

RULES FOR PREVENTIVE MACHINERY MAINTENANCE SYSTEMS

GUIDANCE FOR PREVENTIVE MACHINERY MAINTENANCE SYSTEMS

Rules for Preventive Machinery Maintenance Systems

2007 AMENDMENT NO.1

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Rule No.50 / Notice No.54 27th September 2007

Resolved by Technical Committee on 2nd July 2007

Approved by Board of Directors on 24th July 2007

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RULES FOR PREVENTIVE MACHINERY MAINTENANCE SYSTEMS

RULES

2007 AMENDMENT NO.1

Rule No.50 27th September 2007

Resolved by Technical Committee on 2nd July 2007

Approved by Board of Directors on 24th July 2007

AMENDMENT TO THE RULES FOR PREVENTIVE MACHINERY MAINTENANCE SYSTEMS

“Rules for Preventive Machinery Maintenance Systems” has been partly amended as follows:

Chapter 1 GENERAL

1.1 General

Paragraph 1.1.5 has been amended as follows.

1.1.5 Definitions

The definitions of terms which appear in the Rules are specified as following ~~(1) to (4)~~ and (2).

- (1) “Condition monitoring and diagnosis system” is a system that monitors the operating conditions of the main propulsion machinery, etc., with sensors and outputs useful information for preventive maintenance by diagnosing the performance and the conditions of equipment or its components on the basis of monitored data.
- (2) “Preventive Maintenance management system” is a system that ~~executes~~ manages a preventive maintenance planning management on the basis of information from the condition monitoring and diagnosis system, and ~~comprises a preventive maintenance planning management system and a spare parts inventory management system~~ includes the plans and execution of maintenance and inspection for each piece of equipment and its components.
- ~~(3) “Preventive maintenance planning management system” is a system capable of planning inspections, maintenance and inspection timing for each equipment and its components and manages the system operations.~~
- ~~(4) “Spare parts inventory management system” is a system capable of controlling the storage locations and quantities of spare parts and outputting necessary data record ships and reports.~~

Chapter 2 SURVEYS

2.2 Registration Surveys

Paragraph 2.2.1 has been amended as follows.

2.2.1 Drawings and Data

For an preventive machinery maintenance system intended to be registered, three copies of the following drawings and data are to be submitted for the approval of the Society.

- (1) Drawings and data concerning the preventive machinery maintenance systems

- (a) Specifications and particulars of the system
- (b) Equipment and components monitored by the system
- (c) Drawings showing the system configuration and arrangements
- (d) Procedure for ~~shop test and~~ sea trials
- (e) Other drawings and data deemed necessary by the Society
- (2) Drawings and data concerning the condition monitoring and diagnosis system
 - (a) Instruction manuals for system functions and ~~operations~~ usage
 - (b) Condition monitoring and diagnosing procedures and sensor lists
 - (c) Kinds and contents of information to be outputted
- (3) Drawings and data concerning preventive maintenance management systems
 - (a) ~~Preventive maintenance planning management contents~~ Instruction manuals for system functions and usage
 - (b) ~~Instruction manuals for preventive maintenance planning management functions and operation~~ Contents of the Preventive maintenance plan
 - (c) ~~Instruction manuals for spare parts inventory management functions and operation~~
- (4) Other drawings and data deemed necessary by the Society

Paragraph 2.2.2 has been amended as follows.

2.2.2 Shop Tests

Preventive machinery maintenance systems are to be subjected to the following tests after manufactured:

- (1) Environmental tests

Fixed detectors (temperature sensors, pressure sensors, revolution sensors, piston ring surveillance sensors, etc.) are to be subjected to the ~~following~~ environmental tests specified in **18.7.1(1) Part D of Rules for the survey and construction of steel ships** at the place of manufacture's works. The procedures of the tests are to be as deemed appropriate by the Society.

