

CLASS PROGRAMME

DNVGL-CP-0484

Edition February 2019

Approval of service supplier scheme

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FOREWORD

DNV GL class programmes contain procedural and technical requirements including acceptance criteria for obtaining and retaining certificates for objects and organisations related to classification.

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CHANGES – CURRENT

This document supersedes the March 2018 edition of DNVGL-CP-0484.

Changes in this document are highlighted in red colour. However, if the changes involve a whole chapter, section or subsection, normally only the title will be in red colour.

Changes February 2019

<i>Topic</i>	<i>Reference</i>	<i>Description</i>
Acceptance of hired level 3 NDT supervisor for some methods	App.B [4.2.5]	Described that the full-time employed supervisor may not be qualified in all relevant methods. If so, agreement with external level 3 shall be documented in writing.
Coverage of the suppliers locations	App.B [4.4.2]	Clarified that the certificate only cover the suppliers locations covered by the Society's audit.
Implementation of IACS UR Z17 rev. 13, changes to service category A1	App.A [1]	The title of service category A1 has been amended with the text "and mobile offshore units".
Implementation of IACS UR Z17 rev. 13, new service category	App.A [16]	Added a new service category for companies delivering services based on remote inspection techniques.
New requirements for data management and data security	App.B [5.2.2]	Submission of documents - new documentation requirements for data management and data security.
	App.B [5.2.4]	Data quality requirements - new documented information and data management based on ISO 8000-8.
	App.B [5.2.5]	Data security - new documented information and data security management based on IEC 62443-2-4.
New service category	App.B [14]	Added a new service category for service suppliers providing services within alignment and installation of rotating machinery.
Practical examination of NDT supervisor and operators	App.B [4.7.5]	Requirements for mock-up test may be requested by the Society.
Reference to relevant American standards	App.B Table 1	Added relevant American and ISO standards to the list of references.
Removal of DNV GL additional requirements for thickness measurement operators compared to IACS Z17 and competitors	App.A [1.4.5]	Deleted requirement for two UTM operators.
Requirements for acceptance of NDT operators qualified to ASNT's SNT-TC-1A or ANSI/ASNT CP-189 or similar	App.B [4.7]	Clarified requirements in case of acceptance of operators qualified to ASNT's SNT-TC-1A or ANSI/ASNT CP-189 or similar.
Scope of the approval programme - extended from CM to CBM	App.B [5.1.1]	Scope of the approval programme - changed from condition monitoring (CM) to also include condition based maintenance (CBM).
	App.B [5.1.5]	Introduction of terms, definitions and abbreviations.

Topic	Reference	Description
	App.B [5.1.6]	Split in to normative and informative references.
	App.B [5.2.1]	Extent of approval - new CM measuring techniques, use of parameters (non-manipulated) and testing and inspection (condition assessment). New service level data-driven CM supplier and CBM supplier.
	App.B [5.2.3]	<ul style="list-style-type: none"> — New and updated requirements for the maintenance programme: <ul style="list-style-type: none"> — App.B [5.2.3.1] Maintenance task analysis — New App.B [5.2.3.2] Monitoring method - Changed, new requirements for additional measurement techniques, ref. ISO 1843 — App.B [5.2.3.3] Diagnostics - New requirements: <ul style="list-style-type: none"> — documentation — diagnostic accuracy — confidence level. — App.B [5.2.3.4] Prognostics - New requirements: <ul style="list-style-type: none"> — documentation — expected remaining useful life (RUL) or time to failure — prognostics confidence. — App.B [5.2.3.5] Reporting - New requirements: <ul style="list-style-type: none"> — current state (diagnostics) — estimated RUL or ETTF with level of confidence — applicable conditions — maintenance recommendations.
	App.B [5.2.6.2]	Training, competence and certification of condition monitoring personnel: new requirements for services including data-driven, knowledge-based or other physics-based models.
	App.B [5.2.6.3]	New position for service responsible including competence requirements and responsibilities.

Editorial corrections

In addition to the above stated changes, editorial corrections may have been made.

CONTENTS

Changes – current.....	3
Section 1 General.....	8
1 Introduction.....	8
2 Objective.....	8
3 Scope.....	8
4 Definitions.....	8
5 Requirements.....	8
6 Validity of the certificate.....	9
Appendix A Special requirements for categories of service suppliers listed in IACS UR Z17.....	10
1 Thickness measurements on ships and mobile offshore units.....	10
2 Tightness testing of closing appliances such as hatches, doors etc. with ultrasonic equipment.....	13
3 In-water survey on ships and mobile offshore units by diver or Remotely Operated Vehicle (ROV).....	14
4 Inspection and maintenance of fire extinguishing equipment and systems.....	15
5 Service of inflatable liferafts, inflatable lifejackets, hydrostatic release units, inflatable rescue boats, marine evacuation systems.....	15
6 Inspection and testing of radio communication equipment and automatic identification systems (AIS).....	15
7 Inspections and maintenance of self-contained breathing apparatus.....	17
8 Examination of Ro-Ro ships bow, stern, side and inner doors.....	17
9 Annual performance testing of Voyage Data Recorders (VDR) and simplified Voyage Data Recorders (S-VDR).....	17
10 Inspection of low location lighting systems using photo luminescent materials and evacuation guidance systems used as an alternative to low-location lighting systems.....	18
11 Sound pressure level measurements of public address and general alarm systems on board ships.....	18
12 Testing of coating systems in accordance with IMO Resolution MSC.215(82) as amended and IACS UI SC223 and/or MSC.288(87) as amended.....	19
13 Servicing and maintenance of lifeboats, launching appliances, on-load release gear and davit-launched liferaft automatic release hooks.....	21
14 Measurements of noise level on board ships.....	21

15 Tightness testing of primary and secondary barriers of gas carriers with membrane cargo containment systems for vessels in service.....	21
16 Firms engaged in survey using remote inspection techniques (RIT) as an alternative means for close-up survey of the structure of ships and mobile offshore units.....	21
Appendix B Special requirements for categories of service suppliers not listed in IACS UR Z17.....	23
1 Service suppliers engaged in testing of navigational equipment and systems.....	23
2 Service suppliers engaged in preparation of Inventory of Hazardous Materials (IHM).....	25
3 Service suppliers engaged in inspection and testing of centralised gas welding and cutting equipment.....	26
4 Service suppliers engaged in Non-destructive testing (NDT) on classification projects.....	27
5 Service suppliers firms engaged in condition monitoring and condition based maintenance.....	34
6 Service suppliers engaged in resin casting of chock foundations, stern tubes, etc.....	46
7 Service suppliers engaged in lay-up service of vessels.....	48
8 Service suppliers engaged in testing of ballast water management systems (environmental testing).....	48
9 Service suppliers engaged in testing of ballast water management systems (land-based and shipboard testing).....	50
10 Laboratories engaged in mechanical and analytical testing.....	55
11 Laboratories engaged in corrosion testing of corrosion resistant steels.....	60
12 Renewal survey examination of mooring chain intended for mobile offshore units.....	63
13 Service suppliers engaged in noise, vibration and/or indoor climate measurements according to DNV GL's comfort class onboard ships.....	64
14 Service suppliers engaged in alignment of propulsion shafting and installation of rotating machinery.....	67
Appendix C Guidelines for the technical inspection of radio installations onboard ships fitted for compliance with GMDSS.....	72
1	72
2 Introduction.....	72
3 Documentation.....	73
4 Antennae.....	73
5 Inspection of the reserve source of energy and automatic battery charger(s).....	74
6 Inspection of maritime VHF.....	75

7 MF or MF/HF radiotelephone equipment including DSC and NBDP.....	75
8 INMARSAT ship earth station.....	77
9 Float-free satellite EPIRB.....	77
10 Enhanced group call (EGC) receiver.....	77
11 HF MSI with direct-printing (NBDP) receiver.....	78
12 NAVTEX receiver.....	78
13 Two-way VHF radiotelephone apparatus.....	78
14 Radar transponders.....	78
15 Methods of maintenance.....	78
16 Handbooks and documentation.....	79
17 Signs and labels.....	79
18 Special requirements for passenger vessels.....	80
Appendix D Guidelines for the technical inspection of Automatic Identification System onboard ships fitted for compliance with SOLAS V.....	81
1	81
2 Introduction.....	81
3 Documentation.....	81
4 Antennae.....	81
Changes – historic.....	83

SECTION 1 GENERAL

1 Introduction

The approval of service supplier scheme is a procedure by which the Society approves suppliers providing services to the customer, such as measurements, tests or maintenance of safety systems and equipment, the result of which may form the basis for the Society's decisions.

2 Objective

The objective of this procedure is to provide minimum requirements for approval and certification of service suppliers and is applicable to both initial and renewal audits.

3 Scope

The scope of the Society's approval of service supplier will normally include the following activities:

- review of documentation
- verification of competence and control needed to perform the service
- verification of equipment and facilities for the service
- assessment of the supplier and any servicing stations and subcontractors
- evaluation of how the service will be reported
- witnessing of a practical demonstration of the performance of the service including satisfactory reporting
- issuance of approval of service supplier certificate.

4 Definitions

<i>Term</i>	<i>Definition</i>
<i>IACS</i>	International Association of Classification Societies
<i>IACS UR</i>	IACS Unified Requirements

5 Requirements

5.1 Services listed in IACS UR Z17

For services listed in IACS UR Z17 the requirements of IACS UR17 apply with any additions and clarifications as given in [App.A](#).

5.2 Services not listed in IACS UR Z17

For services not listed in IACS UR Z17, the general provisions of IACS UR Z17 apply. Amendments/deviations are defined in [App.B](#) below. If requirements in [App.B](#) below are in conflict with IACS UR Z17 then the requirements in [App.B](#) will prevail.

5.3 Applicable revision of IACS UR Z17

The in force date for revisions shall follow IACS UR Z17 revision notes.

6 Validity of the certificate

6.1 Renewal

Renewal of the certificate shall be made at intervals not exceeding three (3) years by verification through audits that approved conditions are maintained or, where applicable, on expiry of the supplier's approval received from an equipment manufacturer, whichever comes first. In the latter case, the Society shall be informed in due course by the service supplier.

6.2 Periodical audits

The Society may, at its own discretion, require periodical audits in the validity period of the certificate.

APPENDIX A SPECIAL REQUIREMENTS FOR CATEGORIES OF SERVICE SUPPLIERS LISTED IN IACS UR Z17

1 Thickness measurements on ships and mobile offshore units

IACS UR Z17 Annex 1 [1] applies with the following additions.

1.1 Application

Firms carrying out thickness measurements on board ships and offshore units, the results of which are used by the Society's surveyors in making decisions affecting classification, are subject to approval by the Society in accordance with the mandatory procedures given in this class programme.

All firms shall be certified as one of the following two categories:

- *Category I*: authorised to do measurements onboard all types and sizes of ships.
- *Category II*: authorised to do measurements onboard fishing vessels of all sizes, and non-ESP¹⁾ ships of less than 500 GT²⁾.

ESP ships of all sizes and general cargo ships of more than 500 GT can only be measured by category I companies.

Category I companies shall be certified according to [Sec.1 \[1\]](#) to [Sec.1 \[5\]](#) of this document. Category II shall be certified according to [Sec.1 \[6\]](#).

¹⁾ ESP ships: ships subject to enhanced survey programme, i.e. oil tankers, tankers for chemicals and bulk carriers, with the mandatory class notation **ESP**.

²⁾ As per the international convention on tonnage measurement of ships, 1969.

1.2 Objective

The objective of this programme is to ensure that measurements and reporting of structural scantlings are correct. This is done by ensuring that firms engaged in thickness measurements have qualified personnel that are able to recognise corroded or pitted areas and understand ship's drawings, implemented written systems for training, control, verification and reporting, in addition to the necessary technical equipment and facilities to render professional assistance.

1.3 Limitation to the size of the company

Where several servicing stations are owned by a given company, each station shall be assessed and approved separately, according to the same requirements as for the main company.

1.4 General requirements

1.4.1 Training and qualification

The operators carrying out the measurements shall be certified in ultrasonic testing at level 1 and relevant industry sector, according to a recognised international standard for qualification and certification of NDT personnel (i.e. EN ISO 9712 or equivalent). Personnel qualification to an employer based qualification scheme as SNT-TC-1A may be accepted if the employer's written practice is reviewed and found acceptable by the Society. Operators shall have had a minimum of one (1) year tutored on-the-job training.

The operator shall have adequate knowledge of the relevant rules and ship's structures, sufficient to select a representative position for each measurement.

Operators and supervisors shall be able to communicate in English.

The responsible supervisor shall be certified in ultrasonic testing at level 2 and relevant industry sector, according to a recognized international standard for qualification and certification of NDT personnel (i.e. EN

ISO 9712 or equivalent). Personnel qualification to an employed based qualification scheme as SNT-TC-1A may be accepted if the employer's written practice is reviewed and found acceptable to the Society.

1.4.2 Equipment and facilities

Instruments using pulsed echo technique, either with oscilloscope or digital instruments using multiple echo are required *Single echo instruments are not accepted*. A record of the equipment used shall be kept. The record shall contain information on maintenance and calibration. Confirmation from the manufacturer that the instruments satisfy the requirement above shall be enclosed in the instrument record.

1.4.3 Work procedures

The firm shall have documented work procedures covering planning, execution and reporting including items listed in [1.4.4], [1.4.5], [1.4.6] and [1.4.7].

1.4.4 Preparation

- practise of verification of readings by attending surveyor to be agreed
- the supplier is responsible for using the latest version of the report form that can be found on www.dnvgl.com/, under Maritime, Publications & downloads
- the surveyor's presence shall be recorded in the report
- all data given in the minimum thickness list shall be entered into the template before the job is started, as part of the preliminary preparation
- operators and supervisor shall carry ID cards with photo
- an up-dated list of approved operators and supervisor shall be kept at the approving office so that identification can be verified by the attending surveyor. Readings taken by non-listed operators will be rejected
- the operators shall attend the planning meeting which is held before each job is started. Owner's representative and the attending surveyor will also participate in the meeting
- equipment shall be calibrated with the Society's surveyor present.

1.4.5 Execution

- Measurements that are not carried out in cooperation with the Society will not be accepted. The firm shall inform the owner accordingly.
- When onboard the operator/supervisor shall have his/her certificate and identification papers readily available. The operator shall notify the Society's surveyor of any structural deficiencies or abnormal measurements detected. That includes areas with substantial corrosion, which shall be mapped with an increased number of measurements, taken in co-operation with the Society's surveyor.
- Unless otherwise specified, the measurements shall be taken in line with the Society's guideline for thickness measurements, available at www.dnvgl.com.

1.4.6 Sub-contractors shall not be used

To hire certified operators from another approved service supplier is not considered sub-contracting. This is, however, to be included in the report. Subcontractors providing anything other than subcontracted personnel or equipment shall also meet the requirements given in this document.

1.4.7 Verification

The firm shall have the Society's surveyor verification of each separate job.

1.4.8 Reporting

The UTM report shall be made in the Society's electronic reporting format, *Pegasus*, available at www.dnvgl.com.

Prior to commencing measurements onboard, in addition to the measured values, the original scantlings, the minimum thickness and the substantial corrosion limits shall be stored in the electronic report.

When on board, measured thicknesses shall be continuously recorded in the the Society's electronic report form, based on the operator's working notes, photos and sketches and are regularly to be made available for the attending surveyor's review and verification.

Upon completion of the measurements onboard the operator shall provide the surveyor with a temporary electronic draft of the results presented in the Society's electronic report form, and supplied with the operator's notes, as found necessary. The location of the measurements shall be illustrated by sketches or drawings.

The preliminary report shall include a longitudinal strength evaluation when required, (IMO Res.A.744(18) Annex 12) valid for oil tanker with length above 130 meters and over 10 years of age, e.g. at the third renewal survey and subsequent renewal surveys.

Final reporting in original electronic form or in a non-editable electronic form (e.g. PDF-format) shall be presented to the surveyor within two (2) weeks after the job is terminated. The firm shall have the surveyor's verification of each separate job, documented in the report by his signature and the text "Verified and Evaluated".

The report shall include a copy of the certificate of approval of the firm, containing the names of all approved operators and supervisors.

1.5 Certification

1.5.1 Information on the certificate

The certificate will list the certified operators and the supervisor.

1.5.2 Alterations

In case any alteration to the certified service operation system of the firm is made, including changes related to UTM operators, such alteration shall immediately be reported to the Society.

1.6 Category II companies - limited approval of firms locally engaged in ultrasonic thickness measurements of ship's structure

1.6.1 Application

Firms carrying out thickness measurements on fishing vessels of all sizes and non-ESP¹⁾ ships below 500 GT²⁾, may be qualified according to the requirements in this section.

If the company in addition complies with IACS Unified Requirements Z17, it may carry out thickness measurements onboard fishing vessels of all sizes and non-ESP ships with length less than 100 meters, except *General dry cargo ship subject to Extended hull survey requirements (EHSR)* above 500 GT, as per the definition set in [DNVGL-RU-SHIP Pt.7 Ch.1 Sec.1](#) or IACS Unified requirements Z7.1.

¹⁾ ESP ships: ships subject to enhanced survey programme, i.e. oil tankers, tankers for chemicals and bulk carriers, with the mandatory class notation **ESP**.

²⁾ As per the *International convention on tonnage measurement of ships*, 1969.

Guidance note:

IACS UR Z17 is available on the Internet at <http://www.iacs.org.uk/> under *Publications, Unified requirements*.

