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M-01
DIESEL ENGINES AND THEIR MAIN COMPONENTS AND PARTS

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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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Main change:

The particulars concerning the application range, drawings and documents, technical requirements, materials and components as well as type test and unit/batch inspection keep consistent with the applicable provisions in the Rules for Classification of Sea-going Steel Ships. Furthermore, the requirements for assessment of manufacturers adopting technology licensing mode have been supplemented.

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DIESEL ENGINES AND THEIR MAIN COMPONENTS AND PARTS

1 Application

1.1 This Guideline applies to the approval and inspection of main propulsion diesel engines driving propellers or impellers (for hydraulic propulsion), diesel engines driving generators for electric propulsion, diesel engines driving auxiliary generators, diesel engines driving auxiliary machinery as well as emergency diesel engines.

This Guideline is mainly applicable to such diesel engines as those installed in the ships that are designed in accordance with CCS Rules for Classification of Sea-going Steel Ships, while it works as a reference for the other diesel engines.

1.2 The emission of the diesel engines shall live up to the statutory requirements.

2 Normative references

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

(2) CCS Rules for Materials and Welding

(3) International Convention for the Safety of Life at Sea (SOLAS)1974

(4) IMO International Code for Fire Safety Systems

(5) IMO MSC.Circ 647 Guidelines to Minimize Leakages from Flammable Liquid Systems

For dated references in this Guideline, only the editions cited apply. For undated references, the latest editions (including any and every revision) apply.

3 Terms and definitions

3.1 The definitions in CCS Rules for Classification of Sea-going Steel Ships are applicable to this Guideline.

3.2 The definitions involved in this Guideline are detailed as follows:

(1) Low cycle fatigue (LCF): It, also termed "conditional fatigue limit", refers to the fatigue with failure cycles less than 1,000~10,000 given that the high stress is applied in a part or a structure. For instance, the high-temperature components of the diesel engine often bear frequent alternation between idle load and full load;

(2) Alternative Certification Scheme (ACS): It means a certification scheme through which the classification society will evaluate manufacturer's quality assurance and quality control arrangement, and authorize the manufacturer to replace classification society's surveyor in undertaking and witnessing tests after confirming the compliance of the arrangement with the rules. For details, refer to Section 10, Chapter 3, Part One of CCS Rules for Classification of Sea-going Steel Ships.

4 Drawings and documents

4.1 The drawings and documents shall be submitted for drawing approval.

4.1.1 The applicant for CCS approval of diesel engines shall submit the drawings and documents in accordance with Article 9.1.12.1 and 9.1.12.2 of Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships for CCS approval and for information. The applicant for CCS inspection of diesel engines shall submit the drawings and documents as specified in Table 1, Appendix 5, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships for CCS examination.The welding procedure specification of welding parts, type test procedures and type test reports required to be submitted can also be submitted when applying for CCS approval.

4.1.2 The torsional and longitudinal vibration equivalent values (if applicable) of the diesel engine shall be submitted pursuant to Chapter 12, Part Three of CCS Rules for Classification of Sea-going Steel Ships.

4.1.3 Other drawings/documents that are considered to be necessary by CCS.

4.2 Documents to be submitted for product approval

4.2.1 The documents shall at least include:

(1) Technical features of products;

(2) Type test program (including internal test items, exemption explanation in application for exemption);

(3) Factory internal test items and reports (if appropriate) as required in Article 1.3.1(1) of Appendix 4, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships;

(4) Type test report (to be submitted after fulfillment of type tests).

4.2.2 The following additional documents shall be submitted when the type approval of the diesel engine is applied for:

(1) General information of the factory: factory name, address, production history, production capacity, technical and inspection personnel, main products, affiliation and product trademark, etc.;

(2) Supplier list of raw materials and main components and parts;

(3) Other effective documents, reports and documentary evidence proving that the applicant has the production capacity within approval range and meets the quality requirements of the products;

(4) Quality assurance system documents, including the quality manual and the product quality control procedures, the production equipment and inspection/testing facilities of the main products;

(5) Technological documents of main components, such as welding procedure specification (the welding procedure evaluation and approval are subject to CCS Rules for Materials and Welding), production techniques of castings and forgings, and product technological processes;

(6) Business registration certificate, business license, qualification and/or production license (if any);

(7) Nameplate of marine product requiring CCS inspection, use identifier, use/operation instructions and quality certificate (containing such information as standard reference, product performance, quality assurance and responsibilities) shall be prepared in such languages as are specified by the purchaser. Where the product is applied in the international navigation ship, at least English is required.

(8) The applicant for type approval (Mode A) of diesel engine shall also provide the documents as specified in Article 3.4.3.3, Section 4, Chapter 3, Part One of CSS Rules for Classification of Sea-going Steel Ships.

