

Guideline No.: M-26(201708)



M-26

STRAIGHT-WING RUDDER PADDLE

Issued date: August 15, 2017

© China Classification Society

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.

Historical version and release date::M-26(201708), issued time: August 15, 2017.

Main change: New Release

Contents

1	Scope of Application	3
2	Normative References	3
3	Terms and Definitions	3
4	Drawings and Documents	4
5	Technical Requirements	5
6	Raw Materials and Spare Parts & Components	6
7	Type Test	6
8	Inspection by Piece/Batch	8

STRAIGHT-WING RUDDER PADDLE

1 Scope of Application

1.1 The Guideline is applicable to product drawing review, verification and certification of straight-wing rudder paddle for main propulsion or side propulsion of vessel and offshore facilities.

1.2 Straight-wing rudder paddle includes: gear box, blade, blade rotation mechanism, turning system, etc.

1.3 Considering product specification diversity of straight-wing rudder paddle, factory approval or type approval for such product is not required by CCS, thus the Guideline is applicable to straight-wing rudder paddle without type test. For such mass-produced products, CCS encourages marine product manufacturers to implement type approval and test for straight-wing rudder paddle. Specific requirements may refer to product standards specified in Article 2 of the Guideline and applicable requirements in the Guideline shall be met.

1.4 Inspection of similar equipment for offshore facilities shall be governed by the above mentioned standards.

1.5 The Guideline is not applicable to approval and inspection of electrical/electronic equipment (e.g. control box) for above mentioned equipment. The requirements may refer to *Technical Guideline for Straight-wing Rudder Paddle*.

2 Normative References

2.1 *Rules for Classification of Sea-going Steel Ships* (CCS)

2.2 *Rules for Construction of Inland Steel Ships* (CCS)

2.3 *Rules for Materials and Welding* (CCS)

2.4 *Technical Guidelines for Straight-wing Rudder Paddle* (CCS)

All above referenced specifications and guidelines are currently valid versions.

3 Terms and Definitions

Terms and definitions defined in the above inspection basis are applicable to the Guideline. For easy to write and use, the following definitions are directed quoted or supplemented in the Guideline.

- (1) RCSSS: refers to *Rules for Classification of Sea-going Steel Ships* (CCS);
- (2) Turning System (equivalent to steering system): refers to direction control system of vessel, including main turning gear (equivalent to main steering gear), auxiliary turning gear (equivalent to auxiliary steering gear) and turning control system (equivalent to steering gear control system);
- (3) Main Turning Gear: refers to power equipment, turning mechanism (equivalent to steering mechanism) and their auxiliary equipment as well as components for applying torque to blade shaft required for changing turning angle of vessel by actuating blade shaft in order to navigate vessel under normal voyage. Turning motor may be regarded as a part of power equipment and turning mechanism;
- (4) Auxiliary Turning Gear: refers to equipment used for navigating vessel in case of failure of main turning gear. Such equipment does not belong to any part of main turning gear but can share the component for applying torque to blade shaft;

4 Drawings and Documents

4.1 The following drawings and documents shall be submitted for approval during product drawing review:

- (1) Main product performance specifications (such content may be not separately submitted if included in drawings and technical documents);
- (2) General assembly drawing;
- (3) Drawings of main parts and components: including parts and components (e.g. shaft, gear, blade and blade shaft) for transmitting propulsion power and parts and components (e.g. shaft and link bar) for transmitting steering force;
- (4) Calculations (including calculations of shafting intensity, blade strength, gear strength check for transmitting propulsion power and calculations for steering transmission shaft, link bar and their accessories (if any));
- (5) List of physical and chemical properties of main part materials (such content may be not separately submitted if included in drawings);
- (6) Schematic diagram and layout drawing of turning system;
- (7) Outline for factory inspection/test (shall be submitted to site inspection department for approval).

4.2 The following drawings and documents shall be submitted for review during approval of drawings and documents:

- (1) Factory profile: factory name, address, production history, production capacity, technique and inspection personnel, major products, relationships, production brand, etc.;
- (2) Details of products applying for approval;
- (3) List of main manufacturing equipment;
- (4) List of main testing equipment;
- (5) Brief production process of products applying for approval;
- (6) Quality management document or quality system certificate;
- (7) Business registration certificate;
- (8) Qualification and/or production permission, if applicable;
- (9) Sample of production quality certificate or qualification;
- (10) Quality control plan, if applicable.
- (11) List of qualified suppliers, if applicable.
- (12) Type test outline.