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1.6.2 Objective

The objective of this limited approval programme is to ensure that firms engaged in thickness measurements have qualified personnel that are able to measure thicknesses, recognise corroded or pitted areas and understand ship's drawings in addition to having the necessary technical equipment to render professional assistance.

1.6.3 Procedure for approval

1.6.3.1 The following documents shall be submitted to the Society for review

- description of company's management structure and manning
- name of operators and supervisor, documenting training, experience and qualifications
- description of equipment used including routines for maintenance and calibration
- a guide for operators of such equipment.

1.6.3.2 Operator

The operators carrying out the measurements shall be certified in ultrasonic at level 1 and relevant industry sector, according to a recognised international standard for qualification and certification of NDT personell (i.e. EN ISO 9712 or equivalent). Personnel qualification to an employer based qualification scheme as SNT-TC-1A may be accepted if the employer's written practice is reviewed and found acceptable by Society. Operators shall have had a minimum of one (1) year on-the-job training. The operator shall have adequate knowledge of ship's structure sufficient to select a representative position for each measurement.

Guidance note:

For more information please see [DNVGL-CG-0285](#), available on DNV GL internet homepage www.dnvgl.com.

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1.6.3.3 Equipment

Instruments using pulsed echo technique, either with oscilloscope or digital instruments using multiple echo, single crystal technique are required. Single echo instruments are not accepted. Confirmation from the manufacturer that the instrument satisfies the requirement above shall be enclosed in the instrument record.

1.6.3.4 Work execution

- the firm shall attend the planning meeting that is held before each job is started
- measurements that are not carried out in cooperation with the Society, unless otherwise agreed, will not be accepted. The firm shall inform the owner accordingly
- the operator shall notify the surveyor of any structural deficiencies detected.

1.6.4 Reporting

Measured thicknesses shall be continuously recorded and to be made available for the attending Society's surveyor.

The operator shall report in a recognised system and may illustrate the result by sketches or on the drawings.

In addition to the measured values, the original scantlings, the minimum thickness and the substantial corrosion limits, shall be included in the report.

Final reporting shall be presented to the surveyor within two (2) weeks after the job is terminated. The firm shall have the surveyor's verification of each separate job, documented in the report by his signature.

The report shall include a copy of the certificate of approval, containing the names of all approved operators.

1.6.5 Certification

Any alteration to the certified service operation system shall immediately be reported to the Society.

2 Tightness testing of closing appliances such as hatches, doors etc. with ultrasonic equipment

IACS UR Z17, including Annex 1 [2], applies with the following additions.

2.1 Equipment and acceptance criteria

2.1.1 The following minimum criteria for the equipment is normally applicable:

- The transmitter shall provide a uniform open hatch value (OHV) over the tested area.
- The OHV shall be adjustable to a stable value allowing maximum sensitivity without false side effects.
- The receiver shall be provided with an audible signal and a visual readout, calibrated in decibel.
- The visual readout shall be able to hold peak values encountered during the measurements.
- The equipment shall be demonstrated to achieve the fail/pass criterion set by the Society, (see [2.1.4]).

2.1.2 The following minimum criteria for calibration is normally applicable:

- Biannual re-calibration tests shall be carried out by laboratories authorised by the manufacturer, in accordance with procedures accepted by the Society.
- Procedures for on-site testing of functionality of transmitters/receivers and of accuracy of the equipment shall be established. This procedure shall guarantee continuing accuracy during the measurements.

2.1.3 Record of equipment shall be kept and shall contain a log of calibration and maintenance.

2.1.4 The fail/pass criterion to be applied in tightness testing shall normally be taken as follows:

- 0 dB shall mean that the hatch cover is leak tight.
- From 1dB to 10% of OHV shall mean that the hatch cover is considered weather tight, subject to verifying the design and the condition of the hatch cover, the coaming and the drainage arrangements.
- Above 10% of the OHV shall mean that the hatch cover is considered not to be weather tight and that corrective action to gaskets and drains is required.

3 In-water survey on ships and mobile offshore units by diver or Remotely Operated Vehicle (ROV)

IACS UR Z17, including Annex 1 [3], applies with the following additions.

3.1 Reporting

The report shall give a complete summation in writing, including still photos, as applicable.

The report shall as a minimum contain information on the condition, including any damages of:

- propeller
- rudder
- sea suction
- underwater discharges
- bilge keels
- side and bottom plating
- thrusters (if fitted)
- marine fouling
- painting
- structure
- cathodic protection (depletion by visual inspection and measurement of potential)
- diving/ROV conditions (visibility, swell and current).

Damages found shall be documented by sketches and/or photos showing location and size.

The report shall include a copy of the certificate of approval.

3.2 Remote survey

Upon a case-by-case evaluation, in-water survey on ships and mobile offshore units may be carried out as remote survey provided that the quality of data stream (video, photos, etc.) and communication provides a level of assurance equivalent to the one obtained during a survey on board.

4 Inspection and maintenance of fire extinguishing equipment and systems

IACS UR Z17 Annex 1 [4] applies with the following additions:

- [4.3] Procedures:
CO2 systems - IMO MSC.1/Circ.1318:
 - Section valves of fixed gas fire-fighting systems shall be internally inspected every five (5) years (see IMO MSC.1/Circ.1432 and [DNVGL-SI-0364](#)).
 - CO2 pipes shall be blown through annually to ensure that they are free from debris and not clogged. Test or record of the test shall be presented to the attending surveyor (see [DNVGL-SI-0364](#)).

5 Service of inflatable liferafts, inflatable lifejackets, hydrostatic release units, inflatable rescue boats, marine evacuation systems

IACS UR Z17 Annex 1 [5] applies.

6 Inspection and testing of radio communication equipment and automatic identification systems (AIS)

IACS UR Z17 Annex 1 [6] applies with the additions given below in [6.1] to [6.9]. Guidelines for the technical inspection of radio installations and automatic identification systems are given in [App.C](#) and [App.D](#) respectively.

6.1 Extent of engagement

Approval of inspection and testing of radio communication equipment and AIS are independent processes and the applicant may apply for each approval separately or combined. The applicant may apply for inspection and testing of:

- 1) radio communication equipment, or
- 2) AIS, or
- 3) both radio communication equipment and AIS.

The application shall clearly state the type of inspection 1), 2) or 3) applied for.

6.2 Reference documents

The service supplier shall additionally have access to the following documents:

- DNVGL Statutory Interpretations of SOLAS, as amended
- MODU Code
- HSC Code
- IMO Res. A.1053(27) as amended
- IMO Res. A.789(19)
- MSC.1/Circ.1039
- DNVGL survey report forms: CRC 629a, CRC 630a, MOD CRC 304a and AIS 001a.

6.3 Supervisors

- Certificate recognized by the ITU shall be understood as first- and second-class radio electronic certificate, as per ITU Radio regulations, volume 1, chapter IX, article 47.
- The supervisor for AIS shall document AIS training at the AIS manufacturer(s).

6.4 Radio inspector

The inspector shall be different than the installation/commissioning/repair/service technician.

6.5 Equipment and facilities

No additions.

6.6 Minimum required instruments

Certificates for calibration of the testing equipment shall be submitted.

6.7 Procedures and instructions

- If survey of radio installations based on MODU Ch. 11 as amended is included in the application, then the procedures shall also cover this area. Descriptions showing understanding of the GMDSS radio requirements in the MODU code shall be submitted.
- The procedures shall conform to the requirements in the applicable IMO Resolutions listed in [App.C](#) for radio and [App.D](#) for AIS, and shall include:
 - details about what to check, how to check, and testing instrument used for each check item
 - instructions on how to correctly complete the survey reports as listed in [\[6.8\]](#).
 In addition, procedures and instructions for operating each item of the testing/inspection equipment shall also be kept and be available at all times.
- If [App.C](#) and [App.D](#) are adopted as the service supplier's inspection procedures, then additional information describing the testing instrument/"how to check" and reason for acceptance in some cases shall be provided.

6.8 Reporting

The report form used shall be one of the following report forms:

- 1) For radio equipment:
 - CRC 629a (for ships and HSLC)
 - MOD CRC 304a (for MODU)
 - the form CRC 630a (annual testing of 406 MHz EPIRB) or equivalent to be used for reporting of annual testing of the EPIRB for all vessels.
- 2) For AIS:
 - AIS 001a or appendix to IMO MSC.1/Circ.1252 (2007).

The name of the inspector shall be clearly indicated (preferably with upper-case letters) on the reports, stamped and signed by the inspector.

6.9 Communication with DNV GL station

When approached directly by owners or managers of a ship for conducting a radio or AIS survey, before conducting the survey the service supplier shall always notify the appropriate DNV GL station for further instructions.

In addition, a DNV GL surveyor should normally be present during the radio and AIS surveys. Deviation from this shall be clarified with appropriate DNV GL station before conducting the survey.

Failure in complying with the above requirements may result in cancellation of the certificate.

Before attending the vessel, the service supplier shall clarify with the owner/manager whether the radio survey is handled as remote survey by DNV GL. In case DNV GL will conduct the radio survey as remote survey, the service supplier shall obtain contact information of the DNV GL remote surveyor from the owner/manager and establish contact with Technical Support/remote surveyor instead of local DNV GL station before attending the vessel.

7 Inspections and maintenance of self-contained breathing apparatus

IACS UR Z17 Annex 1 [7] applies.

8 Examination of Ro-Ro ships bow, stern, side and inner doors

IACS UR Z17 Annex 1 [8] applies.

9 Annual performance testing of Voyage Data Recorders (VDR) and simplified Voyage Data Recorders (S-VDR)

IACS UR Z17 Annex 1 [9] applies with the following additions:

— [9.3] Procedures:

The service supplier shall have documented procedures, instructions and checklists stating how to carry out annual performance testing and examination of the:

- condition of all protective enclosures, including labelling
- condition of interfaces and converters
- condition of the UPS
- condition of the acoustic beacon
- condition of the release mechanism
- condition of microphones
- condition of the alarm/operating panel
- availability of all data recorded on the final recording medium
- any special items according to the applicable manufacturer's maintenance scheme
- for installations on or after July 1st 2014:
 - functions for performance test
 - data recorded on the final recording medium shall also include ECDIS display, AIS, rolling motion, configuration data and electronic logbook (if fitted).

The instructions or checklists shall include pass criteria where relevant. Procedures and instructions for operation of each item of the test equipment shall also be kept and be available during the annual survey.

The person carrying out annual performance testing shall additionally have access to IMO resolution A.861(20), MCS.333(90) and IEC 61996 as well as particular documentation from the VDR manufacturer during the annual survey on board.

— [9.6] Reporting - Test Report:

Successfully passed annual performance test shall be documented in form of a *Certificate of compliance* (COC) and shall be prepared in a standard form acceptable to the Society. The COC shall as a minimum contain:

- the heading *Certificate of compliance for voyage data recorder*
- name and IMO number of the ship
- date and place of successfully passed testing
- make, model and serial number of the VDR
- list the reference standards in IACS UR Z17 [9.4.1]
- name and address of service supplier
- name of the technician carrying out the annual performance test
- DNV GL service supplier approval certificate number and the date of expire of the service supplier certificate.

One copy of the COC shall be retained onboard the vessel, and one copy filed at the supplier. The COC shall be traceable to the order reference system.

— Practical demonstration:

Certification is conditional on a practical demonstration of an annual VDR performance test (APT) as well as satisfactory reporting being completed. Practical demonstration is required for both initial certification and renewal.

10 Inspection of low location lighting systems using photo luminescent materials and evacuation guidance systems used as an alternative to low-location lighting systems

IACS UR Z17 Annex 1 [10] applies.

11 Sound pressure level measurements of public address and general alarm systems on board ships

IACS UR Z17 Annex 1 [11] applies with the additions given below.

The service supplier may apply for a combined approval for sound pressure measurements of GA/PA and measurements of noise levels (see [14] below). Both the requirements in [11] and [14] will then be applicable.

— [11.5] Reporting:

The sound pressure level of the General alarm system, the ambient noise level and the arithmetic difference of them shall be stated in the report. Whereas the ambient noise level is in general the noise level measured in the specified space with machinery and equipment under normal operating condition.

The sound level of the public address system, the speech interference level (SIL) and the arithmetic difference of them shall be stated in the report. Whereas the SIL shall be determined by measuring the octave band levels 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz in the specified space with machinery and equipment under normal operating condition.

The operating condition and the environmental condition shall be reported accordingly.

— [11.7] Reference documents:

The supplier shall in addition have access to the following document:

- IEC 60942 - Electroacoustics - Sound calibrators (2003-01).

12 Testing of coating systems in accordance with IMO Resolution MSC.215(82) as amended and IACS UI SC223 and/or MSC.288(87) as amended

IACS UR Z17 Annex 1 [12] applies with the following additions.

12.1 Application

The test laboratories shall be recognized by the Society and approved in accordance with this class programme. The approval may be given to both a recognized test laboratory independent of the coating manufacturer, and to the coating manufacturer's own laboratory.

In the following, such laboratories are also referred to as the supplier.

12.2 Auditing of the supplier

When actual testing, forming basis for test reports used to seek type approval from the Society, is carried out, the Society's local office's surveyor shall be called in for witnessing milestones as given in [DNVGL-CP-0108 Non-metallic materials - Protective coating systems - seawater ballast tanks and double-side skin spaces](#) or [DNVGL-CP-0139 Non-metallic materials - Protective coating systems – cargo oil tanks](#). This is mainly related to testing performed at the coating manufacturer's own laboratory and may typically be:

- witnessing of selection of paint material in the stock if appropriate
- witnessing of sample surface preparation
- witnessing of primer application and weathering
- examination of surface and preparation prior to application of top coat
- witnessing of top coat application
- witnessing during testing
- witnessing evaluation of test.

12.3 Documentation

- List and documentation of licences granted by equipment's manufacturer, if any.

12.4 Reference documents

The supplier shall have access to:

- IMO Resolution MSC.215(82), Performance standard for protective coatings for dedicated seawater ballast tanks in all types of ships and double-side skin spaces of bulk carriers (IMO PSPC-WBT).
- The relevant standards listed in the IMO Resolution MSC.215(82), and which are made mandatory via IACS UI SC 223.
- IACS UI SC 223, For application of SOLAS Regulation II-1/3-2 Performance standard for protective coatings (PSPC) for dedicated seawater ballast tanks in all types of ships and double-side skin spaces of bulk carriers, adopted by Resolution MSC.215(82).
- IMO MSC.1/Circ.1465 Unified interpretations of the performance standard for protective coatings for dedicated seawater ballast tanks in all types of ships and double-side skin spaces of bulk carriers (Resolution MSC.215(82))IMO Resolution MSC.288(87), IMO Performance standard for protective coatings for cargo oil tanks of crude oil tankers (IMO PSPC-COT).
- IACS UI SC 259, For application of SOLAS Regulation II-1/3-11 Performance standard for protective coatings for cargo oil tanks of crude oil tankers (PSPC-COT), adopted by Resolution MSC.288(87)
- IMO MSC.1/Circ. 1479: Unified Interpretation on the application of the performance standard for protective coatings for cargo oil tanks of crude oil tankers (Resolution MSC.288(87)).

- The relevant standards listed in the IMO Resolution MSC.288(87), and which are made mandatory via IACS UI SC 259.
- IACS Recommendation no. 101, IACS Model report for IMO Resolution MSC.215(82) App.1 *Test procedures for coating qualification* (REC 101).
- IACS Recommendations no. 102, IACS Model report for IMO Resolution MSC.215(82) App.1 *Test procedures for coating qualification*, Section 1.7 - Crossover test (REC 102).

12.5 Administrative procedures

The supplier shall have an order reference system where each engagement is traceable to when, who and where testing was carried out, including location of test records and reports.

12.6 Work procedures and instructions

The supplier shall have documented procedures, instructions and checklists for how to carry out testing and reporting. Procedures and instructions for operating of each item of the testing equipment shall also be kept and be available at all time.

12.7 Verification

The supplier shall have a system for verifying that the services provided are carried out in accordance with approved procedures. Performed verification shall be documented.

12.8 Reporting

All test records shall be properly documented and retained in such a way that the performed testing can easily be re-traced later. The report shall identify extent and location of testing performed and a conclusive statement as to whether the test results satisfy the acceptance criteria or not.

The test report shall include references to relevant documents, as a minimum as referred to in [2].

In addition, and as a minimum, the following information shall be given:

- name, address and other contact information of the supplier
- contract requirements, e.g. order no., reference documents, specifications, special agreements etc.
- place and date of sample preparation and testing
- test equipment used
- name and signature of the person preparing the test samples
- name and signature of the person performing the tests
- name and signature of the person issuing the test report
- name and signature of the supervisor verifying the report.

The supplier shall file one copy of the test report, and the test report shall be traceable to the order reference system. Also reports for testing of coating systems that have failed shall be reported and filed in accordance with above.

IACS' model reports shall be used as basis for the coating test laboratory's own test report format.

12.9 References

- DNVGL-RU-SHIP Pt.6 Ch.1 Sec.9.

13 Servicing and maintenance of lifeboats, launching appliances, on-load release gear and davit-launched liferaft automatic release hooks

IACS UR Z17 Annex 1 [13] applies.

14 Measurements of noise level on board ships

IACS UR Z17 Annex 1 [14] applies.

The service supplier may apply for a combined approval for measurements of noise levels and sound pressure measurements of GA/PA (see [11] above). Both the requirements in [11] and [14] will then be applicable.