(9) The manufacturer that intends to adopt Alternative Certification Scheme (ACS) shall additionally submit the documents as specified in Article 3.10.3.1, Section 10, Chapter 3, Part One of CCS Rules for Classification of Sea-going Steel Ships.

5 Technical requirements

5.1 Ambient conditions

The design, model selection and location of the marine diesel engine shall ensure that the engine works normally at such inclination angles of the ship and under such temperature conditions as specified in Article 1.2.1, Section 2, Chapter 1, Part Three of CCS Rules for Classification of Sea-going Steel Ships.

5.2 Material and non-destructive tests

The requirements for material and non-destructive tests of diesel engine components and parts are detailed in Article 9.2.2, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships and the Rules for Materials and Welding. For acceptance criteria of non-destructive tests, refer to Article 5.10 of this Guideline.

5.3 Pressure tests of diesel engine components and parts

For requirements concerning pressure tests of diesel engine components and parts, refer to Article 9.2.2, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships.

5.4 Piping arrangement

5.4.1 For requirements of diesel engine piping arrangement, refer to Section 4, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships.

5.4.2 Diesel engines (including those driving the emergency fire pumps, but excluding those for lifeboats) shall be fitted with high-pressure jacketed pipe assemblies or equivalent devices and fuel leak alarms to comply with Ch.II-2/Reg.4.2.2.5.2 and Reg.4.2.2.5.4 of International Convention for the Safety of Life at Sea (SOLAS) 1974 and its amendment.

5.5 Starting arrangements

For details, refer to Section 5, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships. The diesel engines driving emergency fire pumps shall also conform to the requirements for starting the diesel engines as specified in Article 2.2.2.1, Chapter 12 of the International Code for Fire Safety Systems as amended in MSC.339(91).

5.6 Scavenging and supercharging arrangements

For details, refer to Section 6, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships.

5.7 Fittings

For details, refer to Section 7, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships.

5.8 Control, alarm and protection system

For details, refer to Chapter 9 of Part Three and Part Seven of CCS Rules for Classification of Sea-going Steel Ships.

5.9 Electronically-controlled diesel engines

For details, refer to Appendix 2, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships.

5.10 Acceptance criteria for non-destructive tests of main components and parts, and piping systems

The main components and parts of diesel engines shall receive the non-destructive tests pursuant to Article 9.2.2.1, Section 2, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships. The non-destructive tests shall be subject to the testing techniques and acceptance criteria formulated by diesel engine manufacturer or designer, and approved or recognized by CCS. Table 5.10 in this Guideline is for reference.

N.D.T. Standards and Acceptance Levels of Main Components and Piping Systems

Table 5.10

Test method and standard / Product Name	Radiographic test		Ultrasonic test		Magnetic test		Penetrating test	
	Standard code	Level	Standard code	Level	Standard code	Level	Standard code	Level
Welding structure and piping system	ISO 10675-1 or EN 12517-1	1①/2	EN-ISO 11666	2①/3	EN-1SO 23278	2X	EN-ISO 23277	2X
	CB/T 3558	II①/III	CB/T 3559	II①/III	CB/T 3958	II①/III	CB/T 3958	II①/III
	JIS Z3104	II①/III	JIS Z3060	II①/III	-	-	-	-
Steel casting	-	-	GB 7233	II	GB 9444	II	-	-

	-	-	IACS Rec.69	Qualified	IACS Rec.69	Qualified	IACS Rec.69	Qualified
Steel forging	-	-	CB/T 3907	Ⅱ	-	-	-	-
	-	-	IACS Rec.68	Qualified	IACS Rec.68	Qualified	IACS Rec.68	Qualified

Notes: Acceptance level marked by ① is applicable to the weld joints of welding structures and Class I piping systems.

6 Materials, components and parts

6.1 The materials, components and parts shall be controlled in accordance with the applicable requirements of current rules of CCS.

6.2 As for the main components and parts referred to in article 6.1 of this Guideline, if they are produced by the diesel engine manufacturer itself, the surveyor shall carry out related tests and inspections on site and sign the reports. And the certificate of completion may be exempted. If they are purchased, the supplier shall apply for inspection and certification to CCS. If raw materials are purchased from other manufacturer, the material manufacturer shall apply for inspection and certification to CCS. The attending surveyor shall check the material certificates during inspection of completed components and parts.

7 Type test

The diesel engine designer (technology licenser) or manufacturer (licensee) shall apply for CCS type approval certificate for each diesel engine type requiring approval.

-- Low-speed diesel engine: For the low-speed diesel engine produced in technology licensing mode, where the equivalent substitution applies, the manufacturer (licensee) shall receive assessment by CCS and to be satisfactory (assessment requirements are detailed in Appendix 1 of this Guideline) after the designer (technology licenser) applies for and is granted the design approval certificate by CCS.

