeller hub lubricating system, if any) is to comply with the following requirements:

The “material”, “piping system” and “arrangement” of hydraulic transmission piping system are to comply with relevant provisions of Section 7, Chapter 4, Part Three of *Rules for Classification of Sea-going Steel Ships*.

7.4.2 Alarm

Alarm items of controllable-pitch propeller are to comply with the provisions of 11.3.8.8, Chapter 11, Part Three of *Rules for Classification of Sea-going Steel Ships*.

Ships to apply for CCS class notation for dynamic positioning are to comply with relevant requirements of 11.5.10, Chapter 11, Part Eight of *Rules for Classification of Sea-going Steel Ships*.

8 Type test

8.1 Selection of typical sample

8.1.1 The first product of the same type is to be type-tested.

8.2 Type test items are to include:

- (1) Visual inspection;
- (2) Dimensional inspection;
- (3) Hydraulic test;
- (4) Tightness test;
- (5) Pitch control test (where applicable);
- (6) Functional tests of safety protection and alarm;

- (7) Other test items (The hydraulic power pack and electrical control box of controllable-pitch propeller are to be subjected to combined commissioning with the transverse propulsion arrangement for functional check. The hydraulic power pack of controllable-pitch propeller is to be tested according to Section 7, Chapter 2, Part Three of *Rules for Classification of Sea-going Steel Ships*.)
- (8) Overall idling test (where applicable). For the overall idling test, the manufacturing works may apply to CCS for assessment. For the enterprises passing the assessment, the test may be replaced by other inspection methods.

8.3 Type test methods and requirements

8.3.1 Visual inspection

- (1) The main components such as propeller, propeller shaft, drive/driven gear, drive shaft and equipment and connecting pipes of hydraulic system are to be subjected to visual inspection and feel test according to the plan requirements.
- (2) The components of the product are to be complete with intact and undamaged appearance, sound protective layer and tight fasteners.
- (3) The pipelines of hydraulic units are to be arranged regularly and bended smoothly; long pipelines are to be fixed; and flexible hoses are to be short as much as possible without abrupt bends or twisting.

8.3.2 Dimensional inspection

- (1) The measured outline dimensions of drive shaft, propeller shaft, drive/driven gear and propeller blade are to be in line with those indicated in the approved plans.
- (2) The measured gear contact area and backlash are to be in line with those indicated in the approved plan.
- (3) The measured tip clearance between the propeller blade and the tunnel is to be in line with that indicated in the approved plan.

8.3.3 Pitch control test (if any)

- (1) The transverse propulsion arrangement with a controllable-pitch propeller is to be subjected to tests on pitch control time, pitch control stability, pitch control accuracy, pitch indication accuracy, etc.

8.3.4 Hydraulic/tightness test

- (1) Before being assembled, the pipelines and pressure elements of hydraulic transmission system and control system for controllable-pitch propellers are to be subjected to hydraulic tests to a pressure of 1.5 times the working pressure. Before the tightness test, the pipelines of hydraulic transmission system and control system for controllable-pitch propellers are to

be oil-flushed. On completion of assembling, the pipelines and pressure elements of hydraulic transmission system and control system for controllable-pitch propellers are to be tested to 1.25 times the working for tightness. The fixed sealing parts and pipe joints are free of leakage.

- (2) The gearbox of transverse propulsion arrangement is to be subjected to a hydraulic test to 0.2 MPa on completion of fabrication, and a tightness test on completion of assembling. The tightness test may be conducted with a liquid at a pressure of 0.1 MPa or compressed air at a pressure of 0.03 MPa by the soap liquid application method. The test is to last for at least 5 min. Leakage is not allowed.
- (3) For the turning test of oil distributor sealed bearing, the amount of leakage and the temperature under specified pressure and rated speed are to be in line with those indicated in the approved plan.