15 Tightness testing of primary and secondary barriers of gas carriers with membrane cargo containment systems for vessels in service

IACS UR Z17 Annex 1 [15] applies.

16 Firms engaged in survey using remote inspection techniques (RIT) as an alternative means for close-up survey of the structure of ships and mobile offshore units

IACS UR Z17 Annex 1 [16] applies with the additions and clarifications given below in [16.1] to [16.3]. [16.1] is applicable for all types of RIT, [16.2] is applicable for remotely operated vehicles (ROV), and [16.3] is applicable for other inspection techniques than those explicitly mentioned in IACS UR Z17.

16.1 General

16.1.1 Thickness measurements

Service suppliers undertaking thickness measurements are to hold separate approval as a 'Firm engaged in thickness measurements on ships and mobile offshore units' (see [1]).

16.1.2 Language

Operators and supervisors shall be able to communicate in English.

16.1.3 Equipment

The equipment used for the survey must be suitable for the intended purpose. The equipment shall be non-hazardous to the involved personnel and to the structure being inspected both during normal operations and in the event of a malfunction or failure.

Guidance note:

The following specifications are considered acceptable:

- high definition live video monitoring for DNV GL Surveyor during survey. Minimum screen size 10"
- 4K definition video recording device
- 4096x2160 still image capture device.

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16.1.4 Reporting and data storage

Upon completion of survey, the service supplier shall provide DNV GL with photographs and/or video footage from the survey, for the purpose of documenting the observed findings. The photographs and videos shall have acceptable quality. The naming of the files should reflect the structural element surveyed, or otherwise be easily identifiable. The data shall be stored by the service supplier, and shall be available at request from DNV GL for 5 years.

Within two week of the survey completion date, DNV GL shall receive a written report in PDF format. The following shall as a minimum be included in the report:

- particulars of the ship
- information about the service supplier and pilot
- date, place and type of survey
- descriptions, photos and other information relevant for the class-related activities.

16.1.5 Safety

It is the responsibility of the supplier to ensure safe operation for services for which approval is sought. The supplier shall document a process ensuring sufficient safety level for all inspection techniques which they have chosen to qualify. The process shall include a case by case evaluation related to each inspection (Ship/MOU).

16.1.6 Practical demonstration

A practical demonstration (inspection) is required for the initial approval. It shall be demonstrated that the test objectives can be achieved in a realistic test environment, within agreed acceptance criteria. The demonstration shall be performed according to applicable work procedure(s).

16.2 Remotely Operated Vehicle (ROV)

16.2.1 General

For in-water close-up survey of the internal compartments by remotely operated vehicle (ROV), suppliers are also to hold separate approval as a "Firm carrying out an in-water survey on ships and mobile offshore units by diver or Remotely Operated Vehicle (ROV)" (see [3]).

16.3 Other inspection techniques

16.3.1 General

Other inspection techniques than those explicitly mentioned in IACS UR Z17, for instance crawlers, borescopes, laser scanning, hyperspectral imaging, etc., may be included in the service for which approval is sought.

APPENDIX B SPECIAL REQUIREMENTS FOR CATEGORIES OF SERVICE SUPPLIERS NOT LISTED IN IACS UR Z17

1 Service suppliers engaged in testing of navigational equipment and systems

1.1 Application

1.1.1 This programme is applicable to service suppliers engaged in performing inspection and testing of navigational equipment and systems on board ships for compliance with SOLAS requirements.

1.1.2 Service suppliers should be approved for the functional level and not for the manufacturer level. Approval of service suppliers by classification societies does not include the ability to service the equipment down to the manufacturer level.

If a service suppliers is not able to cover all groups of navigational equipment the groups of equipment for which the firm is approved should be listed on any certificate issued.

1.1.3 The service supplier engagements are divided into five (5) groups of services:

Group 1:

- 1) Heading information systems, including bearing devices:
 - 1) magnetic compass
 - 2) gyro compass
 - 3) transmitting heading device (THD).
- 2) Rate-of-turn indicator.
- 3) Rudder, propeller, thrust, pitch and operational mode indicators.

Group 2:

- 1) speed and distance measuring equipment (SDME)
- 2) echo-sounding equipment.

Group 3:

- 1) Position-fixing systems:
 - 1) Loran C/Chayka
 - 2) GPS
 - 3) GLONASS
 - 4) GPS / GLONASS
 - 5) DGPS 7 DGLONASS.

Group 4:

- 1) bridge navigational watch alarm system (BNWAS)
- 2) radar system, including plotting aids
- 3) electronic chart display and information system (ECDIS).

Group 5:

- 1) heading control system (HCS)
- 2) track control system (TCS)
- 3) integrated navigational system (INS).

1.2 Requirements for supplier

1.2.1 Reference documents

The service supplier should have access to the following documents:

- SOLAS 1974 as amended.
- IMO Res. A.789(19): Specification on the survey and certification functions of recognized organizations acting on behalf of the administration.
- All IMO Performance standards relevant for each group of services listed in [1.1.3] as well as all IEC cross product standards (IEC 60945 and IEC 61162 series).
- Flag state administration requirements.
- Relevant parts, if any, of the Society's rules and guidelines.

1.2.2 Personnel

1.2.2.1 The service supplier should provide evidence that the person carrying out the inspection has education from a technical school (a minimum two years' programme of engineering or physical science) or from a nautical institution with relevant seagoing experience as a certified ship's officer.

1.2.2.2 Personnel should be trained in testing navigational equipment and systems, preferably by the manufacturer of the equipment. Personnel should also have passed training concerning initial, annual, periodical and renewal surveys and have proficiency in the English language commensurate with the work.

1.2.2.3 Personnel testing colour calibration on ECDIS should, in addition, have a documented.

Ishihara colour vision deficiency test or equivalent and have colour vision not worse than would be required for seagoing service as an officer.

1.2.3 Procedures and instructions

The supplier should have documented procedures and instructions for carrying out the testing and examination of navigational equipment and systems. Such procedures and instructions should ensure that the level of performance tests is in compliance with the relevant technical standards.

1.2.4 Equipment and facilities

1.2.4.1 The supplier should have the major and auxiliary equipment (e.g. multi meter, earth fault finder, NMEA logger, etc.) required for correctly performing the testing.

1.2.4.2 A record of the test equipment used should be kept. The record should contain information on manufacturer and type of equipment, and a log of maintenance and calibrations.

1.2.4.3 A standard which is relevant to the navigational equipment and systems to be tested is available for the equipment and is cited in the inspection report.

1.2.4.4 For equipment employing software in conjunction with the testing/examination, this software shall be fully described and verified.

1.2.5 Reporting

The service supplier should confirm by means of a documented report that the equipment has been tested satisfactorily, using relevant DNV GL forms.

1.2.6 Review and verification

1.2.6.1 The surveyor should be on board to the extent necessary to control the process.

1.2.6.2 The surveyor should confirm that no further testing is needed or specify additional testing.

1.2.6.3 The surveyor should verify the report of the service supplier.

2 Service suppliers engaged in preparation of Inventory of Hazardous Materials (IHM)

2.1 Application

This programme is applicable to service suppliers engaged in the following services:

- preparation of inventory of hazardous materials (IHM)
- IHM laboratory and testing services.

2.2 Specific requirements for hazmat expert companies

2.2.1 The active hazmat experts need to demonstrate practice experience for at least one (1) project per year.

2.2.2 At least one employee of the audited company possesses a valid DNV GL fully approved hazmat expert qualification certificate. The training includes a participation in the 3-4 days seminar *Approved HazMat Expert* as a theoretical and practical introduction to the business and mandatory to pass the exam. Moreover a witnessing of the hazmat expert during his first assignment is required.

2.2.3 An operational manual is provided, which describes the project execution according to the IMO IHM guidelines.

2.2.4 The reports may be compiled in the following main structure:

- executive summary
- scope and method
- visual and sampling check plan
- pictorial report
- lab report
- findings and conclusions
- references and qualification.

2.3 Specific requirements for laboratories (lab)

2.3.1 Only ISO/IEC 17025 accredited laboratories should be used.

2.3.2 The lab is accredited for the respective test items and test methods stated in the IMO IHM guidelines.

2.3.3 At least one employee of the audited company possesses a valid DNV GL HazMat Expert qualification certificate or an equal qualification issued by a recognized organization.

2.3.4 For asbestos the supplier should demonstrate his quality performance through so called proficiency test events organized by independent institutes at least two (2) times a year.

2.3.5 The reports should content in particular scope, method, detection level and signature.

2.4 Relevant documents

- 1) The HKC: The 'Hong Kong international convention for the safe and environmentally sound recycling of ships, 2009' SR/CONF/45.
- 2) IHM guidelines: *Guidelines for the development of the inventory of hazardous materials* Resolution IMO MEPC.269(68).
- 3) Survey and certification guidelines: *2012 Guidelines for the survey and certification of ships under the Hong Kong convention* Resolution IMO MEPC.222(64).
- 4) EU SRR: Regulation (EU) No 1257/2013 of the European Parliament and of the council of 20 November 2013 on ship recycling and amending Regulation (EC) No 1013/2006 and Directive 2009/16/EC.
- 5) IACS Recommendation 113 Expert parties engaged in visual and/or sampling checks for preparation of inventory of hazardous materials.
- 6) [DNVGL-RU Pt.6 Ch.7 Sec.4](#) Recycling/Recyclable.
- 7) ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories.

3 Service suppliers engaged in inspection and testing of centralised gas welding and cutting equipment

3.1 Procedures

3.1.1 Service suppliers shall have documented procedures and instructions on how to carry out the servicing of the equipment and/or system. These shall either contain or make reference to the manufacturer's servicing manuals, servicing bulletins, instructions and training manuals, as appropriate, and to international requirements.

3.1.2 Additionally they shall make reference to any requirements (e.g. what markings should be appended to the equipment/system).

3.2 Administrative procedures

The supplier should have an order reference system where each engagement is traceable to the inspection and testing report.

3.3 Training of personnel

The supplier is responsible for the qualification and training of its supervisors and inspectors/operators to a recognised national, international or industry standard as applicable. A plan for training of personnel is included.

3.4 Reporting

Every assignment shall be accompanied with a written report. One copy shall be handed to the vessel, and filed at the supplier premises. The report shall be traceable to the order reference systems. The report shall in addition to specify the works carried out give information of any deficiencies found on components, non-conformance detected and any replacements done of components. NMA forms shall be used as applicable. The report shall include a copy of the certificate of approval.

3.5 Reference documents

The service supplier shall have access to the following documents:

- Manufacturer's servicing manuals, servicing bulletins, instructions and training manuals, as appropriate.
- Approval certificates showing any conditions that may be appropriate during the servicing and/or maintenance of gas welding and cutting equipment.

4 Service suppliers engaged in Non-destructive testing (NDT) on classification projects

4.1 General

4.1.1 Scope

This appendix is applicable to service suppliers engaged in performing NDT (Non-destructive testing) on ship and/or offshore components/structures which have or will have DNV GL classification. The general requirements are given in [Sec.1](#). Relevant service suppliers shall be approved by the Society if required by relevant part of the Society's rules and standards. In this programme such service suppliers are referred to as the supplier.

4.1.2 Objective

The objective of this approval programme is to ensure that the supplier is using appropriate procedures, has qualified and certified personnel and has implemented written procedures for training, performance, application, control, verification and reporting of NDT. In addition, the supplier shall ensure that appropriate equipment and facilities is utilized in order to provide a professional service.

4.1.3 Extent of programme

The approval programme defines the procedures required in obtaining the Society's approval for carrying out NDT of ship and offshore units (components and structures) classed by the Society.

4.1.4 Terms and definitions

The following terms and definitions apply for this document and approval programme.

<i>ACFM</i>	= alternating current field measurements
<i>Client</i>	= firm purchasing the services of a supplier (i.e. NDT services provider)
<i>ET</i>	= electromagnetic testing (i.e. Eddy Current testing and/or alternating current field measurements [ACFM])
<i>Industrial sector</i>	= particular section of industry or technology where specialised NDT practices are used, requiring specific product-related knowledge, skill, equipment and/or training
<i>MT</i>	= magnetic particle testing
<i>NDT</i>	= non-destructive testing. Comprising, but not limited to the methods and techniques MT, PT, RT, VT, UT, PAUT, TOFD and ET
<i>PAUT</i>	= phased array ultrasonic testing (technique within the method UT)
<i>PT</i>	= penetrant testing
<i>RT</i>	= radiographic testing
<i>Significant interruption</i>	= absence or change of activity which prevents the certified individual from practising the duties corresponding to the level in the method and the industrial sector(s) within the certified scope, for either a continuous period in excess of one year or two or more periods for a total time exceeding two years

Guidance note:

Legal holidays or periods of sickness or courses less than 30 days are not taken into account when calculating the interruption.

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Society = the classification society conducting the approval. For this programme the society is DNV GL

<i>Supplier</i>	= independent NDT company or NDT department/section that forms a part of a company providing NDT services on ship and/or offshore components/structures
<i>TOFD</i>	= time of flight diffraction (technique within the method UT)
<i>UT</i>	= ultrasonic testing
<i>VT</i>	= visual testing

4.1.5 References

Applicable reference documents are given in [Table 1](#).

Table 1 Reference documents

<i>Document code</i>	<i>Title</i>
ASME ANDE-1	Nondestructive Examination and Quality Control Central Qualification and Certification Program
ANSI/ASNT CP-105	Nondestructive Testing – Qualification and Certification of Personnel
ANSI/ASNT CP-106	Standard for Qualification and Certification of Nondestructive Testing Personnel
ANSI/ASNT CP-189	Standard for qualification and certification of non-destructive testing personnel
ASME V	Nondestructive Examination: Article 14 - Examination System Qualification
ASNT SNT-TC-1A	Personnel Qualification and Certification in Nondestructive Testing
CAN/CGSB-48.9712/ISO 9712	Non-destructive testing – Qualification and certification of NDT personnel
EN 4179	Aerospace series. Qualification and approval of personnel for non-destructive testing
NAS 410	Standard for qualification and certification of nondestructive testing personnel
ISO 9001	Quality management systems - Requirements
ISO 9712	Non-destructive testing - Qualification and certification of NDT personnel
ISO 11484	Employer's qualification system for non-destructive testing (NDT) personnel (For steel products: tubes, pipes (seamless or welded), flat products, long products, rails, bars, sections, rod, and wire)
ISO/IEC 17011	Conformity assessment – General requirements for accreditation bodies accrediting conformity
ISO/IEC 17020	Conformity assessment - Requirements for the operation of various types of bodies performing inspection
ISO/IEC 17024	Conformity assessment - General requirements for bodies operating certification of persons
ISO/TS 11774	Non-destructive testing – Performance-based qualification
ISO 18490	Non-destructive testing – Evaluation of vision acuity of NDT personnel
ISO/TS 22809	Non-destructive testing - Discontinuities in specimens for use in qualification examinations
ISO/TR 25108	Non-destructive testing - Guidelines for NDT personnel training organizations
ISO/TR 25107	Non-destructive testing – Guidelines for NDT training syllabuses

4.2 Requirements for supplier

A certificate of approval will be awarded and maintained on the basis of compliance with the following.

4.2.1 Submission of documents

The following documents shall be submitted to the Society for review before the audit is scheduled:

- an outline of supplier's organisation and management structure, including any subsidiaries to be included in the approval
- information on quality management system
- master list of the quality manual and documented procedures covering the requirements given in [4.2.2]
- for companies with in-house personnel certification scheme; a written practice developed in accordance with a recognised standard or recommended practice (i.e. ASNT's SNT-TC-1A, ANSI/ASNT CP-189 or similar).
- operational work procedures for each NDT method including procedure for selection of NDT technique
- training- and follow-up programmes for NDT operators including practical training on various ship and offshore products
- procedure for supervisor's authorisation of NDT operators
- experience of the supplier in the specific service area
- a list of NDT operators' documented training and experience within the relevant service area, including qualifications and third party certification according to EN ISO 9712 based certification schemes
- description of equipment(s) used for the particular service for which approval is sought
- a guide for NDT operators to use relevant equipment
- record formats for recording results of the services referred to in [4.2.13]
- information on other activities which may present a conflict of interest
- record of customer claims and corrective actions
- any legal proceedings against the company in the past/currently in the courts of law.

4.2.2 Quality management system

The supplier shall have a documented quality management system, covering at least:

- work procedures for all tasks and operations, including the various NDT methods and NDT techniques for which the supplier is involved
- preparation, issuance, maintenance and control of documents
- maintenance and calibration of the equipment
- training programs for the NDT operators and the supervisors
- maintenance of records for NDT operators' and the supervisors' training, qualification and certification
- certification of NDT operators including re-validation and re-certification
- procedure for test of operators visual acuity
- supervision and verification of operation to ensure compliance with the operational procedures
- quality management of subsidiaries
- job preparation
- recording and reporting of information, including retention time of records
- code of conduct for the supplier's activities; especially the NDT activities
- periodic review of work process procedures
- corrective and preventive action
- feedback and continuous improvement
- internal audits
- the provision of an engineering library with required codes, standards and procedures to assist NDT operators.

A documented quality system complying with the most current version of ISO/IEC 17020 or similar and including the above would be considered acceptable. The supplier should satisfy the requirements of type A or type B inspection body, as described in ISO/IEC 17020.

Guidance note:

With reference to [Sec.1 \[5\]](#), IACS UR W17 requires a quality system complying with ISO 9000. A quality system complying with ISO/IEC 17020 will be considered as complying with ISO 9000 as applicable.