 - ~~(a) External examination~~
 - ~~(b) Operation tests and performance tests~~
 - ~~(c) Electrical power supply failure tests (to be applied to electrical devices, electronic devices and so on)~~
 - ~~(d) Electrical power supply fluctuation tests (to be applied to electrical devices, electronic devices and so on)~~
 - ~~(e) Power supply fluctuation tests (to be applied to hydraulic devices, pneumatic devices and so on)~~
 - ~~(f) Insulation resistance tests (to be applied to electrical devices, electronic devices and so on)~~
 - ~~(g) High voltage tests (to be applied to electrical devices, and electronic devices and so on)~~
 - ~~(h) Pressure tests (to be applied to hydraulic devices, pneumatic devices and so on)~~
 - ~~(i) Dry heat tests~~
 - ~~(j) Damp heat tests~~
 - ~~(k) Vibration tests~~
 - ~~(l) Inclination tests~~
 - ~~(m) Cold tests~~
 - ~~(n) Salt mist tests (to be applied to devices installed in unenclosed spaces such as open decks)~~

- ~~(o) Electrostatic discharge tests (to be applied to electronic devices and so on)~~
 - ~~(p) Radiated electromagnetic field tests (to be applied to electronic devices and so on)~~
 - ~~(q) Electrical fast transient/burst tests (to be applied to electronic devices and so on)~~
 - ~~(r) Other tests considered necessary by the Society~~
- (2) Completion tests
- Components forming a condition monitoring and diagnosis system are to be subjected to the following tests specified in **18.7.1(2), Part D of the Rules for the Survey and Construction of Steel Ships** after completing assembly. The procedures of the tests are to be deemed appropriate by the Society.
- ~~(a) External examination~~
 - ~~(b) Operation tests~~
 - ~~(c) Insulation resistance tests~~
 - ~~(d) Other tests considered necessary by the Society~~

Paragraph 2.2.3 has been deleted.

~~**2.2.3 Tests after installation on board**~~

~~Preventive machinery maintenance systems are, after installed on board, to be confirmed that they operate effectively, respectively under as far practical conditions as possible. However, a part of these tests may be carried out during sea trials.~~

Paragraph 2.2.4 has been renumbered to 2.2.3, and sub-paragraph -2 has been amended.

- 2 ~~Preventive Machinery~~ maintenance management systems are to be inspected and tested in accordance with the test procedures submitted in advance to confirm that they function satisfactorily. The test procedures are to include at least the tests to confirm that the preventive maintenance ~~planning management~~ system is capable of functioning ~~as planned~~ on the basis of data from the condition monitoring and diagnosis system.

Chapter 3 PREVENTIVE MACHINERY MAINTENANCE SYSTEMS

3.1 General

Paragraph 3.1.1 has been amended as follows.

3.1.1 Scope

The requirements of this Chapter apply to preventive machinery maintenance systems comprising condition monitoring and diagnosis systems and preventive maintenance management systems.

3.2 Condition Monitoring and Diagnosis Systems

3.2.1 General

Sub-paragraph (3)(b) has been amended as follows.

- (b) A trend analysis of Condition monitoring data for trend analyses are is to be suitable for easy execution converted into those in standard conditions for easy trend analyses.

Sub-paragraph (5) has been amended as follows.

- (5) Condition monitoring and diagnosis systems are to be provided with suitable interface units ~~such as floppy disk or cassette tape so that~~ to make back-ups of the database can be backed up.

3.2.2 Equipments and Components subject to Monitoring and Diagnosis Scheme

Sub-paragraph (3) has been amended as follows.

- (3) ~~Propeller shaftings and p~~Propulsion power transmission systems
(a) Thrust bearing of propulsion shafting system
(b) ~~Main engine #~~Reduction gear bearings of propulsion shafting system
(c) ~~Stern tube bearings~~

Paragraph 3.2.3 to 3.2.6 has been amended as follows.

3.2.3 Condition Monitoring and Diagnostic Functions for Main Diesel Engines

For condition monitoring and diagnostic functions for main diesel engines, at least the requirements (1) through (8) below are to be complied with:

