Guideline No.: E-03(202607)

E-03

MOTORS

Issued date: Jul. 01, 2026

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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

Historical versions and release date:

E-03(201510)	October 20, 2015
E-03(201610)	October 28, 2016
E-03(201705)	May 9, 2017
E-03(201909)	Sep. 9, 2019
E-03(202208)	Aug. 25, 2022
E-03(202511)	Nov. 01, 2025

Main changes:

1. Partly based on the document in accordance with the current valid specifications and standards update.

2. Adjusted the wording of some text and corrected errors.

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MOTORS

1 Application

1.1 This Chapter applies to motors for ships and offshore installations, but not to micro control motors.

1.2 This Chapter is applicable to motors for general purposes. Where motors, which are intended for special purposes or for which special tests are required, are not specifically covered by this Chapter, the standards for such motors are to apply.

2 Normative references

2.1 The approval and inspection of motors are to be based on the following documents:

(1) CCS Rules for Classification of Sea-going Steel Ships, 2015 and its amendments;

(2) CCS Rules for Materials and Welding, 2015 and its amendments;

(3) CCS GD 19-2024<Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version);

(4) IACS UR E13 (Rev.3 Corr.1 May 2022) Test requirements for Rotating Machines;

(5) IEC60092-301:2025{Ed.4.0}Electrical installations in ships - Part 301: Equipment– Generators and motors;

(6) IEC 60034-1:2022{Ed.14.0} Rotating machines - Part 1: Rating and performance;

(7) IEC 60085:2007{Ed.4.0} Electrical insulation – Thermal classification;

(8) IEC60034-5:2020 {Ed.5.0} Rotating machines - Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification;

(9) IEC 60034-6:1991 {Ed.2.0} Rotating machines - Part 6: Methods of cooling(IC code);

(10) IEC 60034-7:2020{Ed.3.0} Rotating machines - Part 7: Classification of types of construction, mounting arrangement and terminal box position (IM Code);

(11) IEC60034-8:2014 {Ed.3.1} Rotating machines - Part 8: Terminal markings and direction of rotation;

(12) IEC60034-15:2009 {Ed.3.0} Rotating machines - Part 15: Impulse voltage withstand levels of rotating AC machines with form-wound stator coils;

(13) IEC60068-2-30:2025 {Ed.4.0} Environmental testing - Part 2 – 30: Tests-test Db: Damp heat, cyclic (12h + 12h cycle);

(14) IEC60068-2-11:2021 {Ed.4.0} Environmental testing - Part 2: Tests – test Ka: Salt mist;

(15) CB /T 3907-1999 Ultrasonic testing of marine forged parts;

(16) IACS Rec.68 Guidelines for non-destructive examination of hull and machinery steel forgings;

(17) IEC 60092-501:2025{Ed.6.0} Electrical installations in ships - Part 501: Special features - Electric propulsion plant.

2.2 In lieu of the standards referred to in this Chapter, other equivalent standards or standards acceptable to CCS may be applied as appropriate.

3 Terms and definitions

3.1 For the purpose of this Chapter:

3.1.1 Rules for Classification of Sea-Going Steel Ships, It means the CCS Rules for Classification of Sea-Going Steel Ships.

3.1.2 AC high-voltage motor is a 3-phase AC motor rated over 1 kV.

3.1.3 Propulsion motor means electrical motor intended to provide propulsion power.

4 Plans and documents

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

(1) General plans;

(2) Detailed drawings of main parts, including assembly of stators, assembly of rotors, turning axle, assembly of collector rings or commuters, bedplates, and structure of terminal boxes;

(3) Technical specifications of the products;

(4) Type test program(At the time of type approval).

(5) Drawing of nameplate;

(6) Specimen of test quality certificate;

(7) Operation instructions for the products.

