
Z27 Condition Monitoring and Condition Based Maintenance

(July 2018)

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Note:

- 1. This UR is to be uniformly implemented by IACS Societies for survey schemes approved on and after 1 January 2020.

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(cont)**1 General****1.1 Application**

1.1.1 These requirements apply to the approved Condition Monitoring and Condition Based Maintenance schemes where the condition monitoring results are used to influence the scope and/or frequency of Class survey.

1.1.2 This scheme may be applied to components and systems covered by Continuous Machinery Survey (CMS), and other components and systems as requested by the owner. The extent of Condition Based Maintenance and associated monitoring equipment to be included in the maintenance scheme is decided by the Owner.

1.1.3 These requirements can be applied only to vessels operating on approved PMS survey scheme.

1.1.4 The scheme may be applied to any individual items and systems. Any items not covered by the scheme shall be surveyed and credited in accordance with the requirements of UR Z18 and / or UR Z20.

1.2 Definitions

1.2.1 The following standard terms are defined in ISO 13372:2012:

- **Condition monitoring:** acquisition and processing of information and data that indicate the state of a machine over time. The machine state deteriorates if faults or failures occur.
- **Diagnostic:** examination of symptoms and syndromes to determine the nature of faults or failures.
- **Condition Based Maintenance:** maintenance performed as governed by condition monitoring programmes.

1.3 Condition Monitoring (CM)

1.3.1 Where an approved condition monitoring system is fitted, credit for survey may be based on acceptable condition monitoring results. The condition monitoring results are to be reviewed during the annual audit.

1.3.2 Limiting parameters are to be based on the Original Equipment Manufacturers guidelines (OEM), or a recognised international standard.

1.3.3 The condition monitoring system is to provide an equivalent or greater degree of confidence in the condition of the machinery to traditional survey techniques.

1.3.4 The condition monitoring system shall be approved in accordance with each Member Society's procedures.

1.3.5 A condition monitoring system may be used to provide a greater understanding of equipment condition, and a condition based maintenance scheme may be used to obtain maintenance efficiency. Class approval is required where owners wish to change the survey cycle based on CM/CBM.

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1.3.6 Software systems can use complex algorithms, machine learning and knowledge of global equipment populations/defect data in order to identify acceptability for continued service or the requirement for maintenance. These systems may be independent of the OEM recommended maintenance and condition monitoring suggested limits. Approval of this type of software is to be based on OEM recommendations, industry standards and Class Society experience.

1.3.7 The Society retains the right to test or open-up the machinery, irrespective of the CM results, if deemed necessary.

1.4 Condition Based Maintenance (CBM)

1.4.1 Where an owner wishes to base their equipment maintenance on a CBM approach, this is to meet the requirements of the ISM Code.

1.4.2 Where an agreed planned maintenance and CBM scheme is in operation, the CMS and other survey intervals may be extended based on OEM maintenance recommendations and acceptable condition monitoring results.

1.4.3 Limiting parameters (alarms and warnings) are to be based on the OEM guidelines, or a recognised international standard.

1.4.4 The CBM scheme is to provide an equivalent or greater degree of confidence in the condition of the machinery to traditional maintenance techniques.

1.4.5 The scheme shall be approved in accordance with each Member Society's procedures.

1.4.6 Software systems can use complex algorithms, machine learning and knowledge of global equipment populations/defect data in order to identify acceptability for continued service or the requirement for maintenance. These systems may be independent of the OEM recommended maintenance and condition monitoring suggested limits. Approval of this type of software is to be based on OEM recommendations, industry standards and Class Society experience.

2 Procedures and Conditions for approval of CM and CBM**2.1 Onboard Responsibility**

2.1.1 The chief engineer shall be the responsible person on board in charge of the CM and CBM.

2.1.2 Documentation on the overhaul of items covered by CM and CBM schemes shall be reported by the chief engineer.

2.1.3 Access to computerized systems for updating of the maintenance documentation and maintenance program shall only be permitted by the chief engineer or other authorized person.

2.1.4 All personnel involved in CM and CBM shall be appropriately qualified.

Note: CM does not replace routine surveillance or the chief engineer's responsibility for taking decisions in accordance with his judgement.

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2.2 Equipment and System Requirements

2.2.1 CM equipment and systems shall be approved in accordance with a procedure of each individual Member Society.

2.2.2 The CM/CBM scheme and its extent, are to be approved by the Society.

2.2.3 The CBM scheme is to be capable of producing a condition report, and maintenance recommendations.

2.2.4 A system is to be provided to identify where limiting parameters (alarms and warnings) are modified during the operation of the scheme.

2.2.5 Where CM and CBM schemes use remote monitoring and diagnosis (i.e. data is transferred from the vessel and analysed remotely), the system is to meet the applicable standards for Cyber Safety and Security. The system shall be capable of continued onboard operation in the event of loss of the communication function.