- (1) Condition monitoring sensors are to be provided for temperature, pressure and other operating parameters given in **Table 3.1**.
- (2) Cylinder pressure sensors, scavenging air pressure sensors, ~~fuel injection pressure sensors~~ and crank angle sensors are to be provided in order to monitor the combustion condition.
- (3) ~~Cylinder liner wall temperature sensors, cylinder oil flow rate sensors, and sensors for monitoring the condition of piston rings by a~~ Sensors for monitoring the condition of cylinder liners and piston rings by suitable means are to be provided.
- (4) Sensors for monitoring the condition of main bearings by ~~a~~ suitable means are to be provided.
- (5) Sensors for monitoring the deterioration of performance of turbochargers by ~~a~~ suitable means are to be provided.
- (6) ~~Sensors for monitoring the condition of filters in the fuel~~ Conditions of the lubricating oil line of the main engine are to be provided.
- (7) Condition monitoring and diagnosis systems are to ~~be~~ have functions for monitoring combustion conditions in each cylinder, conditions of ~~elements respect to~~ parts around the combustion chamber, ~~respect,~~ conditions of each main bearing, ~~performance of and~~ turbochargers, ~~conditions of the fuel oil high pressure lines and fuel oil inlet filters~~ on the basis of data from the sensors specified in (1) through ~~(6)~~ (5) above and the condition of

the lubricating oil specified in (6) above.

- (8) Condition monitoring and diagnosis systems are to have functions for diagnosing the combustion conditions in each cylinder, conditions of ~~elements respect to parts around the combustion chamber respect,~~ conditions of each main bearing, ~~elements of and turbochargers, conditions of the fuel oil high pressure lines and fuel oil inlet filters~~ on the basis of information described in (7) above.

3.2.4 Condition Monitoring and Diagnostic Functions for Main Turbines

For the condition monitoring and diagnostic functions for main turbines, at least the requirements (1) through ~~(4)~~(5) given below are to be complied with:

- (1) Condition monitoring sensors are to be provided for temperature, pressure and other operating parameters given in **Table 3.2**.
- (2) Sensors for directly monitoring the condition of rotor shaft bearings by a suitable means are to be provided.
- (3) Condition of lubricating oil of the main turbine is to be monitored.
- ~~(3)~~(4) Condition monitoring and diagnosis systems are to have functions for monitoring the conditions of turbine rotors and rotor bearings on the basis of data from the sensors specified in (1) and (2) above and the condition of the lubricating oil specified in (3) above.
- ~~(4)~~(5) Condition monitoring and diagnosis systems are to have functions for diagnosing the conditions of turbine rotors and rotor bearings on the basis of the information described in ~~(3)~~(4) above.

3.2.5 Condition Monitoring and Diagnostic Functions for ~~Propeller Shaftings and Power Transmission Systems~~

For the condition monitoring and diagnostic functions for ~~propeller shaftings and~~ power transmission systems, at least, the requirements (1) through ~~(3)~~(4) below are to be complied with:

- (1) Sensors for directly monitoring the condition of thrust bearing of propulsion shafting systems and each bearing of the reduction gear installation are to be provided.
- (2) Condition of the lubricating oil of the power transmission systems is to be monitored.
- ~~(2)~~(3) Condition monitoring and diagnosis systems are to have functions for monitoring the conditions of ~~each shaft bearing of the propeller shaftings and~~ the power transmission systems on the basis of data from the sensors specified in (1) above and monitoring the temperatures of the stern tube bearings.
- ~~(3)~~(4) Condition monitoring and diagnosis systems are to have functions for diagnosing the conditions of ~~the propeller shaftings and~~ the power transmission systems on the basis of ~~the~~ the information described in ~~(2)~~(3) above.

3.2.6 Condition Monitoring and Diagnostic Functions for Prime Movers Driving Generators

For condition monitoring and diagnostic functions for prime movers driving generators, at least the following requirements are to be complied with:

- (1) Diesel engines driving main generators
- (a) Condition monitoring sensors are to be provided for temperature, pressure and other operating parameter given in **Table 3.3**.
- ~~(b) Sensors for exhaust gas temperature at each cylinder outlet, and scavenging air pressure and temperature sensors are to be provided.~~ Condition of the lubricating oil of the engine is to be monitored.
- (c) Condition monitoring and diagnosis systems are to have functions for monitoring

the conditions of ~~diesel~~ the engines ~~driving main generators~~ on the basis of data from the sensors specified in (a) and the condition of the lubricating oil specified in (b) above.