-- Medium/high-speed diesel engine: For the medium/high-speed diesel engine produced in technology licensing mode, the designer (technology licenser) shall apply for and obtain the type approval certificate by CCS. And it is generally the same with the manufacturer (licensee) which, however, may be exempted from some type tests considering its quality control performance. Where the technology licenser is able to establish an effective control system on all fronts and ensure the diesel engines and their components and parts produced by all of the manufacturers

keep consistent, the assessment for manufacturer is available alternatively (assessment requirements are detailed in Appendix 1 of this Guideline).

As for the diesel engine that has been approved by CCS, in case that the supplier for main moving components (such as crankshaft, piston, connecting rod and cylinder liner) and fittings (such as supercharger, fuel injector, high-pressure oil pump and inlet/vent valve) and the supplier for sample engine receiving type test for approval changed, the evaluation shall be conducted by CCS, and according to the evaluation results, CCS may validate type tests partially or wholly as needed.

7.1 Selection of typical samples

The typical samples shall be selected referring to type test requirements as specified in Section 10, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships.

7.1.1 Each low-speed diesel engine type shall be sampled for type test. Before test, the samples shall be selected as per the following principles:

(1) The engines selected have been manufactured in accordance with the drawings and technical documents approved by CCS;

(2) Internal tests have been carried out by the manufacturer for ensuring reliable performance of diesel engines.

7.1.2 The medium/high-speed diesel engines shall be sampled for type test pursuant to the following principles:

(1) The engine type selected shall represent the normal production ability of the manufacturer;

(2) The engines selected shall comply with strengthening indicators.

7.2 Type test items

7.2.1 The type test of the diesel engine shall be subject to Appendix 4, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships. For test items, test methods and relevant requirements, refer to Table 7.2.1 of this Guideline.

Test Items, Test Methods and Relevant Requirements Table 7.2.1

No.	Test item		Test methods and requirements
1①	Protection/alarm test (to be conducted before	Diesel, water and air temperature/pressure alarm/stop test	In line with the technical requirements, the diesel engines may be tested in simulation manner. In alarm/stop test, the alarm/stop signal shall be sent normally. The

Continued Table 7.2.1

No.	Test item		Test methods and requirements
	running test of diesel engine)	(applicable to medium/high-speed diesel engine)	alarm/stop test items shall be defined referring to Part Seven of CCS Rules for Classification of Sea-going Steel Ships and submitted by the manufacturer to CCS for approval considering the automation degree of the console matching the diesel engine and test conditions.
		Low pressure of main lubrication oil inlet (applicable to low-speed diesel engine)	It is required to start the diesel engine and keep it running at low load as specified by the manufacturer, reduce the pressure detected by the main lubrication oil pressure sensor to the default value in simulation manner. At this time, the tested diesel engine shall stop and give an alarm.
		Over-speed protection test (applicable to the main diesel engine with rated power not less than 220kW which can be declutched from the transmission shafting or which drives a controllable pitch propeller, and the diesel engine with rated power not less than 220kW which drives the generator)	In type test, the diesel engine shall be accelerated intentionally when the engine runs at idle load or at such load as is specified by the manufacturer until the over-speed protection device is triggered. The over-speed protection device shall work to control the speed of main engine not higher than 120% of the rated speed and to control the speed of diesel engine dedicated to generator set not exceeding 115% of the rated speed. In Factory Acceptance Test, the over-speed protection may be validated in simulation manner according to the actual test conditions.
		Oil mist detection and alarm equipment test (applicable to diesel engine with power not less than 2,250kW or whose cylinder diameter is more than 300mm)	It is required to start the diesel engine and keep it running, simulate a state in which the oil mist concentration exceeds upper limit relying on smog or other medium, detect the actual concentration by any selected detector probe. The medium/high-speed diesel engine shall give an alarm and stop automatically when the oil mist concentration is detected to exceed upper limit and the number of the detector that indicates the above case shall be displayed in the control panel. The low-speed diesel engine shall trigger an alarm and reduce its speed (considering the limited bench test conditions in the factory, the validation involving alarming and stopping is available), and the number of the detector that indicates the above case shall be displayed in the control