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4.2.3 Extent of approval

The supplier shall demonstrate, as required in [\[4.2.4\]](#) to [\[4.2.13\]](#), that it has the competence and control needed to perform the specified services.

The extent of the approval shall include and be limited to the NDT methods, NDT techniques and personnel upon which approval will be granted.

4.2.4 Qualification and certification of NDT personnel

The supplier is responsible for the training and third party certification of its supervisors and operators to a recognised certification scheme based on ISO 9712.

Personnel qualification to an employer based qualification scheme as e.g. SNT-TC-1A or ANSI/ASNT CP-189 may be accepted if the supplier's written practice is reviewed and found acceptable by the Society. The supplier's written practice shall as a minimum, except for the impartiality requirements of a certification body and/or authorised body, comply with ISO 9712.

The supervisors' and operators' certificates and competence shall comprise all industrial sectors and techniques being applied by the supplier.

Level 3 personnel shall be certified by an accredited certification body.

4.2.5 Supervisor

The supplier shall have a supervisor or supervisors, responsible for the appropriate execution of NDT operation and for the professional standard of the operators and their equipment, including the professional administration of the working procedures.

The supervisor shall be directly involved in review and approval of NDT procedures, NDT reports, calibration of NDT equipment and tools. The supervisor shall on behalf of the supplier re-evaluate the training, qualification and experience of the operators annually.

The supplier shall employ, on a full-time basis, at least one supervisor for the NDT method(s) concerned and as described in [\[4.2.4\]](#). The supervisor shall be certified to level 3 by an accredited certification body.

It is recognised that small suppliers may not directly employ a level 3 in all the applicable methods. In such cases, limited to suppliers with no more than 10 NDT operators, it may be accepted that the supplier employ an external, independently certified, level 3 in those methods not held by the full-time level 3(s) of the supplier. Such employment/agreement shall be documented in writing, and the service supplier shall document continuously that the level 3 in question is sufficiently available and fulfilling all assigned tasks.

Note:

The Society may at its own discretion request any supplier to have full-time employed level 3 in certain NDT methods. Example: Suppliers mainly doing UT may be requested to have full-time employed level III in UT. This is particularly relevant for suppliers qualified for advanced NDT.

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The supervisor's training, qualification, experience and certification shall be re-evaluated at regular intervals for re-certification set by the accredited body that originally certified the supervisor (normally every five (5) years).

4.2.6 Operators

The operator carrying out the NDT shall, as a minimum, be qualified and certified to level 2 in the NDT method(s) concerned and as described in [\[4.2.4\]](#). However, operators only undertaking the gathering of data

using any NDT method and not performing data interpretation or data analysis may be qualified and certified as appropriate, at level 1.

The operator shall have adequate knowledge of materials, structures or components, NDT equipment and limitations that are sufficient to apply the relevant NDT method for each application appropriately.

4.2.7 Personnel records

The supplier is required to keep and maintain records of the qualified NDT operators. The supplier shall submit an updated list of qualified operators to the Society on request.

The records shall contain information on age, formal qualification, training, certification, authorisation/re-validation, recertification and experience in the NDT method(s) concerned.

4.2.8 Equipment

The supplier shall maintain records of the NDT equipment used and detail information related to maintenance, calibration and verification activities. If the supplier hires equipment, such equipment shall have updated calibration records, and the operators shall be familiar with the specific equipment type prior to using it. Under any circumstance, the supplier shall possess sufficient equipment to carry out the services being a part of the NDT scope required by the Society.

Where the equipment is of unique nature, the NDT operators shall be trained in the operation and use of the equipment before carrying out NDT using this equipment.

4.2.9 Work procedures and instructions

The supplier shall establish written procedures for the NDT being applied. These procedures shall be verified/approved by the supplier's level 3. The work procedures are at least to contain information on NDT methods, calibration checks, inspection procedure and defect evaluation against acceptance criteria in accordance with the Society's rules and standards. All NDT procedures and instructions shall be properly documented in such a way that the performed testing can be easily retraced and/or repeated at a later stage.

Guidance note:

The service supplier shall observe that the Society's rules and standards may give further specific requirements for NDT procedures, e.g. that project specific procedures shall be prepared and submitted for formal approval by the Society, etc.

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4.2.10 Administrative procedures

The supplier shall have an order reference system where each engagement is traceable to when, who and where the test was carried out including the location of test record and reports.

4.2.11 Verification

The supplier shall have a system to verify that the service provided is carried out in accordance with approved or agreed procedures. Executed verification shall be documented. Verification shall be performed by personnel possessing similar qualifications as the personnel performing the service.

4.2.12 Sub-contractors

The supplier shall give information of agreements and arrangements if any part(s) of the services provided are subcontracted. The supplier, in the following-up of subcontracts shall give particular emphasis to the quality management system of the subcontractor.

Subcontractors shall meet the same requirements placed on suppliers.

4.2.13 Reporting

All NDT shall be properly documented in such a way that the performed examination can be easily retraced and/or repeated at a later stage. The reports shall identify the defects present in the tested area, and a conclusive statement as to whether the material, weld, component or structure satisfies the acceptance criteria or not.

The report shall as a minimum have a content covering the same items as listed in [DNVGL-CG-0051](#). Applicable standard, NDT procedure and acceptance criteria shall comply with the Society's rules.

4.3 Approval procedure

4.3.1 Initial audit

The Society will carry out an audit of the supplier once all documentation and information received from the supplier has been evaluated and accepted.

The audit will be carried out by reviewing records submitted by the supplier, a visit to the supplier's facility/ office and interview of personnel including certified level 3 supervisor.

Acceptance of the supplier's supervisor(s) and NDT operators shall be done according to [4.7] of this programme.

4.3.2 Renewal audit

Renewal of the certificate of approval shall be made at intervals specified in Sec.1 [6.1]. The supplier should submit an application for renewal to the Society at least three months before the expiry date.

4.3.3 Additional audits

The Society may require additional audits where deemed necessary, e.g. as part or condition of the approval or as the result of findings during a project. The scope of the audit may be limited where relevant, e.g. a review of documentation, a verification of personnel or a verification of processes. See also Sec.1 [6.2].

The supplier shall provide access to their records, people and facility upon request.

4.4 Certificate of approval

4.4.1 Approval of the supplier

If the submitted documentation, the audit and where relevant the practical examination is found satisfactory, the supplier is qualified for a certificate of approval.

4.4.2 Scope of the approval

The approval will be specific and limited to supplier specified on the certificate, to the listed NDT methods and techniques, and the list of qualified operators. The certificate do not cover the supplier's organization and facilities not covered by the Society's audits as specified in [4.3.1] to [4.3.3].

The approval for NDT methods will depend on availability of supplier's certified supervisor and NDT operators certified in the methods for which the approval is sought.

The approval of the supplier covers the NDT operators on the list of operators submitted to the Society.

4.5 Information on alteration to the approved service operation system

In cases where any alteration to the approved service operation system or alteration of supervisors covered by the suppliers approval or NDT operators of the supplier are made, such alteration shall be reported immediately to the Society. A re-audit and/or re-approval may be required when deemed necessary by the Society.

4.6 Cancellation or suspension of the certificate of approval

4.6.1 Right to cancel or suspend

The Society reserves the right to cancel or suspend the certificate of approval in the following cases:

- where the service was improperly carried out or the results were improperly reported
- where a surveyor finds deficiencies in the approved service operation system of the supplier, and appropriate corrective action is not taken
- if any NDT work are done without following procedures approved by the Society
- where the supplier fails to give information of any alteration, as given in [4.5]

- where an intermediate audit, if requested as described in [4.3.2], has not been carried out
- where wilful acts or omissions are ascertained
- violation of code of ethics and conduct.

4.6.2 Information

The Society reserves the right to inform interested parties on cancellation or suspension of the certificate of approval.

4.6.3 Re-approval

A supplier that has had the certificate of approval cancelled may apply for re-approval after a period of one (1) year.

This possibility is not open, if the cancellation was based on a serious fault, such as a violation of code of conduct.

A supplier that has had the certificate of approval suspended can have the certificate reinstated as soon as issues listed in [4.6.1] are rectified.

4.7 Requirements for qualification of NDT personnel

4.7.1 General

The following approach shall be used in order to qualify NDT operators employed or hired by suppliers approved according to this programme or seeking approval according to this programme.

The Society reserves the right to require practical examination including reporting (e.g. using test samples), witnessed or arranged by the Society accordingly for NDT operators and supervisors. The scope and grading of practical examination of NDT operators will typically be as specified in ISO 9712 latest revision.

4.7.2 Acceptance of supervisors for service suppliers

The supplier's supervisor or supervisors, responsible for the appropriate execution of NDT operation and for the professional standard of the operators and their equipment, including the professional administration of the working procedures (see [4.2.5]) shall be certified as outlined in this appendix.

In particular, the supplier shall ascertain that the supervisor:

- has satisfactory vision and colour perception
- is familiar with and able to satisfactorily interpret standards codes and draft NDT procedures and/or NDT instructions for the testing in the relevant industrial sector(s)
- is familiar with applicable rules, standards and requirements for NDT, for the method(s) and sector(s) for which approval as service supplier is sought
- has acquired suitable industrial experience at typical level corresponding with the certification level in the applicable NDT method and relevant sector(s)
- has been successful in job-specific practical third party certification examinations that are relevant to the industrial sector which approval is sought
- continues to be qualified, without significant interruption, in the industrial sector which approval is sought.

4.7.3 Route A for acceptance of NDT operators qualifications

An individual holds at least an ISO 9712 level 2 certificate in a method and relevant sector issued by a certification body which is accredited for certification of persons according to ISO/IEC 17024 confirming compliance with ISO 9712. Furthermore, the supplier has active working procedures for follow-up and yearly authorisation of the certified individual.

4.7.4 Route B for acceptance of NDT operators qualifications

An individual qualified and certified to at least level 2 in a method and relevant sector against criteria of a standard that is equivalent to ISO 9712, may be accepted as being qualified provided it is satisfied that all criteria are equivalent to those of ISO 9712.

In this case the individual may be accepted as being qualified upon receipt of satisfactory documented evidence of qualification and certification provided by the certification body concerned and that the supplier has active working procedures for follow-up and yearly authorisation of the certified individual.

4.7.5 Route C for acceptance of NDT operators qualifications

An individual qualified and certified to at least level 2 in a method and relevant sector against criteria of a standard or recommended practice that is based on so called in-house certification (e.g. according to ASNT's SNT-TC-1A or ANSI/ASNT CP-189 or similar), may be accepted provided it is satisfied that all criteria regarding training, theoretical and practical competence are equivalent to those of ISO 9712.

In particular, the supplier shall ascertain and provide evidence that the operators have:

- satisfactory vision and colour perception
- completed general and job-specific training prior to examination
- acquired suitable industrial experience in the applicable NDT method and relevant sector(s)
- been successful in general and relevant specific written qualification examinations
- been successful in job-specific practical examinations that are relevant to the industrial sector which approval is sought
- continues to be qualified, without significant interruption, in the industrial sector which approval is sought, and
- is familiar with and able to satisfactorily implement defined NDT procedures and/or NDT instructions for the testing in the relevant industrial sector.

5 Service suppliers firms engaged in condition monitoring and condition based maintenance

5.1 General

5.1.1 Scope

Companies providing condition monitoring (CM) and/or condition based maintenance (CBM) services for machinery and equipment, in order to offer an alternative to calendar based maintenance, shall be approved by the Society. The companies shall be approved in accordance with this programme and applicable DNV GL rules. In the following, such companies are referred to as the supplier.

5.1.2 Objective

The objective of this approval programme is to ensure that the supplier is using appropriate procedures, has qualified personnel and has implemented written procedures for training, performance, application, control, verification and reporting.

5.1.3 Extent of the approval programme

The approval programme defines the requirements for obtaining the Society's approval for carrying out CM and/or CBM on machinery and equipment, normally subject to renewal/complete and annual survey on vessels classed by the Society.

5.1.4 Use of standards

The requirements for this approval programme is mainly based on international standards.

5.1.5 Terms, definitions and abbreviations

The following terms and definitions apply for this document and approval programme.

Alarm = operational signal or message designed to notify personnel when a selected anomaly or a logical combination of anomalies, requiring corrective actions is encountered (ISO 13372)

<i>Alert</i>	= operational signal or warning message designed to notify personnel when a selected anomaly, or a logical combination of anomalies, requiring heightened awareness is encountered (ISO 13372)
<i>Competence</i>	= proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development
<i>Access control</i>	= means to ensure that access to assets is authorized and restricted based on business and security requirements
<i>Account management</i>	= method associated with establishing, granting and revoking access accounts and maintaining the permissions and privileges provided under these accounts to access specific resources and functions in the physical premises, network and systems
<i>Accuracy</i>	= composite of trueness and precision (ISO 5725-1)
<i>Anomaly</i>	= irregularity or abnormality in a system (ISO 13372)
<i>Abnormality</i>	= deviation from a standard condition (ISO 13372)
<i>Audit</i>	= systematic, independent and documented process for obtaining objective evidence and evaluating its objectively to determine the extent to which the audit criteria are fulfilled
<i>Baseline</i>	= descriptor or group of descriptors which provides a criterion of the normal behaviour of a machine under various process states (ISO 13372)
<i>Condition Monitoring (CM)</i>	= activity, performed either manually or automatically, intended to measure at predetermined intervals the characteristics and parameters of the actual state of the item (EN 13306)
<i>Corrective maintenance</i>	= maintenance carried out after fault recognition and intended to restore an item into a state in which it can perform a required function (EN 13306)
<i>Condition based maintenance (CBM)</i>	= preventive maintenance which includes assessment of physical conditions, analysis and the possible ensuing maintenance actions (EN 13306)
<i>Continuous improvement</i>	= recurring activity to enhance performance (ISO 9000)
<i>Continuous operation</i>	= service provided by the supplier as per the terms and conditions agreed shall not under normal circumstances be discontinued
<i>Confidence level</i>	= figure of merit (e.g. percentage) that indicates the degree of certainty that the diagnosis/prognosis is correct (ISO 13381-1)
<i>Data-driven model</i>	= simple trending, neural network, pattern recognition/correlations, statistical data analysis, etc.
<i>Data acquisition rate</i>	= frequency of data sampling relative to a time unit
<i>Data flow diagram</i>	= graphical representation of the system and any connections to it illustrating the flow of data from sensor system through any node (component) before made available for analysis
<i>Descriptor</i>	= data item derived from raw or processed parameters or external observation
<i>Diagnostics</i>	= examination of symptoms and syndromes to determine the nature of faults or failures (kind, situation, extent) (ISO 13372)
<i>ETTF</i>	= estimated Time To Failure: estimation of the period from the current point in time to the point in time where the monitored machine is deemed to be in the failed condition (ISO 13381-1)
<i>Failure mode</i>	= manner in which the inability of an item to perform a required function occurs EN 13306
<i>Failure mechanism</i>	= physical, chemical or other processes which may lead or have led to failure (EN 13306)

<i>Failure modes effects analysis (FMEA)</i>	= structured procedure to determine equipment functions and functional failures, with each failure being assessed as to the cause of the failure and the effects of the failure on the system (ISO 13372)
<i>Failure modes effects and criticality analysis (FMECA)</i>	= FMEA with a classification process based on the severity of the faults (ISO 13372)
<i>Failure modes symptoms analysis (FMSA)</i>	= process based on FMECA that documents the symptoms produced by each mode and the most effective detection and monitoring techniques in order to develop and optimize a monitoring programme (ISO 13379-1)
<i>Inspection</i>	= examination for conformity by measuring, observing, or testing the relevant characteristics of an item (EN 13306)
<i>Influence factors</i>	= parameter that affect the deterioration rate of a failure mode (ISO 13381-1)
<i>Knowledge-based model</i>	= fault/symptom diagnostic, causal tree diagnostics
<i>Maintenance task analysis</i>	= a guided logic approach to select most appropriate maintenance task based on a maintenance strategy
<i>Malware</i>	= software intentionally designed to cause damage to a computer, server or network
<i>Malware management</i>	= method to ensure that information and information processing facilities are at any time protected against current malware threats
<i>Minimum manning level</i>	= minimum manning level indicates that the supplier shall be able to continue performing all relevant services and verification of work according to approved procedures and requirements even if relevant personnel for some reason is unavailable in a period to perform their intended function
<i>Operating conditions</i>	= physical loads and environmental conditions experienced by the item during a given period (EN 13306)
<i>Preventive maintenance</i>	= combination predetermined and condition based maintenance carried out intended to assess and/or to mitigate degradation and reduce the probability of failure of an item
<i>Predetermined maintenance</i>	= preventive maintenance carried out in accordance with established intervals of time or number of units of use but without previous condition investigation (EN 13306)
<i>Patch management</i>	= area of systems management that involves acquiring, testing and installing multiple patches (code changes) to an administered computer system (IEC 62443-2-1)
<i>Parameter</i>	= variable representing some significant measurable system characteristic (ISO 13372)
<i>Precision</i>	= the closeness of agreement between independent test results obtained under stipulated conditions (ISO 5725-1)
<i>Primary condition monitoring method</i>	= a principal condition monitoring method that require a qualified supervisor
<i>Prognostics</i>	= analysis of the symptoms of faults to predict future condition and residual life within design parameters (ISO 13372)
<i>Physics-based model</i>	= first principle equations, finite element methods etc.
<i>Remote access</i>	= communication with, or use of, assets or systems within a defined perimeter from any location outside that perimeter (IEC 62443-2-1)
<i>Reliability centred</i>	= method to identify and select failure management policies to efficiently and effectively achieve the required safety, availability and economy of operation (IEC 60300-3-11)