- (d) Condition monitoring and diagnosis systems are to have functions for diagnosing the conditions of ~~diesel~~ the engines ~~for main generators~~ on the basis of information specified in (c) above.
- (2) Turbines driving main generators
 - (a) Condition monitoring sensors on the temperature and pressure items etc. in **Table 3.3** are to be provided.
 - (b) Condition monitoring sensors for rotor bearings, lube oil temperatures of rotor bearings, rotor and casing vibrations, and axial displacements of the rotors are to be provided.
 - (c) Condition of the lubricating oil of the steam turbines is to be monitored.
 - ~~(d)~~(d) Condition monitoring and diagnosis systems are to have functions for monitoring the conditions of the steam turbines of driving main generators on the basis of information from the sensors specified in (a) and (b) above and the condition of the lubricating oil specified in (c) above.
 - ~~(e)~~(e) Condition monitoring and diagnosis systems are to have functions for diagnosing the conditions of the steam turbines for driving main generators on the basis of information described in ~~(e)~~(d) above.

The Title of section 3.3 has been amended as follows.

3.3 Preventive Maintenance Management Systems

Paragraph 3.3.1 has been amended as follows.

3.3.1 Preventive Maintenance Planning Management Systems General

Preventive maintenance ~~planning~~ management systems are to comply with requirements (1) through ~~(6)~~(4) below:

- (1) Preventive maintenance ~~planning~~ management systems are to have functions to draw up plans for inspection, maintenance and inspection timing for each item of equipment and its components subject to a preventive maintenance scheme according to the inspection and maintenance time intervals recommended by manufacturers and survey interval specified in **Part B of the Rules for the Survey and Construction of Steel Ships**, considering the schedule of a ship's operation. ~~The items of equipment subject to a preventive maintenance scheme are to be those deemed appropriate by the Society.~~
- (2) Preventive maintenance ~~planning~~ management systems are to have functions to update and coordinate the predetermined preventive maintenance plans on the basis of diagnostic information from a condition monitoring and diagnosis system.
- ~~(3) Preventive maintenance planning management systems are to have functions for outputting details of work when equipment or its components are due for maintenance or overhaul inspections.~~
- ~~(4) Preventive maintenance plans are to be capable of being renewed when maintenance or overhaul inspections have been completed.~~
- ~~(5)~~(3) Preventive machinery maintenance ~~planning~~ management systems are to ~~have functions~~

~~for generating the forms of various plans including the followings, and storing, managing and printing them be suitable to make the following forms and records.~~

- ~~(a) List of items for regular maintenance services and overhaul inspections~~
- ~~(b) Records of regular maintenance services and, overhaul inspections, inspection and maintenance work records, and damages/failures/repairs records~~

~~(4) Preventive maintenance planning management systems are to have functions to store and manage condition monitoring and diagnostic information, and to output the various information needed for acceptance survey and inspection results and condition monitoring data.~~

Paragraph 3.3.2 has been deleted.

~~3.3.2 Spare Parts Management Systems~~

~~Spare parts management systems are to comply with the requirements (1) to (3) below. In case management of spare parts etc., is executed by other effective management systems, the spare parts management system may be omitted.~~

- ~~(1) Spare parts management systems are to have functions for managing the locations of storage, quantities in stock, ordered quantities and delivered quantities of spare parts for the main propulsion machinery, prime movers driving main generators and other machinery and equipment.~~
- ~~(2) Spare parts management systems are to be capable of generating formats such as requisitions for spare parts and inventory lists, and storing, managing and printing these documents.~~
- ~~(3) Spare parts management systems are to have functions to change the quantities of spare parts in stock etc., using information from the preventive maintenance planning management system or by simple operations.~~

Table 3.3 has been amended as follows.

Table 3.3 Prime Movers Driving Generators

Monitored Variables	Remarks
Diesel engine for generator	
Temperature	
L.O. inlet	
Cooling water outlet	or low pressure/flow
Exhaust gas, turbocharger each inlet or cylinder each outlet	
F.O. injection pump inlet	or viscosity, applied when a viscosity control of F.O. is performed
Pressure	
L.O. inlet	
Cooling water inlet	or flow, or high temperature of cooling water outlet
Other	
Oil mist concentration in crankcase	or bearing temperature, not required for engines with maximum continuous output less than 2250kW and cylinder diameter of 300mm or less
Steam turbine for generator	
Temperature	
L.O. inlet	
Pressure	
L.O. inlet	
Steam inlet	for steam turbine ships, applied only where extracted steam is used
Exhaust steam	

EFFECTIVE DATE AND APPLICATION

1. The effective date of the amendments is 1 October 2007.
2. Notwithstanding the amendments to the Rules, the current requirements apply to ships other than ships for which the application for Classification Survey during Construction is submitted to the Society on and after the effective date.
3. Notwithstanding the provision of preceding 2., the amendments to the Rules may apply to ships other than ships for which the application for Classification Survey during Construction is submitted to the Society on and after the effective date upon request by the owner.