5 Technical requirements

5.1 The design and manufacture of products is to comply with the requirements of CCS Rules for Classification of Sea-going Steel Ships, CCS Rules for Materials and Welding and IEC 60092-301; thermal classification of electrical insulation is to comply with IEC 60085; classification of degrees of protective enclosures is to comply with IEC 60034-5; methods of cooling are to comply with IEC 60034-6; construction and mounting arrangement is to comply with IEC 60034-7;terminal markings and direction of rotation are to comply with IEC60034-8;Explosion-proof electric motors should also meet the requirements of IEC 60079 series or other explosion-proof standards accepted by CCS. Propulsion motors are to comply with IEC 60092-501.

5.2 Electrical machines are to be protected against ill effects of shaft current.

5.3 For non-closed-type bearings of electrical machines, consideration is to be to the fitting of grease cups or oil holes and corresponding oil drainage so as to ensure efficient lubrication.

5.4 Water-cooled motor should be carried out hydraulic test of cooling water pipeline refer to Chapter 2 Section 7 PART THREE of the Rules.

5.5 AC high-voltage motor

5.5.1 Rotating machinery is to be provided with temperature detectors in their stator windings to actuate a visual and audible alarm in a normally attended position whenever the temperature exceeds the permissible limit. If embedded temperature detectors are used, means are to be provided to protect the circuit against overvoltage.

5.5.2 In addition to the tests normally required for rotating machinery, a high frequency high voltagetest in accordance with IEC 60034-15 is to be carried out on the individual coils in order to demonstrate a satisfactory withstand level of the inter-turn insulation to steep fronted switching surges.

5.5.3 The degree of protection by enclosures for rotating electrical machines is to be at least IP23. The degree of protection of terminals is to be at least IP44. For motors installed in spaces accessible to unqualified personnel, a degree of protection against approaching or contact with live or moving parts of at least IP4X is required.

5.5.4 The air clearances and creepage distances are to comply with 2.14.2.3 PART FOUR of the Rules.

5.6 Propulsion motors

5.6.1 The lubrication of bearings of propulsion motors is to be effective at all normal speeds from creep speed upwards, either ahead or astern. The above shafts and bearings are not to be damaged by slow rotation caused by motor(s) or propeller(s) under all predictable oil temperature conditions.

5.6.2 Variable speed propulsion motors fitted with an integral fan are to be capable of operating at speeds below the rated speed with full-load torque, full-load current, full-load excitation or in similar conditions, and temperature rises are not to exceed the limits given in 3.2.3 of PART FOUR of the Rules.

5.6.3 The temperature of the cooling air of propulsion motors provided with forced air ventilation is to be continuously monitored by means of direct reading thermometers which are readable from outside the machine and a remote audible alarm actuated by suitable temperature detectors.

5.6.4 For propulsion motors fitted with heat exchangers in closed cooling circuits, the flow of primary and secondary coolants is to be monitored. Alternatively, monitoring of winding temperatures plus alarms may be accepted in lieu of the flow monitoring. In addition, consideration is to be given, where necessary, to the provision of devices for detecting leakage of cooling liquid in the machine enclosure and the operation of an associated alarm.

5.6.5 The collector rings and commutators are to be suitably arranged for easy maintenance. For purposes of inspection, repair, withdrawal and replacement of the field coils, provision is to be made for easy access to all windings and bearings.

5.6.6 Effective means are to be provided for the propulsion motors to prevent condensation and accumulation of moisture when they are out of service. If steam is used for heating purpose, no joints of steam pipes are permitted within the motors.

5.6.7 Propulsion motors are to be capable of withstanding the effects of a sudden short circuit at their terminals under all conditions without suffering damage.

5.6.8 Stator windings of AC machines and interpole windings of DC machines, rated above 500 kW, are to be provided with embedded temperature sensors. These sensors are to be arranged to operate an alarm if the temperature exceeds a predetermined safe value.

5.6.9 Stator windings of AC propulsion motors supplied by varied-frequency semiconductor converters are to be capable of withstanding the voltage variation due to action of the high-frequency switch of inverters.