Continued Table 7.2.1

No.	Test item		Test methods and requirements
			panel. For the other oil mist concentration detectors, the test may be conducted in simulation manner when the engine stops.
		High-temperature of thrust block (applicable to low-speed diesel engine)	It is required to start the diesel engine and keep it running at low speed. Rise the temperature of the sensor measuring the temperature of the thrust block to the value as specified by the manufacturer relying on the heating device in simulation manner. Then, the tested diesel engine shall stop and display the alarm information.
		Turning gear interlock (if applicable)	It is required to keep the diesel engine with remote-control or automatic start function halted, meshing with the turning gear; start the diesel engine in remote control mode and at emergency console respectively. In these cases, the diesel engine shall not be started and the control panel shall display the alarm information. For the diesel engine without remote-control or automatic start function, an alarm board shall be set prominently, indicating that "Do not start the diesel engine when it meshes with the turning gear".
		Emergency control test (if applicable)	In the emergency console of the diesel engine, it is required to switch the control position to "local"; conduct ahead/astern start, control and stop tests of the diesel engine in the emergency console respectively. In these cases, the diesel engine shall start, run and stop normally.
		Emergency stop	It is required to start the diesel engine and keep it running at low load as specified by the manufacturer; press emergency stop buttons in the diesel engine console and in the emergency console respectively. After the emergency stop button is pressed, the running diesel engine shall stop.
		Jacketing of high-pressure fuel pipe and fuel leakage detection and alarm	The high-pressure fuel pipes mounted in the diesel engine shall conform to double-pipe requirements in Article 9.4.3, Section 4, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships and Reg.4.2.2.5.2, Chapter II-2 of International Convention for the Safety of Life at Sea (SOLAS). The alarming efficiency of the fuel leakage alarm device shall be

Continued Table 7.2.1

No.	Test item		Test methods and requirements
			validated by operating the floater or connecting/disconnecting the liquid level switch in the alarm device.
		Screening measures of flammable liquid piping joints	The fuel or lubricating oil piping joints shall be fitted with steel hoods designed according to MO MSC.Circ 647, or with splash-proof strips recognized by CCS or with other screening devices approved by CCS. This test shall be verified before the diesel engines are delivered out of the factory.
		Other protection items specified in CCS-approved drawings	The tests shall be performed pursuant to the requirements in CCS-approved drawings, and shall meet the regulations specified by the manufacturer.
2①	Integration test (applicable to electronically-controlled diesel engine)		As system tests, the necessary function test and failure simulation test shall be conducted in the diesel engine manufacturer as far as possible to verify that the machine, its hydraulic and electronic systems in various working modes act as expected. The tests may be performed in sea trial phase where it is unlikely to conduct them by the manufacturer for technical reason. The test items shall be determined on the basis of the failure mode and effects analysis (FMEA) upon approval by CCS.
3	Starting test		(1) The non-reversible diesel engine shall receive starting test or the reversible diesel engine shall receive ahead/astern starting test to determine the minimum air pressure and the air consumption for a start. The minimum air pressure and the air consumption for a start shall live up to the requirements in the manufacturer's instructions. (2) At the engine starting temperature not lower than the minimum value specified in the instructions, the diesel engine shall be started at idle load. When the ambient temperature is lower than the value specified in the instructions, it is allowed to heat the engine oil and cooling water to the specified temperature. (3) ① The diesel engine devoted to the emergency generator set and the emergency fire pump shall be able to start at 0 ℃ or they shall be fitted with pre-heat devices.

Continued Table 7.2.1

No.	Test item	Test methods and requirements
		(4) ①The diesel engine with two starting modes shall be verified in terms of starting effective respectively.
4①	Load test	(1) As for type test, the load test shall be conducted in accordance with Article 2.2.3, Appendix 4, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships. (2) As for factory acceptance test, the load test shall be performed pursuant to Article 2.3, Appendix 6, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships considering the expected purpose of the tested diesel engine. (3) During load test, the parameters of the ambient conditions and those of the diesel engine measured and recorded shall at least live up to Article 1.4 of Appendix 4 and Article 2.2 of Appendix 6, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships. The related parameters shall conform to the diesel engine technical specification and the requirements specified by the manufacturer.
5①	Temperature measurement of high-temperature surface	When the diesel engine runs at 100% load or at approved intermittent overload, the heat-insulating property of high-temperature surface shall be validated by measuring the surface temperature with an infrared thermal scanner (a contact thermometer may be adopted in the factory acceptance test), and shall meet Article 1.3.6.3, Chapter 1, Part Three of CCS Rules for Classification of Sea-going Steel Ships. The equivalent measuring device is available upon approval by CCS. The data accuracy of the above devices shall be verified by random sampling with a contact thermometer. Moreover, the thermally-insulated shield shall be verified to keep free from any conditions enabling oil absorption or permeation.
6①	Astern test (if applicable)	The propulsion-purposed diesel engine tested shall keep running stably at the specified maximum astern power and its parameters shall be measured (except for the diesel engine with reversing gear box, controllable pitch propeller and electric propulsion device). In bench test, where the hydraulic dynamometer works as a load and the diesel engine reversing load cannot be loaded, the