5 Technical Requirements

5.1 Straight-wing main propulsion plant

5.1.1 Blade rotation mechanism

- (1) Blade and blade shaft manufacturing materials shall comply with the relevant requirements in Rules for Materials and Welding (CCS). Inspection of Surface quality and size deviations shall be made to the blades. According to the using condition of propulsion plant, flow field calculation report for blade stress or blade movement may be provided as required;
- (2) Stress evaluation of blade and blade shaft shall be made based on the following principles:
 - ① The strength calculation report (5.1.1.3) shall at least include the following contents:
 - ② Blade load conditions and determination based on ultimate condition and fatigue condition, including: full-speed ahead driving condition based on rated power of propulsion plant; full-speed back driving condition based on rated power of propulsion plant (including emergency reversing operation); load and its determination based on fatigue evaluation;
 - ③ Model diagram of finite element strength analysis and its description, calculation results (including deformation diagram and stress contour) and description using stress criteria;
 - ④ Description on fatigue evaluation method (including fatigue acceptance criteria) and calculation results of fatigue evaluation.
- (3) The gear actuator of power system and turning system in straight-wing rudder paddle shall meet the applicable requirements on gear actuator in Chapter 10, Part 3 of Rules for Classification of Sea-going Steel Ships (CCS).
- (4) The shaft system and its actuator in straight-wing rudder paddle shall meet the applicable requirements on shaft system and actuator in Chapter 11, Part 3 of Rules for Classification of Sea-going Steel Ships (CCS).
- (5) In case output shaft of main and input shaft of straight-wing rudder propulsion plant are not located in the same horizontal surface, a universal coupling shall be provided in pairs at the shaft system, with an inclined angle between the identical shafts. The inclined angle should not be greater than 10 °.
- (6) The sealing arrangement installed shall prevent water and sand from entering tumbler and prevent lubricating grease from leakage.

5.1.2 Turning system

- (1) Straight-wing rudder paddle of sea-going vessel shall be regarded as non-traditional vessel propulsion and turning system and shall meet the applicable requirements on steering gear in Section 1, Chapter 13, Part 3 of Rules for Classification of Sea-going Steel Ships (CCS).
- (2) For straight-wing rudder paddle for vessels navigating in inland rivers, its turning gear shall meet the applicable requirements on steering gear in Section 1, Chapter 9, Part 2 of Rules for Construction of Inland Steel Ships (CCS).
- (3) Straight-wing rudder paddle provided in two sets or above may not be equipped with auxiliary turning gear if the following conditions are met:

- ① Each turning system conforms to performance requirements relating to main turning gear, and: on passenger vessel, each turning system shall be able to operate the vessel direction control system as required by main turning system in case any power equipment is out-of-operation; on cargo vessel, each turning system shall be able to operate the vessel direction control system as required by main turning system when all power equipment are operational; each turning system shall be arranged as that vessel turning capacity can be maintained or recovered rapidly in case single failure occurs to the piping system or 1 power equipment (for example, if necessary, enable the invalid turning system locate at the middle position in emergency).
 - ② In case single failure occurs to the turning mechanism, each turning system shall provide additional capacity to make the failed turning system return and be locked at the middle position. It is acceptable to be locked at the current position if the turning system cannot return to the middle position.
- (4) The requirements in the above mentioned (3) are not applicable to domestic navigating vessels with vessel length of less than 20m and yachts with length less than 24m.
- (5) For link-bar-type straight-wing rudder paddle, link bars and their accessories shall have enough strength to ensure normal operation of the rudder paddle.

5.1.3 Vibration check

The torsional vibration of the shaft system of straight-wing rudder paddle shall conform to the requirements specified in Chapter 12 of *Rules for Classification of Sea-going Steel Ships (CCS)*.

5.2 Straight-wing side propulsion plant

5.2.1 Where straight-wing rudder paddle is worked as side propulsion plant of the vessel, applicable requirements on side propulsion plant in 11.3.8, Chapter 11, Part 3, of *Rules for Classification of Sea-going Steel Ships (CCS)* shall be met.