*maintenance
(RCM)*

Retention time of records = minimum duration of time for which the information and data shall be stored and maintained (retained) irrespective of format (paper, electronic, or other)

RUL = remaining useful life, remaining time before system health falls below a defined failure threshold (ISO 13381-1)

Root cause = set of conditions of a sequence of events that result in the initiation of a failure mode (ISO 13372)

Supplier = firm providing services on behalf of a client on ship and/or offshore unit

Security system specification = specification of components and software

Security system diagram = diagram illustrating architecture (network) with relevant integrations/interconnections in the system

Supplementary monitoring method = condition monitoring method usually used to support a primary condition monitoring method or used in combination with other supplementary monitoring methods to achieve required confidence level

Symptom = perception, made by means of human observations and measurements, which may indicate the presence of one or more faults (ISO 13372)

Syndrome = group of signs or symptoms that collectively indicate or characterize an abnormal condition (ISO 13372)

Trueness = the closeness of agreement between the average value obtained from a large series of test results and an accepted reference value (ISO 5725-1)

5.1.6 References

5.1.6.1 Normative references

- [DNVGL-RU-OU-0101](#) = Rules for classification: Offshore units - Fleet in service
- [DNVGL-RU-SHIP Pt.7](#) = Rules for classification: Ships, Part 7 - Survey requirements for fleet in service
- ISO 13381-1* = Condition monitoring and diagnostics of machines - Prognostics - Part 1: General guidelines
- ISO 17359* = Condition monitoring and diagnostics of machines - General guidelines
- ISO 5725-1* = Accuracy of measurement methods and results
- ISO 13379-1* = Condition monitoring and diagnostics of machines- Data interpretations and diagnostics techniques - Part 1: General guidelines
- ISO 13372* = Condition monitoring and diagnostics of machines - Vocabulary
- ISO 18436-2* = Condition monitoring and diagnostics of machines - Requirements for training and certification of personnel
Part 2: Vibration condition monitoring and diagnostics.
- ISO 18436-4* = Condition monitoring and diagnostics of machines - Requirements for qualification and assessment of personnel - Part 4: Field lubricant analysis
- ISO 18436-6* = Condition monitoring and diagnostics of machines - Requirements for qualification and assessment of personnel - Part 6: Acoustic emission
- ISO 18436-7* = Condition monitoring and diagnostics of machines - Requirements for qualification and assessment of personnel - Part 7: Thermography
- ISO 18436-8* = Condition monitoring and diagnostics of machines - Requirements for qualification and assessment of personnel - Part 8: Ultrasound
- ISO 9001* = Quality management
- ISO 8000-2* = Data quality - Part 2: Vocabulary
- ISO 8000-8* = Data quality - Part 8: Information and data quality: Concepts and measuring

IEC 62443-2-4 = Security program requirements for IACS service providers

5.1.6.2 Informative references

ISO 20958	= Condition monitoring and diagnostics of machines -Electrical signature analysis of three-phase induction motors
ISO 29821-2	= Condition monitoring and diagnostics of machines - Ultrasound - Part 2: Procedures and validation
ISO 29821-1	= Condition monitoring and diagnostics of machines - Ultrasound - Part 1: General guidelines
ISO 22096	= Condition monitoring and diagnostics of machines - Acoustic emission
ISO 13374	= Condition monitoring and diagnostics of machines - Data processing, communication and presentation (1-4)
ISO 13373-3	= Condition monitoring and diagnostics of machines - Data interpretations and diagnostics techniques - Part 3: Basic techniques for diagnostics
ISO 13379-2	= Condition monitoring and diagnostics of machines- Data interpretations and diagnostics techniques - Part 2: Data driven models
EN 62740	= Root cause analysis (RCA)
ISO 19011	= Guidelines for auditing management systems
ISO 14224	= Collection and exchange of reliability and maintenance data for equipment
ISO 17025	= General requirements for the competence of testing and calibration laboratories
ISO 27001	= Information technology - Security techniques - Information security management systems - Requirements
ISO 19847	= Ships and marine technology — Shipboard data servers to share field data at sea
ISO 19848	= Ships and marine technology — Standard data for shipboard machinery and equipment
EN 13306	= Maintenance terminology
IEC 60300-3-14	= Dependability management Part 3-14: Application guide, Maintenance and maintenance support
IEC 60300-3-11	= Dependability management Part 3-11: Application guide, Reliability centred maintenance
IEC 62443-2-1	= Establishing an industrial automation and control system security
IEC 62443-3-3	= System security requirements and security levels
NEK EN 60812	= Failure modes and effects analysis (FMEA and FMECA)
ISO 18436-5	= Condition monitoring and diagnostics of machines - Requirements for qualification and assessment of personnel - Part 5: Lubricant laboratory technician/analyst
IACS UR Z27	= Condition Monitoring and Condition Based Maintenance
DNVGL-RP-0497	= Data quality assessment framework
DNVGL-RP-0496	= Cyber security resilience management for ships and mobile offshore units in operation

5.2 Requirements to supplier

The certificate of approval will be awarded and maintained on the basis of compliance with the requirements in this chapter.

5.2.1 Extent of approval

The supplier shall be approved according to the rules of this programme and applicable monitoring methods as part of their service. The approval shall cover minimum one primary condition monitoring method and supplementary monitoring methods as applicable.

A condition monitoring method can be based on one or more measuring technique (CM) or/and include other type of descriptors (ISO 17359):

- CM measuring technique (manipulated parameters)
- parameters (non-manipulated parameters reflecting the operating conditions of the machine or equipment)
- testing and inspection (condition assessment).

The supplier shall select a service level [Table 2](#) appropriate to their service extent (application) and elements (scope). The service level sought will define the type of service they are approved for.

Table 2 Extent of approval

	<i>Service level</i>		
	<i>CM supplier</i>	<i>Data-driven CM supplier</i>	<i>CBM supplier</i>
Service extent			
Selected functional failure modes	X	X	
All functional failure modes (CBM)			X
Service elements			
CM measurement technique [5.2.3.2]	X	X*	X
Physics-based model (Not covered by a CM measurement technique) [5.2.3.3]	X	X	X
Data-driven model		X	X
Knowledge-based model			X
Inspection and testing (Condition assessment)	X*		X
Maintenance task analysis			X
Maintenance recommendations			X

Note:

*Only applicable as supplementary monitoring method in combination with a primary monitoring method.

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5.2.2 Submission of documents

In addition to the documents listed in the general requirements provided in this programme, see [Sec.1](#), the following documents shall be submitted for review:

- information on the implemented quality management system, quality manual and documented procedures covering the requirements given in [\[5.2.6\]](#)
- documented process for establishing a maintenance programme covering essential elements given in [\[5.2.3\]](#)
- documented information and data management covering the requirements given in [\[5.2.4\]](#)
- documented information and data security management covering the requirements given in [\[5.2.5\]](#).

5.2.3 Requirements for the maintenance programme

The supplier shall be able to select correct monitoring method(s) [5.2.3.2] and establish a maintenance programme according to the agreed service level in Table 2.

A supplier qualified as a CM supplier or Data-driven CM supplier shall select monitoring methods for selected functional failure modes. The selected monitoring methods shall provide capabilities (diagnostics and prognostics) to ensure required function availability and allow for sufficient time to plan and perform associated maintenance tasks.

A supplier qualified as a CBM supplier shall be able to set up maintenance tasks for a machine or equipment covering all functional failure modes. The supplier shall have a documented process, see [5.2.3.1], to analyse and select appropriate maintenance based on an agreed maintenance strategy. The process shall select maintenance CM methods for failure modes and corresponding failure mechanisms that allow for CM and ensure predetermined maintenance for failure modes that do not allow for CM. The maintenance programme shall include the following essential elements:

- maintenance task analysis**
- monitoring method(s)
- diagnostics
- prognostics
- reporting.

Note:

**Maintenance task analysis is only applicable for a CBM supplier.

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5.2.3.1 Maintenance task analysis

The supplier shall document a maintenance task analysis for selecting most appropriate preventive maintenance for all relevant functional failure modes and corresponding failure mechanisms.

The selected maintenance should comply with agreed maintenance strategy.

Guidance note:

It is recommended to apply a standard Reliability Centered Maintenance (RCM) decision logics when selecting appropriate maintenance tasks.

Maintenance tasks can be:

- preventive (Predetermined or Condition based)
- corrective (Immediate Corrective or Deferred Corrective) and;
- based on OEM recommendations.

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Failure modes shall derive from a documented FMEA or FMECA, applicable for the function.

The maintenance task analysis shall include an evaluation and selection process to determine an appropriate monitoring method(s), diagnostic approach and prognostics.

Guidance note:

It is recommended to apply failure mode symptoms analysis (FMSA) as a supplement/modification to the FMEA/FMECA to assist with the selection of appropriate monitoring method and diagnostics approach.

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5.2.3.2 Monitoring method

The supplier shall document any monitoring method part of the approval. This shall include a general description about the machine or equipment and its function, type of measurement(s) and descriptor(s) applied as part of the monitoring method.

Guidance note:

Descriptors can be obtained either directly from a parameter (sensor) or after manipulation by a measurement technique.

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For each applicable condition monitoring method the following shall be documented, as applicable (ISO 17359):

- accuracy of monitored parameters
- operating conditions during monitoring/measurements
- monitoring interval
- data acquisition rate
- measurement locations or data source/sensors
- set points/alarm limits
- baseline data.

Measurements and parameters (descriptors) can be obtained from the following standard (CM) measurement techniques (ISO 18436):

- vibration
- oil analysis (field lubricant analysis)
- acoustic emission
- thermography
- ultrasound.

In addition any measurable parameter can be used solely or in combination with other parameters and/or measurements.

5.2.3.3 Diagnostics

The supplier shall document the diagnostics approach model part of a monitoring method(s). A diagnosis approach/model shall be based on relevant measurement(s) and/or parameter(s) to determine the condition of a machine or equipment with a satisfactory level of confidence (ISO 13379-1).

A diagnostic model shall be documented by:

- development process
- list of descriptors used
- diagnostics accuracy
- confidence level
- limitations and operating conditions.

Development process:

The development shall be documented according type of diagnostic model.

Physics-based models:

A physics-based model encapsulates the physics of a machine or equipment and the deterioration process using appropriate mathematical equations. A physics based model can be part of a measuring technique. The following shall be documented in addition for a physics-based model:

- description of how the condition/state is estimated based on mathematical equation(s) and observed deviations from normal behaviour
- mathematical equations representing the system with an adequate level of decomposition into sub models
- elaboration of mathematical equations in a logical sequence
- definition of alarm limits based on design calculations and/or other documented acceptance criteria.

Knowledge-based models:

Knowledge-based models rely on input from experts (SME) with long time experience (operation and design) with the applicable machine or equipment. The following shall be documented in addition for a knowledge-based model:

- fault hypotheses with description of associations between failure modes, failure mechanisms, symptoms/syndromes and descriptors
- definition of alarms or abnormal behaviour according to relevant fault hypotheses.

Guidance note:

It is recommended to apply a FMSA to document associations between failure modes, failure mechanisms, symptoms/syndromes and descriptors.

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Data-driven models:

Data-driven models provide a representation of observed behaviour without the need to have specific understanding of the physics. The following shall be documented in addition for a data-driven model:

- description of method(s) used
- representative training data:
 - independent from the test data
 - covering all applicable operating conditions
 - retraining to account for new operating conditions
- representative test data:
 - test data shall represent the scenarios (limitations and operation conditions) under which the model will be used
 - test data shall be composed of independent samples.

Guidance note:

Independent samples shall ensure a reliable indication of the expected performance of the system in real conditions. Independent samples are samples from different experiments, rather than multiple samples from the same experiment. Simulations can be considered on a case by-case basis as part of the documentation.

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Diagnostic accuracy

Accuracy (ISO 5725-1) shall be based on level of precision and trueness determined based on the test results. The precision level shall be determined based on a number of tests sufficient to calculate a standard deviation. Repeatability of tests shall be considered when determining the precision level.

Trueness shall be documented by the deviation from an average of measured/calculated value and the real value.

Guidance note:

Real values can be obtained from design documentation, inspection results and alternative measurements.

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Confidence level

The confidence level of a model shall be documented by the cumulative effect of error sources on the final certainty of confidence in the accuracy of the diagnosis. Confidence level should be calculated by using a weighted assessment of the following error sources as a minimum:

- diagnostic accuracy
- data quality level for descriptors used
- system or component design documentation
- failure data and characteristics.

The calculated confidence level shall be compared and evaluated according to the applicable risk level of the failure mode to document and confirm satisfactory confidence level.

Guidance note:

When different types of models are combined in to one this is considered a hybrid model. A diagnostics model can also be a combination of a primary model and one or more sub models. This type of models should be decomposed to calculate the confidence level adequately.

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5.2.3.4 Prognostics

The supplier shall document any prognostics applied to predict future fault progression and expected RUL or ETTF. The prognostics shall be based on a updated diagnosis [5.2.3.3] and current operating condition. The prognostics shall provide capabilities to estimate RUL or ETTF with a satisfactory level of confidence (ISO 13381-1).

Expected remaining useful life (RUL) or time to failure (ETTF):

The supplier shall have a documented process to estimate RUL or ETTF based on an evaluation of:

- descriptor(s) expected behaviour and/or rate of deterioration (failure mechanism)
- effect of other failure modes or other influence factors
- effect of future operating conditions as applicable
- operational history, failure data, previous maintenance and inspection results (condition).

Prognostics confidence:

The prognostics confidence level shall be determined by evaluating the cumulative effect of uncertainties related to the estimate and/or error sources on the final result. The supplier shall have a documented process to determine prognostic confidence level including the following:

- diagnostics confidence level
- level of documentation, data and/or information supporting the RUL or ETTF estimate
- type of estimate made (extrapolation or projection).

Alarm limits and acceptance criteria should be set or updated based on the estimated prognostics.

Based on the result from the prognosis the supplier can make maintenance recommendations in line with the maintenance task analysis.

Guidance note:

Prognostics applied (level of) should be based on function criticality, ensure required function availability and allow for sufficient time to plan and perform associated maintenance tasks.

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5.2.3.5 Reporting

All condition monitoring results shall be properly documented and retained in such a way that all conclusions can easily be traced later. The reporting shall identify extent and location of measurements performed in terms of machine identifying numbers, trends, defects indicated, and a conclusive statement including:

- current state (diagnostics) of the machine or equipment with an estimated level of confidence [5.2.3.3]
- estimated RUL or ETTF with level of confidence [5.2.3.4]
- state conditions and assumptions to which the prognosis remains valid.

Any condition monitoring results shall be presented together with the following information:

- name of the vessel
- identification number (DNV GL ID or IMO number)
- place and date of measurement and analysis
- applicable monitoring method(s) and measurement technique(s)
- measurement equipment used (if applicable)
- name of personnel that has performed the measurement or analysis
- name of personnel that has verified the measurement or analysis.

If the service level [5.2.1] includes issuing maintenance recommendations this shall be documented. Maintenance recommendations given shall include:

- detailed task description to the level of detail necessary for a skilled maintenance person
- due date or running hours for completing the task
- task preparation note describing any preparation necessary
- required materials (consumables, spare parts and special tools)
- list of applicable documentation (maintenance procedures and service manuals and drawings)

- information of checks and measurements to be recorded.

The reporting can be done manually in pdf format reports or electronically made available in a web application. If electronic reporting is used the society shall then have access to the application.

The supplier is responsible for retention of condition monitoring data and issued reports for a minimum of 5 years.

5.2.4 Data quality

The supplier is responsible for using only quality assured information and data for diagnostics and/or prognostics (ISO 8000-8).

The supplier shall have a documented information and data management covering the following elements:

- data flow diagram for sensor system(s)
- responsibilities and competence requirements
- work process that defines characteristics of information and data that determines its quality and provides methods to manage, measure and improve the quality of information and data from sensor system through applicable nodes before made available for analysis and other processing.
- technologies and tools to support data quality processes.

Guidance note:

As part of a process to evaluate sufficient level of data and information management, the supplier is recommended to apply [DNVGL-RP-0497](#) to perform a data quality assessment wrt. relevant data flow(s) and an organisational maturity assessment to evaluate the suppliers ability to manage data quality according to the service sought.

Information and data quality assurance can be performed completely or partly by the machine or equipment owner.

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5.2.5 Data security

The supplier shall have sufficient level of information and data security for the service sought (IEC 62443-2-4).

The supplier shall have a documented information and data security management covering:

- security system specification and diagram
- work process to integrate applicable systems, analyse and identify security threats and provide methods to manage, measure and improve the information and data security at a sufficient level.
- responsibilities and competence requirements
- malware and patch management
- remote access
- access control and account management.

Guidance note:

Information and data security management can be performed completely or partly by the machine or equipment owner.

For suppliers providing services including limited data transfer and secure tunnels a limited scope will be accepted on a case by case basis.

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5.2.6 Quality management system

The supplier shall have a documented quality management system (ISO 9001), covering at least:

- 1) internal audits [\[5.2.6.2\]](#)
- 2) competence requirements and training programmes for the condition monitoring personnel [\[5.2.6.3\]](#)
- 3) competence requirements and responsibilities for service responsible [\[5.2.6.4\]](#)
- 4) Continuous improvement. [\[5.2.6.5\]](#)
- 5) personnel records
- 6) verification of work.