Continued Table 7.2.1

No.	Test item	Test methods and requirements
		engine shall maintain astern operation at idle load for 10 minutes.
7①	Minimum steady speed test	For the propulsion-purposed diesel engine, it is required to reduce load gradually following the propeller characteristic curve and lower the speed until the engine reaches the minimum speed but still stabilizes its running state (which may be judged considering the speed fluctuation rate, cylinder working stability and balance). The diesel engine shall keep running at such speed for 10 minutes and shall not trigger any alarm. The speed shall not exceed 30% rated speed for the low-speed diesel engine, 40% rated speed for the medium-speed diesel engine, and 45% rated speed for the high-speed diesel engine.
8①	Reversing manoeuvring (when applicable)	When the engine is running at the minimum steady speed, the reversing time shall not exceed 15s from the beginning of manoeuvring till starting of running in the opposite direction.
9①	Governor test	(1) After the diesel engine is unloaded fully and suddenly when it works at rated load (for the diesel engine loaded with the hydraulic dynamometer, it is required to shut off inlet valve and open the outlet valve as soon as possible; for the diesel engine loaded with generator set, the load power supply shall be cut off immediately), such data shall be measured and recorded as speed and power before sudden unloading, maximum instantaneous speed in sudden unloading, and speed and its stabilized time after sudden unloading. (2) For the diesel engine devoted to main engine, its maximum speed in sudden unloading of the governor shall not exceed 115% rated speed. (3) For the diesel engine driving generator, the test method of its governor, instantaneous/stable-state speed governing rate and stabilized time shall live up to Article 9.7.10, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships. (4) The governor test shall not result in diesel engine stop due to over-speed.
10	Supercharger stop test	(1) It is required to fix the turbocharger rotor or dismantle the rotor or the bypass turbocharger to stop the

Continued Table 7.2.1

No.	Test item	Test methods and requirements
		supercharger, start the diesel engine, rise the speed and load gradually starting from the minimum steady working speed until the engine reaches the load or the exhaust gas temperature as specified by the manufacturer, keep the engine running stably for 15 minutes. (2) As for the 2-stroke propulsion diesel engine, the possible continuous output power of the diesel engine shall be determined when the supercharger gets damaged. When one supercharger fails to work, the single-propulsion diesel engine driving the fixed-pitch propeller shall still be able to run continuously at 40% rated speed (along the propeller nominal characteristic curve). (3) As for 4-stroke propulsion diesel engine, the possible continuous output power of the diesel engine shall be determined under the condition of turbocharger damage. And the power shall meet the technical requirements of the designer.
11①	Supercharger matching test (applicable to Class-C turbocharger in the propulsion diesel engine)	The methods and requirements of the supercharger matching test shall conform to Article 2.4, Appendix 6, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships. For 2-stroke diesel engine, if it is planned to make validation relying on the turbocharger compressor spectrum , the air compressor curve shall be used after verification by CCS. In the test for the first combination of the diesel engine and the supercharger (including nozzle ring) with the same configuration, it is required to verify the related performance points. Otherwise, such validation method is unavailable. Where the diesel engine and the supercharger with the same configuration (including same nozzle ring) have been tested and verified to be qualified before, this test may be exempted.
12	Measurement of crank web deflection (if applicable)	After load test and other relevant tests, the crank web deflection shall be measured under such conditions as specified by the designer or the manufacturer, and the measurement results shall meet the designed technical requirements.

Continued Table 7.2.1

No.	Test item	Test methods and requirements
13	Endurance test	(1) The endurance test shall be conducted alongside internal test at Stage A as specified in Appendix 4, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships. The test program shall be submitted to CCS for approval by the manufacturer separately before test. CCS reserves the right to witness test process and dismantle the diesel engine for inspection after test. (2) The duration and load of endurance test for the medium/low-speed diesel engine may be specified by the manufacturer according to the design development results. At least 100-hour load test shall be conducted specific to the high-speed diesel engine. (3) This test may be exempted for the branded mature model upon special consideration of CCS.
14	Low cycle fatigue test (only applicable to type test of propulsion-purposed diesel engine in the high-speed ship)	It is generally required to make cycle operations for at least 500 times (idle load - full load - idle load) at the most drastic load change,implement the low cycle fatigue test for the components bearing heating load at such intervals as ensure the temperature of these components reaches stable state. Throughout the test, the diesel engine shall work normally. After test, the relevant components (such as components bearing heating load, friction pair and kinematic pair) shall be dismantled for inspection. If necessary, Nondestructive Testing shall be carried out, and the detection results shall live up to the standard specified by the diesel engine designer or generally accepted standards in the industry.
15	Fuel tank volume verification (only applicable to fuel tank-fitted diesel engine driving emergency fire pump)	The test shall be made to verify that the fuel in the tank enables the diesel engine to run for at least 3 hours under the rated load.
16	Other internal test items	In addition to the requirements concerning Test Item 13 and 14 in this Table, the internal test shall also live up to Article 2.1, Appendix 4, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships.
17①	Opening up for Inspections after test	After type test, it is required to dismantle the diesel engine for overall inspection. To be specific, 1 cylinder shall be dismantled for in-line diesel engine and 2 cylinders for V-type diesel engine. For the V-type diesel