2.2.6 CBM schemes are to identify defects and unexpected failures that were not prevented by the CM system.

2.2.7 Systems shall include a method of backing up data at regular intervals.

2.3 Documentation and Information

2.3.1 The following documentation shall be made available to the Society for the approval of the scheme:

- (i) Procedure for changes to software system and CM parameters
- (ii) Listing of equipment to be included in the scheme
- (iii) Listing of acceptable condition monitoring parameters
- (iv) Description of CBM scheme
- (v) Listing, specifications and maintenance procedures for condition monitoring equipment
- (vi) Baseline data for equipment with condition monitoring
- (vii) Qualification of personnel and company responsible for analysing CM results

2.3.2 In addition to the above documentation the following information shall be available on board:

- (i) All clauses in 2.3.1 in an up-to-date fashion
- (ii) Maintenance instructions (manufacturer's and shipyard's)
- (iii) Condition monitoring data including all data since last opening of the machine and the original base line data
- (iv) Reference documentation (trend investigation procedures etc.)
- (v) Records of maintenance including repairs and renewals carried out

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- (vi) Records of changes to software systems and parameters
- (vii) Sensors calibration records / certification / status

2.4 Approval validity

2.4.1 An Annual Audit shall be carried out to maintain the validity of the CM/CBM scheme.

2.4.2 The survey arrangement for machinery under CM/CBM can be cancelled by the Society if the scheme is not being satisfactorily carried out either from the maintenance records or the general condition of the machinery.

2.4.3 The case of sale or change of management of the ship or transfer of class shall cause the approval to be reconsidered.

2.4.4 The ship owner may, at any time, cancel the survey arrangement for machinery under the scheme by informing the Society in writing and for this case the items which have been inspected under the scheme since the last annual Audit can be credited for class at the discretion of the attending surveyor.

3 Surveys**3.1 Installation Survey**

3.1.1 Condition monitoring equipment is to be installed and surveyed in accordance with class society rules, and a set of base line readings is to be taken.

3.2 Implementation Survey

3.2.1 The Implementation Survey shall be carried out by the Society's surveyor no earlier than 6 months after installation survey and no later than the first Class annual survey.

3.2.2 During the Implementation survey the following shall be verified by a surveyor:

- (i) the CM/CBM scheme is implemented according to the approval documentation, including a comparison with baseline data;
- (ii) the scheme is producing the documentation required for the Annual Audit and the requirements of surveys and testing for the maintenance of class are complied with;
- (iii) the onboard personnel are familiar with operating the scheme.
- (iv) records of any limiting parameters (alarms and warnings) that have been modified during the operation of the scheme.
- (v) Records of any failures of monitored equipment are to be reviewed to ensure that the condition monitoring scheme is effective / sufficient.

3.2.3 When this survey is carried out and the implementation is found in order, a report describing the scheme shall be submitted to the Society and the scheme may be put into service.

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3.3 Annual Audit

3.3.1 An annual audit of the CM and CBM scheme shall be carried out by a Society's surveyor concurrently with the Class annual survey.

3.3.2 The purpose of this audit shall be to verify that the scheme is being correctly operated and that the machinery has been functioning satisfactorily since the previous audit. This is to include any limiting parameters (alarms and warnings) that have been modified since the last audit. A general examination of the items concerned shall be carried out.

3.3.3 The performance, condition monitoring and maintenance records shall be examined to verify that the machinery has functioned satisfactorily since the previous survey, or action has been taken in response to machinery operating parameters exceeding acceptable tolerances.

3.3.4 Written details of break-down or malfunction shall be made available.

3.3.5 At the discretion of the surveyor, function tests, confirmatory surveys and random check readings, where Condition Monitoring / Condition Based Maintenance equipment is in use, shall be carried out as far as practicable and reasonable.

3.3.6 The familiarity of the chief engineer and other personnel involved with the CM system shall be verified.

3.3.7 Calibration status of sensors and equipment shall be verified.

3.3.8 Verification that the suitability of the CM/CBM scheme has been reviewed following defects and failures shall be carried out.

3.4 Damage and repairs

3.4.1 Damage to components or items of machinery is to be reported to the Society. The repairs of such damaged components or items of machinery are to be carried out to the satisfaction of the Surveyor.

3.4.2 Details of repairs and maintenance carried out shall be examined. Any machinery part, which has been replaced by a spare one, due to damage, is to be retained on board where possible until examined by the Society's Surveyor.

3.4.3 Defect and failure data is to be reviewed in order to ensure the system output is appropriate. Where necessary, following review of the failure data, there is to be a method of amending the CM and CBM scheme.

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