5.3 Effective anticorrosion measures shall be taken to prevent corrosive action of sea water to underwater members.

6 Raw Materials and Spare Parts & Components

The raw materials and spare parts & components of the product shall be controlled as per the relevant requirements of current specifications in the Society; main spare parts & components for transmitting propulsion power and steering force, such as motor, electrical control box, main shaft, bevel gear shaft, tooth, blade & shaft, center shaft, center gear, intermediate gear shaft, intermediate gear, shall be included in the list of qualified supplier, and cannot be changed without approval from the Society. Motor (50kW above), electrical control box (if any), main shaft, bevel gear shaft, bevel gear, tooth, blade and shaft shall be inspected by CCS or granted with CCS product certificate; center shaft, center bevel, intermediate gear shaft and intermediate gear shall possess manufacture's certificate.

7 Type Test

7.1 Type test shall be conducted to the first product based on the approved test outline.

7.2 Type test items shall include:

- (1) Physical & chemical performance test and NDT for major spare parts & components and raw materials;
- (2) Welding process evaluation for major welded structural members;

- (3) Appearance inspection;
- (4) Critical dimension inspection for major parts;
- (5) Hydraulic/tightness test;
- (6) Gear engagement inspection;
- (7) No-load running test;
- (8) Function test;
- (9) Overhauling after test (if applicable).

7.3 Type test methods and requirements

7.3.1 Physical & chemical performance test and NDT for major spare parts & components and raw materials

Physical & chemical performance test and NDT shall be conducted for spare parts & components (e.g. shaft, gear, blade & shaft) for transmitting propulsion power as well as spare parts & components (e.g. shaft and link bar) for transmitting steering force, except for purchased raw materials and castings & forgings with product certificate issued by the Society.

7.3.2 Welding process evaluation for major welded structural members;

Prior to manufacturing, welding process evaluation shall be conducted for gear box and tumbler as per the relevant requirements in *Rules for Materials and Welding*.

7.3.3 Visual inspection

- (1) Ensure surfaces of all mechanism parts are smooth, clean, free of rust and crack;
- (2) Inspect firmness and reliability of all linking parts.

7.3.4 Critical dimension inspection for major spare parts & components

Critical spare parts & components, such as main shaft, bevel gear shaft, bevel gear, tooth, blade & shaft, center shaft, center gear, intermediate gear shaft and intermediate gear shall have a dimension inspection prior to assembling; structure and overall dimension shall conform to drawing requirements after assembling.

7.3.5 Hydraulic/tightness test

After completion of assembly, tumbler/box shall have a tightness test. Tightness test may be conducted based on liquid at 0.1MPa; test/inspection may also be conducted in the manner of applying liquid soap based on 0.03MPa compressed air. Leakage shall be avoided.

Prior to assembly, pipes and power elements of hydraulic system (if applicable) shall have a hydraulic test at 1.5 times of design pressure; after assembly, test at 1.25 times of operating pressure shall be conducted.

7.3.6 Gear engagement inspection

- (1) Under appropriate load, contact of gear pair shall be checked in the manner of evenly applying a thin layer of paint;

- (2) Contact spot of gear shall conform to the requirements specified in Table 10.4.3.1, Chapter 10, Part 3 of Rules for Classification of Sea-going Steel Ships.

7.3.7 No-load running test

- (1) No-load running test needs continuous operation at forward and backward directions for at least 15 min;
- (2) During no-load running, inspect if the rudder paddle operate normally and observe if all components are free of abnormal vibration or running sound;
- (3) During no-load running, inspect to see if the appearance of reduction box is free from oil seepage or leakage; measure the oil temperature, which shall not exceed the limit value specified by the factory;

7.3.8 Function test

- (1) Start-stop function test;
- (2) Steering and propulsion control test;
- (3) Control shift test;
- (4) Analog alarm function test (10% of motor overload alarm; power failure alarm; oil temperature alarm; high/low oil level alarm);
- (5) Independent test of steering indicator.

7.3.9 Overhauling after test

- (1) Overhauling can be ignored if there is no abnormal condition during test;
- (2) In case of any anomaly, reduction box shall be disassembled to inspect the contact of gear pairs, shafts and bearings; crack, burn and other damage that may hinder actual use shall be avoided.

8 Inspection by Piece/Batch

Inspection and test shall be conducted to the straight-wing rudder paddles one by one based on the type test items. Notes shall be made in the production certificate if load test is carried out by the factory.