Continued Table 7.2.1

No.	Test item	Test methods and requirements
		engine, one cylinder shall be selected from each row of cylinders and the two selected cylinders shall fall into different cranks. The inspection after dismantlement covers: (1) Lifting out and dismantling the piston; (2) Dismantling the cross-head bearing to verify the conditions of the cross-head and related bearing bush (applicable to low-speed diesel engine); (3) Guide plate (applicable to low-speed diesel engine); (4) Dismantling the connecting rod bearing (big/small end) (special attention shall be made to scratches and abrasion on the contact surfaces between the bearing and the shaft neck); (5) Dismantling the main bearing to verify the conditions of the main shaft neck and the related bearing bush; (6) Cylinder liner in the installed condition; (7) Dismantling the cylinder head and valves; (8) Ahead/astern thrust block, one for each (if applicable); (9) Cam drive gear or chain, camshaft and gear or chain with opened covers, which shall be inspected by rotating the turning gear (if applicable). (10) For the electronically controlled diesel engine, the drive gear driving the hydraulic pump shall be inspected visually (if applicable). The surveyor on site may require further dismantlement of the diesel engine for inspection if necessary. After Factory Acceptance Test, the diesel engine shall be dismantled for inspection, with the inspection scope determined referring to that for type test in principle. Upon approval by CCS surveyor, the inspection scope shall be determined according to the actual conditions.

Notes: Items marked ① in this Table shall be also verified in the factory acceptance test.

7.2.2 As for the newly-designed diesel engines or those encountering major modification, the manufacturer shall make torsional and longitudinal vibration measurement (if required) in the benches in accordance with Article 12.1.3.1 in Part Three of CCS Rules for Classification of Sea-going Steel Ships and check the equivalent parameters. Where the diesel engine manufacturer has fulfilled the tests, the validation may be conducted by reviewing the test reports of the

manufacturer.

7.3 Test conditions

7.3.1 If the test bench of the manufacturer serves for approval test, it shall be able to complete the test items specified in the test program. CCS will check the testing ability, testing means and testing personnel to confirm their compliance with relevant requirements. Otherwise, the tests shall be carried out in such places as are deemed appropriate by CCS.

7.3.2 The measuring instruments used in the tests shall have valid calibration certificates.

7.4 Exemption of type test items

7.4.1 When it comes to the diesel engines produced in technology licensing mode, the type test specific to a certain engine model conducted in any diesel engine manufacturer is applicable to all diesel engines in the same model produced by the patent owner or license holder provided that each diesel engine manufacturer is considered to meet the control requirements of the patent owner in terms of production consistency after assessment of such factors as raw materials, components and parts, production equipment, test equipment as well as production technology difference by CCS. For details, refer to applicable requirements in Appendix 1 of this Guideline.

7.4.2 As for the diesel engines produced in other mode, where sufficient documentary evidence is provided (such as type test reports and other documented signed by IACS member classification society), the type test items may be exempted partially or wholly upon consideration and approval by CCS.

7.4.3 With regard to the cases specified in Articles 9.10.2.4, 9.10.2.5 and 9.10.2.6, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships, the type test items and their exemption shall be subject to the applicable provisions in the rules.

8 Unit/batch inspection

Each diesel engine to be installed in ships classed with CCS shall receive unit/batch inspection and obtain CCS marine product certificate. As for the diesel engines produced in technology licensing mode, their certification and document flow are subject to Appendix 5, Chapter 9, Part Three of CCS Rules for Classification of Sea-going Steel Ships. As for the diesel engines produced in other mode, the manufacturer shall apply for CCS marine product certificate in accordance with Section 2, Chapter 3, Part One of CCS Rules for Classification of Sea-going Steel Ships.

8.1 Unit/batch inspection after approval

8.1.1 The certification for materials, components and parts of the diesel engines shall be subject to Article 6 of this Guideline.

8.1.2 It is only the diesel engines that are qualified in inspection/test conducted by the manufacturer and meet delivery conditions that can apply for CCS unit/batch inspection.

8.1.3 The inspection shall be conducted in accordance with the inspection program as approved in manufacturer assessment (for the diesel engines produced in technology licensing mode) or approval (for the diesel engines produced in other mode). The inspection/test requirements for materials, components and parts of the diesel engines shall meet Article 5 of this Guideline. The factory acceptance test of diesel engine shall be conducted with the applicable test items following the requirements as specified in Article 7.2 of this Guideline.

8.1.4 With application for unit/batch inspection, the product certificates, quality certificates or test/inspection records of the main components and parts or raw materials in the batch involved pursuant to Article 6 of this Guideline shall be submitted to CCS surveyor for review.

8.2 Inspection of products produced by the manufacturer obtaining CCS Type Approval A or Alternative Certification Scheme (ACS)

(1) The inspection of products produced by the manufacturer obtaining CCS Type Approval A or Alternative Certification Scheme (ACS) may reduce or remove the test items to be witnessed by CCS surveyor. The manufacturer is allowed to replace CCS surveyor and execute test and inspection items partially or wholly. The factory acceptance test may be conducted by sampling referring to the quality system assessment results in approval process. And the sampling proportion shall be worked out in the quality control plan or inspection plan.