GUIDANCE FOR PREVENTIVE MACHINERY MAINTENANCE SYSTEMS

GUIDANCE

2007 AMENDMENT NO.1

Notice No.54 27th September 2007

Resolved by Technical Committee on 2nd July 2007

Notice No.54 27th September 2007

AMENDMENT TO THE GUIDANCE FOR PREVENTIVE MACHINERY MAINTENANCE SYSTEMS

“Guidance for Preventive Machinery Maintenance Systems” has been partly amended as follows:

Chapter 1 has been added as follows.

Chapter 1 GENERAL

1.1 General

1.1.2 Equivalency

“Provided that they are deemed by the Society to be equivalent to those specified in the Rules” includes condition monitoring and diagnosing by land facilities base on data from a ship.

Chapter 2 SURVEYS

Section 2.1 has been deleted.

~~2.1 General~~

~~2.1.2 Period of Surveys~~

~~In the wording “the systems have been modified or altered” in 2.1.2-2(3)(b) of the Rules, a case in which a maintenance management system intended to be managed ashore as a spare parts management system is employed, the ship management company is changed with changes also caused in the spare parts management system is included.~~

2.2 Registration Surveys

2.2.2 Shop Tests

Sub-paragraph -1 has been amended as follows.

- 1 Preventive machinery maintenance systems used under special environmental conditions are to be subjected to the following tests where relevant according to the respective service environment, in addition to the tests specified in ~~2.2.2(1)(a) through 2.2.2(1)(q)~~ of the Rules.
 - (1) Tests for degree of protection of enclosures
 - (2) Tests in explosive mixtures

Paragraph 2.2.4 has been renumbered to 2.2.3.

2.3 Registration Maintenance Surveys

Paragraph 2.3.1 has been amended as follows.

2.3.1 Special Surveys

~~The wording “General examination and performance tests” described in 2.3.1-1 of the Rules includes the following confirmation/confirmatory tests.~~

- (1) The self-monitoring system of a condition monitoring and diagnosis system are to function properly, and alarm devices are to operate if an abnormal condition occurs.
- ~~(2) Condition monitoring and diagnosis system is to be rapidly instated into its original state when electrical power is restored after a power failure.~~
- ~~(3)(2) Condition monitoring and diagnosis systems are to be capable of outputting the results of the condition monitoring specified in 3.2.1(3) of the Rules.~~
- ~~(4)(3) Preventive maintenance planning management systems are to be capable of outputting plans etc., the documents and the records specified in 3.3.1(5)(3) of the Rules.~~
- ~~(5) Spare parts management systems are to be capable of outputting documents and formats specified in 3.3.2(2) of the Rules.~~

Chapter 3 PREVENTIVE MACHINERY MAINTENANCE SYSTEMS

3.2 Condition Monitoring and Diagnosis Systems

Paragraph 3.2.3 through 3.2.6 have been amended as follows.

3.2.3 Condition Monitoring and Diagnostic Functions for Main Diesel Engines

- 1 ~~The wording “Sensors for monitoring the condition of cylinder liners and piston rings by suitable means” described in 3.2.3(3) of the Rules means that they can estimate the amount of wear to piston rings and identify abnormalities such as fractures as standard refer to temperature sensors unless specified otherwise. If, however, it has been proved through operating data that the conditions of piston rings can be suitably predicted by combining data of cylinder liner wall temperature and cylinder pressure measurements, reliance on the condition of piston rings can be monitored by monitoring the ferrous particle density of cylinder drain oil or of lubricating oil in 4 stroke-cycle engines, such an alternative means may be accepted.~~
- 2 “Sensors for monitoring the condition of the main bearings by a suitable means” described in **3.2.3(4) of the Rules** ~~are those~~ refer to temperature sensors for the main bearings as standard unless specified otherwise.
- 3 “Sensors for monitoring the deterioration of performance of turbochargers by a suitable means” described in **3.2.3(5) of the Rules** ~~are those~~ refer to sensors that measuring measure physical data needed for calculating the efficiency of a turbocharger, and These are represented by to be pressure sensors and temperature sensors provided at the exhaust gas side and inlet/outlet of the suction side as standard unless specified otherwise.
- 4 ~~“Sensors for monitoring the condition of filters” described in 3.2.3(6) of the Rules are those~~