Guidance note:

The service supplier shall have an active improvement process including evaluation of monitoring methods and any industry development, self-evaluation of relevant services and customer feedback.

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5.2.6.1 Internal audits

The supplier shall have a documented internal audit programme to measure and evaluate compliance with internal work procedures and processes. The auditor(s) performing internal audits shall be qualified and be independent of the organisation that is being audited (Outside CM/CBM organisation). Audit findings shall be reported, followed up and concluded in a systematic process.

5.2.6.2 Training, competence and certification of condition monitoring personnel

The supplier is responsible for ensuring sufficient level of training, competence and experience within the services that are sought.

The supplier shall have a supervisor(s) responsible for the appropriate execution of the service sought for each primary condition monitoring method part of the service sought.

The supervisor(s) shall be responsible for the professional standard of the condition monitoring personnel, monitoring method(s) and the professional administration of relevant working procedures.

Standard measurement techniques:

If the service includes a standard measurement technique, [5.2.3.2] this requires third party certification of involved personnel according to relevant technical part of ISO 18436 *Condition monitoring and diagnostics of machines - Requirements for qualification and assessment of personnel*

Personnel performing standard measurement techniques and analysis on collected data shall be qualified to the appropriate level for their scope of work in accordance with relevant technical parts of ISO 18436. The personnel shall have adequate knowledge of the systems and components handled, sensors, equipment and the limitations of the relevant condition monitoring methods applied.

If a primary monitoring method includes a standard measurement techniques, the supervisor shall as a minimum be independently certified to the requirements of category III for a minimum of one measurement techniques, according to relevant parts of ISO 18436.

Data-driven models:

For a service including data-driven models the supplier shall ensure that personnel involved in development of, diagnostics and prognostics with data-driven models, are qualified to the appropriate level for their scope of work. The supplier shall document personnel with sufficient combination of education, training and experience to ensure that they understand the principles and process applicable to techniques and/or theories used.

If a primary monitoring method is data-driven, the supervisor shall be a qualified professional with an education in data engineering, data science, mathematics or statistics and with documented relevant experience.

Guidance note:

Relevant experience typically includes maintenance management, CM measuring techniques and development and implementation of data-driven models based on statistical methods, neural network analysis, classification trees, random forest, logistic regression and support-vector machines.

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Other models:

For services including knowledge-based models or other physics-based models (not a part of a standard measurement technique), the supplier shall document personnel with sufficient combination of education, training and experience to ensure that they understand the principles and procedures for carrying out condition monitoring, diagnostics and prognostics according to applicable condition monitoring method(s) in which the supplier have chosen to qualify.

5.2.6.3 Competence requirements and responsibilities for service responsible

The supplier shall in addition to the supervisor(s) have a service responsible role as part of the organisation. The service responsible shall ensure the integrity of the programme and the professional standard of the service sought. The responsibilities for the role shall be documented and include ensuring:

- sufficient resources to uphold an uninterrupted service [5.2.6]
- that the maintenance task analysis is performed according to approved process [5.2.3.1]
- that only quality assured data and information are used as part of the service [5.2.4]
- a sufficient level of information and data security [5.2.5]
- operation in accordance with the quality management system [5.2.6].

Guidance note:

The service responsible role can be executed exclusively or in a joint responsibility in a combination with the role as a supervisor.

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5.2.6.4 Continuous improvement

The supplier shall have a documented process for continuous improvement. The process shall be an ongoing effort to improve the services and any internal process. The process shall as a minimum collect information from:

- experience with work processes [5.2.6.1]
- feed back from clients and condition monitoring personnel
- information collected from OEM's (Bulletins)
- industry developments (equipment, monitoring methods and measurement techniques)
- internal audits [5.2.6.2]
- root cause analysis (RCA).

Guidance note:

It is recommended that the continuous improvement includes the design and maintainability of machinery and equipment.

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5.2.6.5 Personnel records

The supplier is required to keep records of its condition monitoring personnel part of the service(s) sought. The records shall contain information on training, certification, re-validation and performing experience with applicable monitoring methods or measurement techniques.

Records of qualifications and training shall be maintained on a continuous basis.

5.2.6.6 Verification of work

The supplier shall have a documented system for verifying that the services provided are carried out in accordance with approved work procedures. Verification of work shall be executed by personnel with the same or higher competence level as the person performing the work.

6 Service suppliers engaged in resin casting of chock foundations, stern tubes, etc.

6.1 Objective

The objective of this programme is to set the specific requirements for approval of service suppliers (AoSS) engaged in resin casting.

A service supplier will have to fulfill both the service specific requirements below and the general requirements in Section 1 of this document.

Service supplier is hereafter also referred to as supplier.

6.2 Application

This programme is applicable to suppliers engaged in resin casting for following applications:

- foundation chocking for machinery installations
- installation of propeller shaft bearings
- installation of rudder stock bearings.

6.3 Reference documents

Type approval programme for resin:

- [DNVGL-CP-0432](#) *Pourable compounds for foundation chocking.*

Classification guideline for installation of machinery components:

- [DNVGL-CG-0372](#) *Foundation and mounting of machinery.*

6.4 Requirements for service supplier

6.4.1 General

The cast resin used for chocking or installation shall have a type approval certificate according to [DNVGL-CP-0432](#) Non-metallic materials.

6.4.2 Servicing station

The supplier shall appoint supervisory staff responsible for installation. The names will be mentioned on the certificate.

The supplier shall maintain an updated list of qualified personnel.

The evidence of qualification of staff performing the installation shall be available on site at the request of the attending surveyor.

6.4.3 Documents

For each application the installation drawings and calculations shall be prepared by the supplier or an authorized representative.

6.4.4 Reporting

Each application shall be reported with the relevant installation conditions and final acceptance statement by the supplier's person responsible.

As a minimum the following information shall be reported:

- clear identification number of project
- responsible person, operators
- used type of resin with batch number
- environmental conditions (temperature(air, joining parts, resin/hardener), relative humidity) with date and time
- start time and duration of casting process
- amount of resin casted/test samples
- heat treatment/tempering during curing process, if any
- environmental conditions during curing process
- final acceptance test with date and time
- final acceptance statement by the supplier's person responsible.

6.4.5 Verification

The supplier shall have the surveyor's verification of each separate job, documented in the report by the attending surveyor's signature.

7 Service suppliers engaged in lay-up service of vessels

The content of this chapter is under development. Contact MRRNO332 for further information.

8 Service suppliers engaged in testing of ballast water management systems (environmental testing)

8.1 Scope

8.1.1 Scope for class approval

Test facilities engaged in testing of ballast water management systems (BWMS) following DNV GL type approval programme [DNVGL-CP-0209](#), the results of which may form the basis for the surveyor's decisions, shall be approved by DNV GL following the criteria established in this programme.

8.1.2 Scope for statutory approval

Test facilities engaged in testing of BWMS following guidelines G8 of the ballast water management convention (BWM Convention), the results of which may form the basis for the surveyor's decisions, shall be approved by DNV GL following the criteria established in this programme, as well as relevant criteria given in guidelines G8 of the BWM convention (hereafter referred to as guidelines G8), where DNV GL is so authorized by the relevant flag administration.

Additional national accreditation, as may be required by the different flag administrations to grant the type approval for the BWMS, shall be complied with and verified by DNV GL. National accreditation or any other accreditation is not considered to be equivalent to the requirements of this programme.

8.1.3 Scope for approval as independent lab for the United States coast guard

This section deals with test facilities engaged in testing of BWMS as sub-contractors to DNV GL acting as independent lab (IL) for the United States coast guard (USCG). In order to be considered as a sub-contractor to DNV GL acting as IL for the USCG, test facilities shall comply with the following:

- Tests shall be conducted following the USCG 46 CFR 162.060 and/or the US environmental protection Agency's environmental technology verification program document *Generic protocol for the verification of ballast water treatment technologies* November 2010 – hereafter referred to as ETV protocol.
- Be approved by DNV GL following the criteria established in this programme.
- Be approved by the USCG as sub-contractors to DNV GL.

Approval according to this programme is a prerequisite for DNV GL to engage in a frame agreement with test facilities when DNV GL is acting as an IL for the USCG.

8.2 Test facility requirements

8.2.1 General

A certificate of approval will be awarded and maintained on the basis of compliance with the requirements given in [\[8.2.3\]](#) to [\[8.2.5\]](#). The test facility shall demonstrate that it has the competence and control needed to perform the tests required by:

- guidelines G8, and
- DNV GL class guideline [DNVGL-CG-0339](#), and/or
- USCG 46 CFR 162.060 and the ETV protocol.

The test facility is responsible for ensuring that the appropriate quality assurance and quality control procedures outlined in the documentation listed in [8.2.2] are implemented.

8.2.2 Documentation

The following documents shall be submitted:

- Valid ISO 17025 certificate.

8.2.3 Quality assurance system

The test facility shall be accredited to ISO 17025.

The accreditation body shall be a member of IAF/EA, and the scope of accreditation shall be relevant and clearly defined.

8.2.4 Sub-contractors

The test facility shall give information of agreements and arrangement if any parts of the services provided are sub-contracted. The information shall be included in the quality assurance project plan (QAPP) and the quality management plan (QMP) shall incorporate all sub-contractors.

The information shall include name, address, function and certification of the sub-contractor. The QAPP shall include in details what the sub-contractor will be responsible for and how proper transfer of authority will be assured.

Particular emphasis shall be given to quality management by the test facility in following-up of such subcontracts. Subcontractors providing anything other than subcontracted personnel or equipment shall also meet the requirements of section [8.2.2] to [8.2.5].

8.2.5 Reporting

A report shall be written for each test. The report shall be based on standard forms and is in addition to describing the work performed to give information of any deficiencies found on components, non-conformance detected and any replacements done of components.

The report shall also include information regarding the test design, methods of analysis and the results of these analyses.

The report shall be traceable to the order reference system.

8.3 Approval procedures

8.3.1 Application as sub-contractor to DNV GL acting as IL to the USCG

DNV GL can, based on request by the test facility, apply to the USCG to include the test facility in DNV GL's list of sub-contractors to DNV GL when acting as IL to the USCG.

Upon approval by the USCG, DNV GL and the test facility can sign a frame agreement allowing the test facility to conduct tests as a sub-contractor to DNV GL.

8.4 References

The following references are used or referred to in this programme:

- DNV GL rules for classification of ships, [DNVGL-RU-SHIP Pt.6 Ch.7 Sec.1](#)
- DNV GL class guideline [DNVGL-CG-0339](#)
- DNV GL type approval programme [DNVGL-CP-0209](#)
- IMO Res. MEPC.174(58) *Guidelines G8 of the ballast water management convention*
- IMO Res. MEPC.169(57) *Guidelines G9 of the ballast water management convention*
- USCG 46 CFR 162.060 – Ballast water management systems
- US environmental protection agency's environmental technology verification (ETV) Program document *Generic protocol for the verification of ballast water treatment technologies* November 2010.
- ISO 17025:2005 standard.

9 Service suppliers engaged in testing of ballast water management systems (land-based and shipboard testing)

9.1 Scope

9.1.1 Scope for class approval

Test facilities engaged in testing of ballast water management systems (BWMS) following DNV GL type approval programme [DNVGL-CP-0209](#), the results of which may form the basis for the surveyor's decisions, shall be approved by DNV GL following the criteria established in this programme.

9.1.2 Scope for statutory approval

Test facilities engaged in testing of BWMS following guidelines G8 of the ballast water management convention (BWM Convention), the results of which may form the basis for the surveyor's decisions, shall be approved by DNV GL following the criteria established in this programme, as well as relevant criteria given in guidelines G8 of the BWM convention (hereafter referred to as guidelines G8), where DNV GL is so authorized by the relevant flag administration.

Additional national accreditation, as may be required by the different flag administrations to grant the type approval for the BWMS, shall be complied with and verified by DNV GL. National accreditation or any other accreditation is not considered to be equivalent to the requirements of this programme.

9.1.3 Scope for approval as independent lab for the United States coast guard

This section deals with test facilities engaged in testing of BWMS as sub-contractors to DNV GL acting as independent lab (IL) for the United States coast guard (USCG). In order to be considered as a sub-contractor to DNV GL acting as IL for the USCG, test facilities shall comply with the following:

- Tests shall be conducted following the USCG 46 CFR 162.060 and/or the US environmental protection Agency's environmental technology verification program document *Generic protocol for the verification of ballast water treatment technologies* November 2010 – hereafter referred to as ETV protocol.
- Be approved by DNV GL following the criteria established in this programme.
- Be approved by the USCG as sub-contractors to DNV GL.

Approval according to this programme is a prerequisite for DNV GL to engage in a frame agreement with test facilities when DNV GL is acting as an IL for the USCG.

9.2 Test facility requirements

9.2.1 General

A certificate of approval will be awarded and maintained on the basis of compliance with the requirements given in [\[9.2.3\]](#) to [\[9.2.8\]](#). The test facility shall demonstrate that it has the competence and control needed to perform the tests required by:

- guidelines G8, and
- DNV GL type approval programme [DNVGL-CP-0209](#), and/or
- USCG 46 CFR 162.060 and the ETV protocol.

The test facility is responsible for ensuring that the appropriate quality assurance and quality control procedures outlined in the documentation listed in [\[9.2.2\]](#) are implemented.

9.2.2 Documentation

The following documents shall be submitted:

- Quality assurance project plan (QAPP) including standard operating procedures (SOP)
- Quality management plan (QMP)
- Environmental safety and health plan (ESH)

- Piping and instrumentation diagram of the test facility set-up
- Detailed sampling facilities and port arrangement and location
- General arrangement plan of the test facility set-up
- Equipment list of pumps, sensors and valves
- Test facility validation plan (see [9.3.3]).

9.2.3 Quality assurance system

9.2.3.1 Accreditation

The test facility shall be accredited to ISO 17025. If not available, compliance with the requirements of ISO 17025 shall be documented and audited by DNV GL.

9.2.3.2 Quality assurance project plan

The test facility shall have an approved quality assurance project plan (QAPP) for BWMS testing that is regularly reviewed and updated as defined in the facility's quality management plan (QMP).

The QAPP is a written document that provides a comprehensive overview of the test facility management, infrastructure, capabilities, test methodology, measurement and data collection systems, data management systems, and includes all relevant facility standard operating procedures (SOPs, typically included as appendices).

The QAPP shall be developed in accordance with ISO/IEC 17025.

9.2.3.3 Standard operating procedures

Standard operating procedures (SOPs) are work procedures following international standards where applicable and individual procedures containing description for an activity to be performed in exactly the same way independent of involved personnel.

The test facility shall have SOPs that include, as a minimum:

- challenge water preparation (biological parameters and physical/ chemical parameters)
- sampling volumes and sample handling
- analytical procedures
- handling of results.

9.2.3.4 Quality management plan

The test facility shall have an approved quality management plan (QMP) describing how it structures its quality system, the quality policies and procedures, areas of application, and roles, responsibilities, and authorities.

The QMP addresses the quality control management structure and policies of the test facility (including subcontractors and outside laboratories).

The QMP shall be developed in accordance with ISO/IEC 17025.

9.2.3.5 Environmental safety and health plan

The test facility shall have an environmental safety and health plan (ESH) that is regularly reviewed and updated.

9.2.4 Personnel

The test facility is responsible for ensuring that a sufficient number of qualified personnel are available to perform the tests required by the regulations described in [9.2]. The personnel shall all be employed or under contract to the test facility and shall meet, as a minimum the requirements listed in [9.2.4.1] to [9.2.4.3].

9.2.4.1 Positions

The staff responsible for the operations under testing shall consist of the following positions, as a minimum:

- on-site test director
- operations staff

- 1 QA/QC¹⁾ person
- 2 analysts for organisms $\geq 50 \mu\text{m}$ size class
- 2 analysts for organisms $\geq 10 - 50 \mu\text{m}$ size class
- 1 analyst for the $< 10 \mu\text{m}$
- 1 sample handling person.

¹⁾ QA/QC: Quality assurance/quality control.

It is acceptable if one key analyst is identified for multiple size classes, provided the number of qualified analysts during testing is consistent with the QAPP.

9.2.4.2 Qualifications

Personnel involved in testing shall have qualifications in the following disciplines, as a minimum:

- chemistry
- engineering
- biology/microbiology.

9.2.4.3 Training

The test facility is responsible for the qualification and training of its personnel to a recognized national, international or industry standard as applicable.

Records of qualifications and training shall be maintained.

9.2.4.4 Personnel records

The test facility shall keep records of the approved personnel responsible for testing. The record shall contain information on age, formal education, training and experience for the services for which they are approved.

9.2.5 Procedures, equipment and premises

9.2.5.1 Procedures

The test facility shall maintain a record of:

- Any issues associated in operation or maintenance of the equipment encountered during test operations, including any recorded data or operator observations associated with performance deviations or abnormal/unexpected operations.
- Consumables, spare parts etc. used for the BWMS during testing period.
- The commissioning process, indicating the equipment was correctly installed and safe to operate under its intended operating conditions, and that the designated laboratory representative has received appropriate instruction in operation and maintenance of the equipment.

The test facility shall have a procedure to monitor any potential chemical residuals that result from BWMS operation during testing.

The test facility ensures that the BWMS successfully alerts/alarms if its discharge exceeds prescribed levels as determined by vendor and/or environmental discharge standards and if any safety issues are encountered during operations.