(2) The manufacturer obtaining CCS Type Approval A or Alternative Certification Scheme (ACS) shall apply for Periodical audit on time pursuant to Section 4 or Section 10, Chapter 3, Part One of CCS Rules for Classification of Sea-going Steel Ships.

9 Miscellaneous

In case of component, part and material substitution or change in drawing and technical document during production, the manufacturer (license holder) shall report the substitution or change to the patent owner for approval, and submit the confirmation issued by the patent owner and changed drawing and technical document to CCS for review and approval (for the diesel engines produced

in technology licensing mode). Or, the manufacturer may directly submit the related documents to CCS for review and approval (for the diesel engines produced in other mode). CCS, if considered necessary, may require validation of type test or endurance test if needed.

10 Appendix

Appendix 1 Assessment Requirements of Diesel Engine Manufacturer

Appendix 1 Assessment Requirements of Diesel Engine Manufacturer

1 Manufacturer assessment purpose

1.1 CCS rules specify that the diesel engines shall receive type approval. When it comes to the diesel engines that are produced by another manufacturer upon authorization after receiving CCS design/type approval, as an equivalent measure for type approval, the assessment on production consistency, production capacity and quality management competence of the authorized manufacturer may be made on the basis of design/type approval obtained by the technology licenser to ensure the products meet the same requirements as the sample engine in type approval.

1.2 The manufacturer assessment works to ensure the quality control requirements related to type approval in CCS rules are executed.

1.3 The manufacturer assessment also works to ensure the consistency of the diesel engines and their components and parts produced by different manufacturers with the samples in type test to avoid repeated type test.

1.4 After manufacturer assessment, Inspection/Test Plan (ITP) and Alternative Certification Scheme (ACS) may be also approved if necessary.

2 Scope of Application

This Appendix applies to the diesel engines produced by other manufacturer upon authorization after design/type approval by CCS. After the technology licenser is granted design/type approval, the manufacturer producing diesel engines by virtue of the technology license shall receive manufacturer assessment.

3 Normative References

3.1 Article 9.10.2.2, Chapter 9, Part Three of the Rules for Classification of Sea-going Steel Ships: A type test carried out for a particular type of diesel engine in any manufacturer will be accepted for all diesel engines of the same type produced by the patent owner or the license holder, and each manufacturer shall receive assessment by and obtain approval from CCS. ”

3.2 Article 3.2.5, Appendix 5, Chapter 9, Part Three of the Rules for Classification of Sea-going Steel Ships: CCS shall implement production consistency assessment of the manufacturer, involving requirements of production equipment and process, machining tools, quality assurance, testing and production facilities. And the satisfactory conformance results in the issuance of an approval document.”

3.3 Article 9.2.1.6, Chapter 9, Part Three of the Rules for Classification of Sea-going Steel Ships: The manufacturer or parts supplier shall be equipped with required production and assembly line, machining equipment, special tools and devices, assembly and testing devices as well as lifting and transporting facilities to ensure all materials and parts are produced meeting the specified standard. ”

3.4 The companies planning to adopt Alternative Certification Scheme (ACS) shall also conform to Section 10, Chapter 3, Part One of the Rules for Classification of Sea-going Steel Ships - Requirements of "Alternative Certification Scheme".

3.5 Article 3.4.4.2 (2), Chapter 3, Part One of the Rules for Classification of Sea-going Steel Ships: Where the sample of type test for design approval is not produced by the applicant, the difference in materials, production equipment and production technology shall be taken into consideration. Unless agreed otherwise, the applicant shall re-conduct type test.”

4 Management Requirements

4.1 Where the diesel engines and their main components and parts with CCS approval are produced by another manufacturer upon authorization, the authorized manufacturer shall receive assessment based on design approval to ensure the products produced by this manufacturer enjoy the same quality. Merits of manufacturer assessment:

(1) The type test items may be exempted partially or wholly considering the quality control performance.

(2) The overall management responsibilities of diesel engine technology licenser are emphasized in terms of diesel engine design, production, quality assurance, technology improvement, after-sales services, maintenance and supply of spare parts.

(3) The right to conduct targeted type test is reserved when the components and parts are different in quality.

(4) CCS may carry out an additional audit for the factory according to the ship owner/ship information feedback.

4.2 As for the diesel engine manufacturer adopting technology licensing mode, the technology licenser shall apply for product design approval, while the manufacturer of diesel engines and their main components and parts shall apply for assessment.

4.3 In accordance with Article 3.5, to avoid repeated type tests, the technology licenser shall

establish a unified quality control system of diesel engines and their components and parts. The conformity of production covers consistency between samples of type test and its designed engines, and consistency between diesel engines in mass-produced after approval and approved samples. The manufacturer assessment aims to ensure the products produced meet approval drawings and have the same quality with the samples in type test.