~~measuring the pressure difference between the inlet and the outlet of the filters. However, filters provided with an automatic back washing system as a self-cleaning method are to have a function to count the frequency of back washings per unit time as standard. “Conditions of lubricating oil of the main engine are to be monitored” stipulated in 3.2.3(6) of the Rules means that the deterioration trend data is to be confirmed by periodical analysis of the property of the lubricating oil.~~

- 5 In the diagnostic function specified in **3.2.3(8) of the Rules**, the functions for indicating the degree of abnormalities or the next time for maintenance of the equipment or its components specified in **3.2.2(1) of the Rules** ~~or the time due for an overhaul and the part to be inspected~~ are to be included.

3.2.4 Condition Monitoring and Diagnostic Functions for Main Turbine

- 1 “Sensors for directly monitoring the condition by a suitable means” described in **3.2.4(2) of the Rules** are the vibration sensors and the axial displacement sensors as standard.
- 2 “Condition of the lubricating oil of the main engine is to be monitored” stipulated in 3.2.4(3) of the Rules means that the deterioration trend data is to be confirmed by periodical analysis of the property of the lubricating oil.
- ~~23~~ In the diagnostic function specified in **3.2.4(4)(5) of the Rules**, the functions for indicating the degree of abnormalities or the next time for maintenance of the equipment or its components specified in **3.2.2(2) of the Rules** ~~or time due for overhaul and the part to be inspected~~ are to be included.

3.2.5 Condition Monitoring and Diagnostic Functions for ~~Propeller Shaftings and Power Transmission Systems~~

- 1 “Condition monitoring sensors” described in **3.2.5(1) and 3.2.5(2) of the Rules** are temperature sensors as standard.
- 2 “Condition of the lubricating oil of the main engine is to be monitored” stipulated in 3.2.5(2) of the Rules means that the deterioration trend data is to be confirmed by periodical analysis of the property of the lubricating oil.
- ~~23~~ In the diagnostic function specified in **3.2.5(3)(4) of the Rules**, the functions for indicating the degree of abnormalities or the next time for maintenance of the equipment or its components specified in **3.2.2(3) of the Rules** ~~or time due for overhaul and the part to be inspected~~ are to be included.

3.2.6 Condition Monitoring and Diagnostic Functions for Prime Movers Driving Generators

In the diagnostic function specified in **3.2.6 of the Rules**, the functions for indicating the degree of abnormalities or the next time for maintenance of the equipment or its components specified in **3.2.2(4) of the Rules** ~~or time due for overhaul and the part to be inspected~~ are to be included.

Section 3.3 has been deleted.

~~3.3 Maintenance Management Systems~~

~~3.3.1 Preventive Maintenance Planning Management Systems~~

~~In the “equipment subject to a preventive maintenance scheme are to be those deemed~~

~~appropriate by the Society” described in 3.3.1(1) of the Rules, equipment covered by the Continuous Machinery Survey scheme prescribed in Part B of the Guidance for the Survey and Construction of Steel Ships of the Society is to be included.~~

~~3.3.2 Spare Parts Management Systems~~

~~“Other effective management systems” described in 3.3.2 of the Rules are independent management systems in the absence of connections with the management system for shore-based management or the preventive maintenance planning management, complying the requirements of 3.3.2(1) and 3.3.2(2) of the Rules.~~

EFFECTIVE DATE AND APPLICATION

1. The effective date of the amendments is 1 October 2007.
2. Notwithstanding the amendments to the Guidance, the current requirements apply to ships other than ships for which the application for Classification Survey during Construction is submitted to the Society on and after the effective date.
3. Notwithstanding the provision of preceding 2., the amendments to the Guidance may apply to ships other than ships for which the application for Classification Survey during Construction is submitted to the Society on and after the effective date upon request by the owner.