9.2.5.2 Equipment

The test facility shall have adequate instrumentation to:

- Log engineering parameters of the operation of the BWMS during testing in order to validate and ensure that the data relevant for the tested BWMS are adequately reported.
- Log power consumption throughout test operations of the BWMS.
- Measure core parameters including temperature, salinity, TSS, POC, DOC, DO, pH and chlorophyll.
- Quantify and analyze samples of organisms in all of the required class sizes.

Calibration certificates and records of all equipment used for monitoring and measuring shall be available on site for inspection.

9.2.5.3 Premises

The test facility shall be outfitted with adequate piping, pumps, valves and calibrated gauges to be able to test a BWMS according to the requirements stipulated by the regulations described in [9.2].

The test facility shall be equipped with at least:

- Three (3) holding tanks, one for feed-water (in case augmentation of the challenge water is necessary) and the other two for holding untreated (control) ballast water and treated ballast water.
- Each of the holding tanks for untreated (control) and treated ballast water shall have a volume $\geq 200 \text{ m}^3$ and the possibility to hold water for a period of at least 24 hours.
- Sampling facilities and ports designed to be in compliance with guidelines G2 of the BWM convention and the ETV protocol.

9.2.6 Challenge water requirements

The test facility shall be able to consistently achieve the water quality conditions (temperature, salinity, organic and mineral matter) and biological conditions required by the regulations described in [9.2].

In the cases where injection of living organisms, sediments, and dissolved organics into challenge water is necessary, appropriate methods and procedures shall be described in the QAPP and relevant SOPs.

9.2.7 Sub-contractors

The test facility shall give information of agreements and arrangement if any parts of the services provided are sub-contracted. The information shall be included in the quality assurance project plan (QAPP) and the quality management plan (QMP) shall incorporate all sub-contractors.

The information shall include name, address, function and certification of the sub-contractor. The QAPP shall include in details what the sub-contractor will be responsible for and how proper transfer of authority will be assured.

Particular emphasis shall be given to quality management by the test facility in following-up of such subcontracts. Subcontractors providing anything other than subcontracted personnel or equipment shall also meet the requirements of section [9.2.2] to [9.2.8].

9.2.8 Reporting

A report shall be written for each test. The report shall be based on standard forms and is in addition to describing the work performed to give information of any deficiencies found on components, non-conformance detected and any replacements done of components.

The report shall also include information regarding the test design, methods of analysis and the results of these analyses.

The report shall be traceable to the order reference system and shall include a copy of the certificate of approval.

9.3 Approval procedures

9.3.1 Application and approval

The test facility intending to receive a certificate of approval based on this programme shall submit an application together with the documentation listed in [9.2.2].

Submitted documentation will be approved or reviewed, as applicable, for compliance with the requirements listed in this programme, guidelines G8 and when applicable the USCG 46 CFR 162.060 and the ETV protocol.

Test facility validation, as detailed in [9.3.3], shall be conducted as part of the initial and renewal audit, or as otherwise required in [9.3.3].

An initial audit as detailed in [9.3.2] can only be conducted after the approval process is finalized.

9.3.2 Initial audit

The surveyor will carry out an audit of the test facility once all documentation and information received from the test facility has been evaluated.

Additionally, certification as detailed in [9.3.6] is conditional on a practical demonstration of at least one BWMS test as well as satisfactory reporting being carried out.

9.3.3 Test facility validation

As part of the initial audit and the renewal audit, the test facility will conduct validation tests to confirm that the methods, procedures, equipment and personnel conducting the tests can deliver consistent results and that the methods used are fit for their intended purpose.

9.3.3.1 Validation of equipment and test set-up

The intention of this validation test is to document, through experimental data, that there are minimal or no differences between the following measurements for control and treatment samples upon water uptake and discharge, when no treatment system is used:

- temperature
- salinity
- total suspended solids
- particulate organic matter
- dissolved organic matter
- dissolved oxygen
- pH
- live and dead organisms for the three different sizes: $\geq 50 \mu\text{m}$, $\geq 10 \mu\text{m}$ and $< 50 \mu\text{m}$, $< 10 \mu\text{m}$
- the $< 10 \mu\text{m}$ is only applicable for test facilities intending to work as sub-contractor for DNV GL when acting as IL for the USCG.

Where piping is shared between treatment and control lines, procedures for cleaning the pipes can be demonstrated. Alternatively, test sequence showing that control water is pumped prior to treated water upon uptake, and treated water is pumped prior to control water upon discharge can be accepted by DNV GL.

9.3.3.2 Validation of the sampling and analysis methods

The test facility shall verify that the chosen sampling design, geometry and installation result in representative samples and that organism mortality as a result of sample acquisition is minimized.

If only a sub-sample of the sampling volumes required by guidelines G8 or ETV protocol are analysed, then the test facility shall apply procedures for estimating uncertainty of measurement. Internal data or reference to published data will be accepted as equivalent to the estimation of uncertainty of measurement.

9.3.4 Application as sub-contractor to DNV GL acting as IL to the USCG

After finalization of the process described in [9.3.1] to [9.3.3] and DNV GL has issued a certificate of approval, DNV GL can, based on request by the test facility, apply to the USCG to include the test facility in DNV GL's list of sub-contractors to DNV GL when acting as IL to the USCG.

Upon approval by the USCG, DNV GL and the test facility can sign a frame agreement allowing the test facility to conduct tests as a sub-contractor to DNV.

9.3.5 Renewal audit

Renewal or endorsement of the certificate of approval shall be made at intervals not exceeding three (3) years. Verification shall be through audits confirming that approved condition is being maintained. Intermediate audits may be required if found necessary by DNV GL. At least three months before the period of validity expires, the test facility shall apply to DNV GL for renewal of the certificate of approval.

9.3.6 Certification

If the submitted documentation and the surveyor's audit and the practical demonstration are found satisfactory then the test facility will receive a certificate of approval.

9.4 Cancellation of the certificate of approval

DNV GL reserves the right to cancel the certificate of approval in the following cases:

- where the service was improperly carried out or results were improperly reported
- where a surveyor finds deficiencies on site compared to approved documentation and appropriate corrective action is not taken within the time limit specified by the surveyor
- where the test facility fails to inform of any alteration
- where intermediate audit, if requested and as described in [9.3.5], has not been carried out
- where willful acts or omissions are ascertained
- where the USCG has withdrawn their approval of the test facility as sub-contractor to DNV GL
- where a national authority has withdrawn their approval of the test facility.

A test facility who has had the certificate of approval cancelled may apply for re-approval after a period of six (6) months. Re-approval is not allowed if the cancellation was based on a grave fault, such as a violation of ethics.

9.5 References

The following references are used or referred to in this programme:

- DNV GL rules for classification of ships, [DNVGL-RU-SHIP Pt.6 Ch.7 Sec.1](#)
- DNV GL class guideline [DNVGL-CG-0339](#)
- Guidelines G8 of the ballast water management convention
- Guidelines G9 of the ballast water management convention
- USCG 46 CFR 162.060 – ballast water management systems
- US Environmental protection agency's environmental technology verification (ETV) program document "*Generic protocol for the verification of ballast water treatment technologies*" November 2010
- ISO/IEC 17025:2005 standard.

10 Laboratories engaged in mechanical and analytical testing

10.1 Introduction

10.1.1 Objective

The objective of this class programme (CP) is to give a description of the Society's approval scheme for laboratories for mechanical and analytical testing.

A service supplier will have to fulfill both the service specific requirements below and the general requirements in Section 1 of this document.

Aim of the assessment of testing laboratories is the verification of the personnel competency related to the scope of the certification. Furthermore, it is intended to ensure that an effective and sufficient quality management system exists.

DNV GL acceptance of test laboratories does not preclude witnessing, survey or inspections where this is required by any rules or contract partner.

Guidance note:

This class programme is not applicable for obtaining EU marine equipment directive (MED) certificates. Visit www.dnvgl.com for information on MED certification.

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10.1.2 Scope

This CP gives a description of the procedures and requirements related to documentation and inspection applicable for approval of *laboratories for mechanical and analytical testing*.

DNV GL acceptance of a testing laboratory is an independent approval system based on assessment of documentation and on-site inspection. Basis for this service is the international standard ISO 17025, the application form AoSS 123 and all supplements provided by the Society.

10.1.3 Application

The procedures and requirements described in this CP are applicable for obtaining approval in accordance with the 's rules and standards.

Note that this is a general program. Wherever specific programs are given for certain laboratories or products, the special programs apply. Examples of other laboratory approval programs are:

- [DNVGL-CP-0277](#) *Laboratories engaged in testing of protective coating systems.*
- [DNVGL-CP-0433](#) *Laboratories engaged in corrosion testing of corrosion resistant steels.*

10.2 Acceptance procedure

10.2.1 Application for acceptance

The application form shall be filled in by the testing laboratory shall be submitted to the together with all documents required in this form.

10.2.2 Inspection

The inspection of procedures, premises and equipment, the checking of documents, management and quality systems shall be conducted by the Society's representative with sufficient competency and experience in the field of testing related to the scope of certification.

10.2.3 Documentation

All the documents required and necessary for the assessment of documentation (see Form AoM 123) should be submitted to the auditor before the on-site inspection. If any serious divergences are already detected within the assessment of documentation, the laboratory will be informed in advance of appraisal. An appointment for the on-site inspection will be arranged during initial audits, only if the assessment of documentation revealed that no significant differences exist, which are not opposed the Society's acceptance.

10.2.4 Audit

The time frame of inspection is based on the extent applied for recognized testing methods and for scope approved employees involved. The minimum duration of on-site inspection is 12 working hours. One-day inspections are only possible in substantiated exceptional cases.

10.2.4.1 Steps of audit

- introductory discussion
- the introductory discussion involves the following points:
 - a) introduction of participants
 - b) introduction to the structure of the organization according to the currently valid organization chart
 - c) confirmation that the applied scope of acceptance is still up-to-date and has not to be adapted
 - d) confirmation of confidentiality. For this a declaration of independence has to be submitted to the auditor
- verification of the requirements to the organization and management as well as the technical requirements
- final discussion
- during the inspection of the testing laboratory the comparison shall be made with the processes, activities and responsibilities associated with the practical implementation, which are described in the submitted documentation.

10.2.4.2 Audit participants

- head of laboratory
- quality management representative (QMR) of the testing laboratory
- responsible employees of the testing laboratory

- auditor (the Society's representative).

10.2.4.3 Audit results

A final discussion will be conducted with the head of laboratory at the end of the audit. The final discussion includes:

- information about the overall impression of the testing laboratory
- information about the ascertained defects or deviations
- definition of the corrective actions. The actions have to be confirmed by the head of laboratory and the auditor. Dates until the corrective actions are finished have to be agreed
- resolve open questions/issues.

10.2.4.4 Corrective actions

The testing laboratory shall send the documentation for implementation of corrective actions to the auditor until the agreed due date. If required, a new on-site inspection shall be carried out.

10.2.4.5 Audit report

The auditor will issue an audit report about the area inspected by him, after on-site audit. One copy will be filed by the Society, and the original will be submitted to the testing laboratory.

10.2.4.6 Acceptance as testing laboratory

The auditor makes a recommendation for acceptance or refusal by the in his audit report, and/or with restriction. The acceptance usually applies for a period of three years. In case of acceptance by the , a certificate is issued in the name of the testing laboratory and will be sent to the testing laboratory. Furthermore, part of the certificate is an appendix, containing all the accepted test methods.

10.2.4.7 Maintenance

In order to maintain the acceptance as testing laboratory, a periodic review (hereafter called interim audit) is required and will be carried out by the Society's surveyor. The cycle will be specified during the audit based on the audit results and/or e.g. round robin tests etc. The cycle shall not exceed 18 month.

10.2.4.8 Renewal

A re-certification is possible after expiry of the period of validity. The extent of the renewal process corresponds roughly to the first certification with the task of reviewing compliance with this approval programme. Re-certification is based on the latest issue of the class programme. In the context of the re-certification audit, the cycle of the interim audit is redefined and the testing laboratory will be informed. The procedure for renewed acceptance begins with sending of a written request by the testing laboratory. The re-audit should take place in time and before the validity end date, for ensuring a complete connection to the expired approval.

10.2.4.9 Extension of scope of acceptance

In principle, it is possible to extend or restrict the scope of the certification. In principle, the same requirements apply, which were already specified in the class programme.

10.2.4.10 Non-standardized test methods

The acceptance of testing methods is possible, which has been developed by the testing laboratory and not described in the normative documents. It is also required to validating the procedure adequately and describing in the testing instruction the procedure extensively stating the intended application, the determining parameters and all required information in order to ensure the correct execution.

10.2.4.11 Sub-contractors

The testing laboratory shall give information of agreements and arrangements if any parts of the services provided are subcontracted. Particular emphasis shall be given to quality management by the laboratory in the follow-up of such subcontracts. Subcontractors providing anything other than subcontracted personnel or test equipment shall also meet the requirements of this programme.

10.3 Audit of the testing laboratory

10.3.1 Review of documentation

All relevant documents and records shall be presented by testing laboratory to the auditor for review.

10.3.2 Issues to be handled during the audit

- In general, deviations between actual state of the laboratory and the submitted documentation.
- The laboratory shall demonstrate and document that the head of the laboratory and its employees have a sufficient qualifications. A systematic approach shall be in place. ensuring that training needs are evaluated and that appropriate measures are taken.
- A matrix shall be submitted, indicating the responsibilities and reporting lines of all employees:
- Proper execution of the testing methods shall be demonstrated
- The suitability of the locations and the equipment for the testing methods. The conformity between submitted documentation of locations and actual locations shall be demonstrated, e.g. with the documents submitted regarding the floor plan and the location laid down therein. The laboratory shall in general be in a clean, tidy and for testing methods appropriate state.
- Control of documents and records. The laboratory's approval process of the existing documents shall be clearly regulated. All documents shall be labelled with an unique document number and the current revision status. Systematic approach shall be in place to ensure that all employees in the laboratory is duly and timely informed about changes in documents and procedures, i.e. where they are affected by these changes. For the standards and specifications used a systematic approach shall be in place which ensures that they are current and always up-to-date (latest revision), and that no invalid standards, specifications, inspection/work instructions etc. are in circulation.

Note:

More and more frequently, the use of printed documents in testing laboratories is waived and instead uses exclusively electronic documents. For the case where electronic documents are applied exclusively, it should be noted that the electronic documents shall be protected against unauthorized modifications, and all printed documents are labelled with an endorsement "uncontrolled copy".

- Demonstration of representative testing methods. The auditor will make a selection of testing methods based on the requested scope of certification, which shall be demonstrated during to the auditor during the audit. The laboratory may request information in advance for which test methods to be demonstrated. The laboratory shall demonstrate that the staff has the ability and competence to perform the test methods professionally and standardised. The laboratory shall ensure that appropriate test specimens are available.
- Calibration status of the testing equipment and devices shall be valid. Calibration with validity time more than one year will normally not be accepted. The laboratory shall have a systematic approach in place to ensure that calibration will not expire, and that no improperly calibrated testing equipment are used. The laboratory shall have assigned the responsibility of keeping calibrations up to date to one or more employees. The responsibility includes ensuring that all the testing equipment and devices have a unique identification (inventory number) and are equipped with a calibration status tag, if possible. Regular calibration of all the testing equipment and devices shall be recorded by the laboratory. If the testing laboratory performs their own calibration, it shall be ensured that the measurement standards used are connected directly to recognised standards. Furthermore, work instructions shall be available for all calibration processes. All calibrations shall be documented. If testing equipment and devices are in circulation, which are not calibrated, they shall be clearly identified as such and should be exclusively used for subordinate measurements.
- The participation in proficiency testing as well as its evaluation and documentation: The testing laboratory should develop a procedure for ensuring test results, which is suitable to monitor the quality of testing methods at regular intervals. This can be achieved e.g. by regular participation in round robin tests. An evaluation with identifying the consequences drawn shall be submitted to the auditor.
- Existence of clear sample labelling and identification systems: The testing laboratory shall have and demonstrate a procedure, ensuring that each individual test specimen is tagged with an unique identification number for excluding confusion between individual test specimens and ensuring a complete

traceability. In cases where the test specimens are too small or otherwise inappropriate for labelling accordingly, an acceptable replacement procedure shall be specified.

- Internal quality assurance measures for the individual testing methods and all other processes, which are necessary for ensuring a smooth processing: Internal audits should be carried out at regular intervals to prove that all the processes still meet the requirements for quality management system. The audit should also be used to ensure, the audit activities correspond with the latest state of standardization and for identifying possibilities for improvement. The planning and conduct of the audits should be the responsibility of QMB. Representative audit reports shall be documented and presented to the surveyor.
- Existence of test and work instructions: For all testing methods to be recognised by the, a work/job/inspection instruction shall be available. The instruction shall describe an exact procedure, for example, for calibrations, sample preparation, maintenance and care of testing machines. It shall be demonstrated that inspection and work instructions are always up-to-date, contain an unique document number, are subject to an approval process and are accessible to all relevant employees.
- Content and structure of test reports: A test report shall be prepared for all tests to be recognised by the Society. Each test report should have a cover sheet, which contain the following information:
 - a) title
 - b) test report number for enabling a clear identification
 - c) name and address of testing laboratory
 - d) name and address of customer
 - e) an indication that the testing laboratory is recognised by DNV GL
Furthermore, a test report should contain the following information:
 - f) a pagination with indication of total number of pages
 - g) indication of the test report number on each page for allowing an allocation for each test report
 - h) indication of the procedures used. Possibly, the hints from the norm text regarding the test report shall be observed
 - i) deviations from standardized test methods
 - j) a detailed description of the tested material or received test specimens. Where possible, a description of the preparation process for test specimens shall be specified
 - k) testing conditions
 - l) the test results, where appropriate and possible, expressing the individual results, average values, standard deviation, measurements of test specimens, number of test specimen verified, graphical presentation of the test results
 - m) information required from the customer
 - n) date of the test
 - o) names and signatures of the persons which create a test report as well as the person which has released the test report
 - p) whether additional requirements are fulfilled, for example, official regulations (see page 123 IMO PSPC).