4.4 Where the diesel engines are produced only according to the purchased drawings but without receiving quality control by the technology licenser, the manufacturer shall develop the effective quality control standard and conduct type test items partially or wholly.

4.5 The key components and parts that are produced by the manufacturer rather than the diesel engine manufacturer as listed in Table 9.2.2.1, Part Three of the Rules for Classification of Sea-going Steel Ships, and which are not required to receive approval by CCS shall be evaluated as well if necessary. When the same level of quality cannot be demonstrated, necessary type tests shall be carried out to the diesel engines.

4.6 On the basis of design approval, CCS will issue the manufacturer assessment report to the qualified manufacturer and approve the related technical documents. The manufacturer shall produce in accordance with the technical documents approved by CCS and the documents provided by the technology licenser and accepted by CCS.

4.7 The manufacturer approval certificate issued after review in production and quality assurance abilities of the manufacturer by the technology licenser may exempt the manufacturer from CCS assessment partially upon approval by CCS.

5 Manufacturer Assessment Particulars

5.1 The manufacturer assessment particulars mainly involve assessment on machining equipment, assembly devices, testing instruments, process control and other production and quality assurance abilities. The manufacturer or parts supplier shall be equipped with required production and assembly line, machining equipment, special tools and devices, assembly and testing devices as well as lifting and transporting facilities to ensure all materials and parts are produced meeting the specified standard.

5.2 Documents to be submitted for manufacturer assessment

(1) Design approval certificate;

(2) Quality standards for production process (where the standards have been provided by the technology licenser, only a list of standards is needed);

(3) Approval certificate of the technology licenser (if applicable);

(4) Approval of the manufacturer's modified quality standards by the technology licenser (if applicable);

(5) Inspection/test plan (ITP);

(6) The companies planning to adopt Alternative Certification Scheme (ACS) shall also submit documents in accordance with Section 10, Chapter 3, Part One of the Rules for Classification of Sea-going Steel Ships - Requirements of "Alternative Certification Scheme".

5.3 The manufacturer shall understand and master the latest quality standards of the technology licenser. The manufacturer may either directly adopt the quality standards of the technology licenser, or formulate its own quality control standards, such as standards concerning materials substitution, material tests, welding and heat treatment, machining and production, non-destructive tests, pressure tests, installation and debugging as well as bench tests. These technical specifications shall meet CCS rules and the quality requirements of the technology licenser, or obtain its approval.

5.4 After review of these documents submitted, CCS shall carry out on-site audit of the production processes in such places as the workshops, warehouses and labs of the relevant departments in terms of their quality control and HSE. The audit involves control in documents, materials purchase and process. The production and test equipment, production technology and testing abilities shall meet the requirements specified by the technology licenser and approved by CCS. The surveyor shall also check the consistency of the production and inspection records with the approval drawings and technical documents of patent owner on site.

5.5 The diesel engine manufacturer shall organize assembly in accordance with the installation process specified by the technology licenser. The surveyor shall audit the compliance of the assembly records with the requirements specified by the technology licenser on site, and check the installation control of the diesel engines by selecting some typical types.

5.6 The surveyor shall review the compliance of the bench test program with the requirements specified by the technology licenser, and inspect the test-stand competence and arrangement to ensure the test-stand is applicable to the type test or factory acceptance test.

5.7 The production, purchase or outsourcing of the main components and parts shall also conform to CCS rules and the standards specified by the technology licenser. The applicant may apply for manufacturer assessment to CCS or for "to-be-controlled" as outsourcing factory considering the

importance of the components and parts and their production arrangement.

5.8 The confirmation shall be made to verify the welding and other special process procedures meet the production requirements. Where the approval is not obtained, it may be conducted in manufacturer approval.

5.9 The diesel engine manufacturer or the manufacturer of the components and parts intending to adopt Alternative Certification Scheme (ACS) may be confirmed to make proper arrangement in the manufacturer assessment and meet Section 10, Chapter 3, Part One of the Rules for Classification of Sea-going Steel Ships - Requirements of "Alternative Certification Scheme".

6 Certificates and Documents

6.1 CSS will issue the manufacturer assessment report after the manufacturer gets qualified in document review and on-site audit. The combination of design approval certificate and manufacturer assessment report may replace the type approval certificate for its equivalent effect. It is not necessary to issue the manufacturer assessment report separately to the manufacturer applying for CCS type approval certificate.

6.2 The inspection and test plans, quality standards and process documents formulated or modified by the manufacturer itself shall be sealed for approval or for information pursuant to the Rules for Classification of Sea-going Steel Ships and their copies shall be returned to the factory with one for each.

6.3 The range and arrangement of the Alternative Certification Scheme (ACS) shall be determined in CCS product inspection plan.