8.3.5 Functional test of alarm/safety

- (1) Alarm required in the bridge with individual or groupwise indicators for the following faults is to be inspected:

Stop of prime mover;

Power failure of remote control system;

Failure of alarm system;

Low level in lubrication oil tank (if fitted);

Low lubrication oil pressure (if forced lubrication oil system);

Low level in hydraulic supply tank (applicable to transverse propulsion arrangements with a controllable-pitch propeller);

Low pressure in hydraulic system (applicable to transverse propulsion arrangements with a controllable-pitch propeller);

- (2) The following individual indication items required in the bridge are to be inspected:

Overload of prime mover or servo unit;

Propeller pitch for controllable-pitch propeller plants;

Direction of rotation and r.p.m for fixed propeller plants;

Power failure of alarm system;

- (3) For transverse propulsion arrangements for ships to apply for CCS class notation for

dynamic positioning, the following alarm or indication items in the control station are to be inspected:

Transverse propulsion speed (for fixed pitch propeller);

Transverse thrust direction;

Coolant leakage of transverse propulsion motor/thyristor inverter;

Temperature of transverse propulsion motor/thyristor inverter;

Short circuit of transverse propulsion motor;

Excitation power supply for transverse propulsion motor (applicable to DC motor);

Power supply for transverse propulsion motor;

Thrust in %.

If the above required alarm and indication items are impractically or unnecessary to be arranged, or have equivalent arrangements, with the consent of CCS, the number of items may be reduced based on the actual situation.

8.3.6 Overall idling test

- (1) Products without a propeller may be driven by the test device on the test bench at the manufacturing works for operation test.
- (2) The rotation speed is to be gradually increased to the rated speed. The test is to last for at least 3 h. The test time of controllable-pitch propeller may be correspondingly reduced. If necessary, a test on board may be conducted.
- (3) The working pressures of all oil pumps and the lubrication oil temperature of the gearbox are to be recorded during the test.
- (4) The system is to be able to work smoothly and steadily without abnormal noise and leakage.

8.3.7 Other tests

- (1) See Chapter 10 “Copper Alloy Propeller” of Part Two of CCS *Guidelines for Product Inspection* for the type test of propeller.
- (2) See guidelines for electrical control system of controllable-pitch propeller for the type test of electrical control system.

9 Unit/batch inspection

9.1 Inspection content

9.1.1 Inspections are to include document examination and in-process inspections and functional tests.

9.1.2 In-process inspections are to mainly include material tests, non-destructive tests of main parts, inspection of manufacturing and assembly qualities of parts (gear engagement inspection, measurement of the clearance between the propeller blade and the tunnel), etc.

9.1.3 The main parts such as propeller, propeller shaft, drive shaft and drive/driven gear are to be subjected to mechanical properties tests of materials.

9.1.4 The transverse propulsion arrangement is classified according to the model and the maximum power. The first product is to be type-tested according to Article 8 of this Guideline. The subsequent products may be tested according to the unit/batch inspection items.

9.2 The reports or records required to be submitted by the manufacturing works are to at least include:

- (1) Quality assurance certificate and/or re-test report of physicochemical properties of materials of main product parts processed at the manufacturing works;
- (2) Certificate of conformity and relevant certificates of main purchased parts or outsourced parts;
- (3) Inspection, measurement and test conditions of manufacturing works, a list of test and inspection equipment and copies of valid verification certificates;
- (4) Test report of manufacturing works, which is to include the model, specifications and serial number of product or sample, test place and date, test environment, test items and data, problems discovered during test and inspection and corresponding solutions, and test results.

9.3 Unit/batch inspection items are to include:

- (1) Visual inspection;
- (2) Dimensional inspection;
- (3) Pitch control test (where applicable);
- (4) Hydraulic test;
- (5) Tightness test;
- (6) Functional tests of safety protection and alarm;

(7) Operation test (where applicable).

9.4 For the transverse propulsion arrangement type-modified after type test, CCS may reduce relevant test items or test time during the inspection provided that its maximum power is not more than that of the prototype and its construction is similar to or main components are carried over from the prototype.