5.6.10 Stator windings of AC propulsion motors supplied by semiconductor converters are to be provided with means to restrict generation of shaft current so as to prevent early damage of bearings.

5.6.11 Propulsion motors are to have a protection degree of at least IP 23. High voltage propulsion motors are to have a protection degree of at least IP 44.

5.6.12 Propulsion motors with semiconductor converters are to be designed for the expected harmonics of the system. A sufficient reserve is to be considered for the temperature rise due to total harmonic distortion.

5.6.13 Any single fault in the propulsion motors excitation system is not to result in a total loss of propulsion power. Field circuits are to be provided with means for suppressing voltage rise when a field switch is opened.

5.6.14 If the protection device of the excitation system trips, the respective circuit breaker of the propulsion motor is also to trip and is to be alarmed. Where fuses are used for excitation circuit protection, it is essential that they do not interrupt the field discharge resistor circuit upon rupturing.

5.7 Explosion-proof electric motor

5.7.1 The explosion-proof electric motor shall be obtained the certificate of explosion-proof as required the competent authority.

5.7.2 The conformity of the CCS inspected/approved products and the approved data of the issuing authority of the certificate of explosion-proof be confirmed.

6 Materials and components

6.1 Materials and components are to comply with relevant requirements of CCS Rules,or control according to recognized international, national, and industry standards.

6.2 For the propulsion motor(Except for the motor that drives the propeller through the gearbox), the shaft should be non-destructive examination, and the material of the shaft should have the certificate issued by CCS.

6.3 The non-destructive examination of the electric motor shaft can be carried out using recognized international, national or industry standards.The following non-destructive testing for common standards, corresponding to the agency determines the acceptable level specified in Table 6.3. When other countries or regional standards, subject to the agency to assess and confirm the level determined before use.

Acceptable non-destructive testing standards and minimum acceptance level① Table 6.3

Ultrasonic Testing		Magnetic particle testing		Penetrant testing	
Standard	Level	Standard	Level	Standard	Level
CB/T3907	II				
IACS Rec.68	qualified	IACS Rec.68	qualified	IACS Rec.68	qualified

①If manufacturers have acceptance criteria can also accept the manufacturer's acceptance criteria.

7 Type test

7.1Selection of typical samples

7.1.1Types and specifications of test samples are to cover the products for which approval is sought and be technically representative for determining, through type test, whether the manufacturer has the capability to manufacture the approval products as required by CCS. At least one of the samples taken from different series is to be rated not less than 80% of the maximum power to be approved.

7.1.2 Samples selected from the same series of motors are to be representative in terms of power, speed, construction type, installation type (vertical or horizontal), degree of protection, duty, method of cooling, insulation level, purpose and manufacturing process.

7.2 Items and requirements for type test

7.2.1 The type test of motors is to be in accordance with Table 7.2.1.

Type Test Items for Motors **Table 7.2.1**

No.	Test item	Technical requirements	Test method
1	Examination of the technical documentation, as appropriate and Visual examination	Approved plans and technical documents	Visual examination of Compliance
2	Measurement of insulation resistance	3.2.9.6, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships	3.2.9.6, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships
3	Measurement of winding resistance	Technical specifications	3.2.9.7, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships
4	Overload/overcurrent test	3.2.5.1, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships	3.2.5.1, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships
5	Over speed test①	IEC 60034-1para.9.7	IEC 60034-1para.9.7
6	Withstand voltage test	IEC 60034-1para.9.2	IEC 60034-1para.9.2
		IEC 60034-15	IEC 60034-15 (for high-voltage motors)
7	No-load test	3.2.9.14,PART FOUR of CCS Rules for Classification of Sea-going Steel Ships	3.2.9.14,PART FOUR of CCS Rules for Classification of Sea-going Steel Ships
8	Examination of bearings	3.2.9.16,PART FOUR of CCS Rules for Classification of Sea-going Steel Ships	3.2.9.16,PART FOUR of CCS Rules for Classification of Sea-going Steel Ships
9	hydraulic test②	2.7.1, PART THREE of CCS Rules for Classification of Sea-going Steel Ships	2.7.1, PART THREE of CCS Rules for Classification of Sea-going Steel Ships
10	Rated load test and measurement of temperature rise	3.2.3.1, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships	IEC 60034-1para.8
11	Test of degree of protective enclosure	IEC60034-5	IEC60034-5
12	Power supply variation test	<Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version),, 2.4	<Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version),, 2.4
13	Inclination test	<Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version),, 2.6	<Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version),, 2.6
14	Damp heat test	<Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version),, 2.10	<Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version),, 2.10
15	Salt mist test Ka③	<Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version),, 2.13	<Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version),, 2.13
16	Electromagnetic compatibility-measurement of conducted emission④	<Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version),, 3.2	<Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version),, 3.2

①Not applicable for squirrel cage motors.

②Only applicable for water-cooled motor

③Only applicable for motor mounted on open deck

④Only applicable for synchronous motors and DC motors.

8 Unit/batch inspection

8.1The manufacturers holding a CCS Type Approval B Certificate are still to carry out routine tests for each motor according to Table 8.1. The routine test report is to contain test results, the manufacturer's serial number of the motor ,the serial number of the machine which has been type tested and the test result.

8.2The number of generators to be inspected by CCS is to be 5% of the total number of submitted ones, but not less than 2 sets, unless the inspection is requested for one generator only.

8.3All motors rated at 50kW or above and intended for essential services are to be inspected by CCS Surveyor during the test and if necessary, in the manufacturing process. CCS and the manufacturer may agree on an alternative survey plan which makes Surveyor’s attendance in accordance with the requirements above unnecessary.

8.4Additional test items may be required where deemed necessary by the Surveyor.

8.5Material certificates are to be checked according to requirements of 6.

8.6 Items for type and routine tests of the electrical machines are to be in compliance with Table 7.2.1(1)、Table 7.2.1(2)、Table 8.1. Test requirements may differ for shaft generators, special purpose machines and machines of novel construction.

Routine Test Items forMotors **Table 8.1**

No	Test item	Technical requirement	Test method
1	Examination of the technical documentation, as appropriate and visual inspection	Approved plans and technical documents	Visual examination of Compliance
2	Measurement of insulation resistance	3.2.9.6, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships	3.2.9.6, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships
3	Measurement of winding resistance	Technical conditions	Bridge method or voltage-current method
4	Overload/overcurrent test①	3.2.5.1, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships	3.2.5.1, PART FOUR of CCS Rules for Classification of Sea-going Steel Ships
5	Overspeed test②	IEC 60034-1para.9.7	IEC 60034-1para.9.7
6	Withstand voltage test	IEC 60034-1para.9.2	IEC 60034-1para.9.2
		IEC 60034-15③	IEC 60034-15 (for high-voltage motors)
7	No load test	3.2.9.14,PART FOUR of CCS Rules for Classification of Sea-going Steel Ships	3.2.9.14,PART FOUR of CCS Rules for Classification of Sea-going Steel Ships
8	Examination of bearings	3.2.9.16,PART FOUR of CCS Rules for Classification of Sea-going Steel Ships	3.2.9.16,PART FOUR of CCS Rules for Classification of Sea-going Steel Ships
9	hydraulic test④	2.7, PART THREE of CCS Rules for Classification of Sea-going Steel Ships	2.7, PART THREE of CCS Rules for Classification of Sea-going Steel Ships

① Applicable for motors rated over 100 kW intended for essential services.

② Not applicable for squirrel cage motors.

③ Review the test report, tests will be witness if the surveyor considers necessary.

④ Only applicable for water-cooled motor.