10.4 Alteration

In case where any alteration to the certified service operation system of the testing laboratory is made, then such alteration shall be reported immediately to the Society.

In such cases re-audit may be required as and when deemed necessary by the Society.

10.5 Cancellation and re-approval

DNV GL reserves the right to cancel the approval of acceptance in the following cases:

- where the service was improperly carried out or results were improperly reported
- where a surveyor finds deficiencies in the approved service operative system of the supplier and appropriate corrective action is not taken

- where the supplier fails to inform the of any alteration made, as given in [1]
- where it as has not been possible to carry out random audit, when requested as described in [3]
- where wilful acts or omissions are ascertained
- or when the Society otherwise finds it justified.

The Society reserves the right to inform interested parties on cancellation of the acceptance of approval.

A testing laboratory who has had the acceptance of approval cancelled may apply for re-approval after a period of six (6) months. Application for re-approval may be refused if the cancellation was based on a grave fault, such as a violation of ethics.

11 Laboratories engaged in corrosion testing of corrosion resistant steels

11.1 Introduction

11.1.1 Objective

The objective of approval according to this approval programme is to ensure that the supplier is using appropriate procedures and test facilities, has qualified and certified personnel and has implemented written procedures for training, performance, testing, control, verification and reporting.

11.1.2 Scope

Corrosion resistant steels (CRS) to be applied in cargo oil tanks of crude oil tankers, in accordance with IMO resolution MSC.289(87), shall be pre-qualified by a third party.

As per the following document:

- IACS UI SC 258, for application of SOLAS regulation 3-1, Part A1, Chapter II-1 of the SOLAS convention (corrosion protection of cargo oil tanks of crude oil tankers), adopted by resolution MSC.289(87) The performance standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers.

The test laboratories shall be recognized by the Society and approved in accordance with this class programme.

Guidance note:

- 1) Approval is not needed for the testing laboratory where a surveyor from the Society **is** present at specified stages to witness the approval tests.
- 2) approval is needed for the testing laboratory where a surveyor from the Society **is not** present at specified stages to witness the approval tests.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

The approval may be given to both a recognized test laboratory, independent of the steel manufacturer and the steel manufacturer's own laboratory.

In the following, such laboratories are also referred to as the supplier.

11.1.3 Extent of engagement

The approval programme defines the procedures required in obtaining the Society's approval carrying out the laboratory tests in accordance with IMO resolution:

- MSC.289(87), Annex 3, Appendix – and further interpreted in IACS UI SC 258.

This approval programme is in agreement with requirements stated in IACS UR Z17, as amended. The specific requirements to laboratories are given in Annex 1, Section 13 of IACS UR Z17.

11.2 Requirements to suppliers

The general requirements related to approval of service suppliers as outlined in class programme DNVGL-CP-0484 apply to this programme.

A certificate of approval will be awarded and maintained on the basis of compliance with [2] through [11].

11.2.1 Submission of documents

The following documents shall be submitted for review:

- an outline of the supplier's organization and management structure, including subsidiaries, if any
- list of operators/technicians/inspectors documenting training and experience within the relevant service area, and qualifications according to recognized national, international or industry standards, as relevant
- list of nominated agents, if any
- quality manual and/or documented procedures covering requirements in the IMO resolution MSC.289(87)
- a detailed list, including description, of the laboratory test equipment for the IMO resolution MSC.289(87)
- a guide for operators of such equipment
- a detailed list of reference documents comprising a minimum those referred to in IMO resolution MSC.289(87) that are available in the laboratory
- details of testing panel preparation, procedure of test panel identification, test procedures and sample test report(s)
- details of exposure method and site for weathering primed test panels
- a sample daily or weekly log/form for recording test condition and observations including unforeseen interruption of the exposure cycle with corrective actions
- experience of the supplier in the specific service area
- details of any sub-contracting agreements, e.g. related to preparation of test samples
- certificates of approval by other bodies, if any
- information on other activities which may present a conflict of interest
- list and documentation of licences granted by equipment's manufacturer, if any
- comparison test report with an approved corrosion resistant steel, if available, or detailed template of test report
- copy of any relevant certificates with their issue number and/or date, such as ISO 17025 and/or ISO 9001 certificates.

11.2.2 Reference documents

The supplier shall have access to:

- IMO resolution MSC.289(87), IMO performance standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers (IMO PS-COT), adopted on 14th May 2010.
- IACS UI SC 258, for application of SOLAS Regulation 3-1, Part A1, Chapter II-1 of the SOLAS convention (corrosion protection of cargo oil tanks of crude oil tankers), adopted by Resolution MSC.289(87) The performance standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers.
- IACS UR W30, normal and higher strength corrosion resistant steels for cargo oil tanks, February 2013 and as later amended.

11.2.3 Extent of approval

The supplier shall demonstrate, as required in [11.2.4] to [11.2.10], that it has the competence and control needed to perform the specified services. A practical demonstration may further be required, if deemed to be necessary.

11.2.4 Equipment

The supplier shall have the test equipment and facilities required for correctly performing the tests as per the IMO resolution;

- MSC.289(87), Annex 3, Appendix.

A record of the equipment and software used shall be kept. The record shall contain information on manufacturer and type of equipment, and a log of maintenance and calibrations. Software used in conjunction with the testing shall be fully described and verified.

11.2.5 Administrative procedures

The supplier shall have an order reference system where each engagement is traceable to when, who and where testing was carried out, including location of test records and reports.

11.2.6 Minimum required equipment and instruments

As given in, and/or necessary to carry out the testing specified in, the IMO resolution:

- MSC.289(87), Annex 3, Appendix.

11.2.7 Work procedures and instructions

The supplier shall have documented procedures, instructions and checklists for how to carry out testing and reporting. Procedures and instructions for operating of each item of the testing equipment shall also be kept and be available at all time.

11.2.8 Verification

The supplier shall have a system for verifying that the services provided are carried out in accordance with approved procedures. Performed verification shall be documented.

11.2.9 Sub-contractors

The supplier shall give information of agreements and arrangements if any parts of the services provided are subcontracted. Particular emphasis shall be given to quality management by the supplier in the following-up of such subcontracts. Subcontractors providing anything other than subcontracted personnel or test equipment shall also meet the requirements of [2] through [11] of this class programme.

11.2.10 Reporting

All test records shall be properly documented and retained in such a way that the performed testing can easily be re-traced later. The report shall identify extent and location of testing performed and a conclusive statement as to whether the test results satisfy the acceptance criteria or not.

The test report shall include references to relevant documents, as a minimum as referred to in [3].

In addition, and as a minimum, the following information shall be given:

- name, address and other contact information of the supplier
- contract requirements, e.g. order number, reference documents, specifications, special agreements etc.
- judgment and conclusion of test results
- place and date of sample preparation and testing
- environmental conditions
- test equipment used
- list of relevant standards
- name and signature of the person preparing the test samples
- name and signature of the person performing the tests
- name and signature of the person issuing the test report
- name and signature of the supervisor verifying the report.

The supplier shall file one copy of the test report, and the test report shall be traceable to the order reference system. Also reports for testing that have failed shall be reported and filed in accordance with above.

11.3 Certificate of approval

11.3.1 Approval of the supplier

If the submitted documentation and the surveyor's audit and the practical demonstration are all found satisfactory to the Society, the supplier will receive a certificate of approval. The certificate of approval will be published on DNV GL's approval finder (<https://approvalfinder.dnvgl.com/>).

11.3.2 Scope of the approval

The approval will be specific as to the types of testing for which approval is sought, i.e. in accordance with IMO resolution:

- MSC.289(87), Annex 3, Appendix.

The approval may be given to both a recognized test laboratory, independent of the steel manufacturer and the steel manufacturer's own laboratory.

When actual testing performed at the steel manufacturer's own laboratory, forming basis for test reports used to seek class approval from DNV GL, is carried out, the DNV GL surveyor shall be called in for witnessing milestones, which may typically be:

- witnessing of steel making process/steel cutting
- witnessing of welding
- witnessing during testing
- witnessing evaluation of test.

11.3.3 Change to scope of the approval

In case of changes to the scope of approval, e.g. additions to the applicable welding consumables, the effects of these changes shall be subjected to corrosion resistance tests for the welded joints specified in:

- MSC.289(87), Annex 3, Appendix.

11.4 References

- IMO Resolution MSC.289(87), IMO performance standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers (IMO PS-COT), adopted on 14th May 2010.
- IACS UI SC 258, for application of SOLAS regulation 3-1, Part A1, Chapter II-1 of the SOLAS convention (corrosion protection of cargo oil tanks of crude oil tankers), adopted by resolution MSC.289(87) The performance standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers.
- IACS UR W30, normal and higher strength corrosion resistant steels for cargo oil tanks, February 2013 and as later amended.
- Current version of ISO 9001 series – quality management systems – requirements.
- DNV GL rules for classification of ships, [DNVGL-RU-SHIP Pt.2 Ch.2](#) (metallic materials).
- DNV GL rules for classification of ships, [DNVGL-RU-SHIP Pt.6 Ch.1 Sec.9](#) (coating).

12 Renewal survey examination of mooring chain intended for mobile offshore units

The content of this chapter is under development. The service specific requirements of the legacy rules shall be applied until the new version of this chapter is published.

13 Service suppliers engaged in noise, vibration and/or indoor climate measurements according to DNV GL's comfort class onboard ships

13.1 Objective

The objective of this programme is to ensure that the measurements and reporting of the results are carried out consistent and correct. This is done by qualifying suppliers to ensure that they have qualified personnel that in addition to the necessary knowledge of the measurement equipment and techniques, are also able to verify that the correct ship operating conditions are set up during the measurements.

13.2 Scope

The additional class notation **COMF(V-crn, C-crn)** is applicable to all ship types which comply with all the rule requirements to noise, vibrations and indoor climate.

13.3 Application

This programme is applicable to service suppliers engaged in performing noise, vibrations and/or indoor climate measurements for compliance with DNV GL's comfort class notations **COMF(V-crn)** and **COMF(C - crn)**. In the following such companies are referred to as the supplier.

13.4 Reference documents

The supplier shall have access to the following documents:

- relevant parts of the Society's rules and guidelines
- relevant international standards referred to in the Society's rules and guidelines
- IACS UR Z17
- SOLAS 1988, as amended (Reg.II-1/3-12)
- resolution A.468(XII) and IMO resolution MSC.337(91) code on noise levels on board ships
- resolution A.343(IX) recommendation on methods of measuring noise levels on board ships
- ISO 18436-2.

13.5 Procedure for approval and certification

The general procedure for approval and certification as given in IACS UR Z17 applies.

In addition, the additional requirements and clarifications as given in [13.5] to [13.8] applies. The service supplier may apply for an individual or combined approval for measurements of noise [13.6], vibrations [13.7] and indoor climate [13.8].

13.6 Submission of documents

The following documents shall be submitted for review in addition to the documents listed in IACS Z17 [5.1.1]:

- a typical measurement report or protocol, e.g. a report template or report from a previous measurement
- calibration certificates of the equipment to be used for the particular service for which the approval is sought
- calibration procedures for the equipment to be used for the particular service for which the approval is sought.

13.7 Noise measurements

13.7.1 Application

This programme is applicable to service suppliers engaged in sound pressure level measurements onboard ships in accordance with the class notation **COMF(V-crn)**. The service supplier may apply for a combined approval for measurements according to this programme and according to measurements of noise level on board ships in accordance with IMO Resolution MSC.337(91), see [App.A \[14\]](#).

The approval may also include field measurements of sound insulation and impact sound insulation according to ISO 140-4 and ISO 140-7.

13.7.2 Requirements

The requirements as given in IACS UR Z17 Annex I [14] applies.

13.7.3 Procedure and instructions

Before the measurements are carried out, a measurement procedure shall be submitted to the Society for approval. The measurements should be made according to this approved measurement procedure.

13.7.4 Reporting

A noise survey report in accordance with the approved measurement procedure, see [\[13.7.3\]](#) shall be made for each individual ship. The report shall comprise information about the ship operating condition(s) and the noise levels in the various spaces on board. The report shall show the reading at each specified point marked on a general arrangement plan, or on accommodation drawings attached to the report. A description of any deviations from the approved measurement procedure shall be included. Further requirements to the content of the report are given in [DNVGL-RU-SHIP Pt.6 Ch.8 Sec.1 \[2.2.6.1\]](#).

All measurement records shall be properly documented and kept in such a way that all results can be reviewed at a later stage.

13.7.5 Operators

The operator shall have adequate knowledge of the ship machinery and manoeuvring systems in order to verify that the vessel has the required operational condition(s) during the measurements.

At the discretion of the Society, the number of required on-the-job training jobs for operators may be reduced from the required five (5) as given in IACS Z17 Annex I [14.3]. The same applies for sound insulation and impact sound insulation if the approval shall include these. Where it is not possible to perform internal training by competent personnel, external training shall be provided by competent DNV GL personnel or a competent external party.

13.8 Vibration measurements

13.8.1 Extent of engagement

The mechanical vibration measurements are made with regards to the habitability on board ships.

13.8.2 Supervisor

The supervisor shall have a minimum of two (2) years of experience and more than five (5) measurement jobs as an operator in vibration measurements.

13.8.3 Operators

The operator shall have the following qualifications:

- Knowledge in the field of mechanical vibrations, vibration measurements with accelerometer and set up and handling of vibration measurement equipment. It is recommended that the operator holds minimum a Category I certificate in accordance with ISO 18436-2.
- Adequate knowledge of the applicable rules and international standards referred to in the rules.

- Adequate knowledge of the ship machinery and manoeuvring systems in order to verify that the vessel has the required operational condition(s) during the measurements.
- At least one (1) years' experience and shall have had minimum three (3) complete on-the-job training jobs of vibration measurements for comfort class **COMF(V-crn)**. Where it is not possible to perform internal training by competent personnel, external training shall be provided by competent DNV GL personnel or a competent external party.
- Be able to document theoretical and practical training onboard in using a portable vibration instrument.
- The operator shall be able to identify possible errors in the measurement results related to e.g. malfunctioning measurement equipment or non- ideal location of the sensor.

13.8.4 Equipment

Measurements of mechanical vibrations on the deck shall be carried out with a digital portable vibration instrument in accordance with the requirements given in ISO 6954:2000 and [DNVGL-RU-SHIP Pt.6 Ch.8 Sec.1 \[2.3.3.4\]](#) DNV GL rules. The measurements shall be analysed using FFT (fast fourier transform or more correctly named discrete fourier transform) and be possible to present in the frequency domain (frequency spectra) in addition to the overall velocity level frequency weighted according to ISO 6954:2000.

A record of equipment used for vibration measurements shall be kept. The records shall contain information on maintenance and calibration. Where the supplier hires equipment from external resources such equipment shall have available calibration records.

13.8.5 Procedure and instructions

The supplier shall have documented procedures and instructions to carry out service of the equipment.

Documented work procedures are at least to contain information on inspection preparation, selection and identification of vibration measurement locations, calibration checks and report preparation.

Before the measurements are carried out a measurement procedure shall be submitted to the Society for approval. The measurements should be made according to this approved measurement procedure.

13.8.6 Reporting

A vibration survey report shall be made for each individual ship. The report shall comprise information about the ship operating condition(s) and the vibration levels in the various spaces on board. The report shall show the reading at each specified point. The points shall be marked on a general arrangement plan, or on accommodation drawings attached to the report. Further requirements to the content of the report are given in [DNVGL-RU-SHIP Pt.6 Ch.8 Sec.1 \[2.3.4\]](#). A description of any deviations from the approved measurement procedures shall be included. Further requirements to the content of the report are given in the applicable DNV GL rules.

All measurement records shall be properly documented and kept in such a way that all results can be reviewed at a later stage.

13.8.7 Verification

The Society shall verify and sign all jobs/reports performed by the service supplier

13.9 Indoor climate measurements

13.9.1 Extent of engagement

This programme is applicable to service suppliers engaged in verification measurements of indoor climate parameters such as air temperature and air velocity inside the accommodation spaces on ships in accordance with the class notation **COMF(C-crn)**.

13.9.2 Supervisor

The supervisor shall have a minimum of two (2) years of experience and more than five (5) measurement jobs as an operator in indoor climate measurements.

13.9.3 Operators

The operator shall have the following qualifications:

- knowledge in the field of measurements of relevant climate parameters with temperature probes and air velocity measurement equipment
- adequate knowledge of the applicable rules and international standards referred to in the rules
- adequate knowledge of the ship HVAC systems in order to verify that the HVAC has the required operational condition during the measurements
- at least one (1) year experience and shall have had minimum two complete on-the-job training jobs of indoor climate measurements for comfort class
- be able to document theoretical and practical training onboard in using the instruments
- the operator shall be able to identify possible errors in the measurement results related to e.g. malfunctioning measurement equipment.

13.9.4 Equipment

Measurements of indoor climate parameters inside the accommodation spaces shall be carried out with a digital instruments in accordance with the requirements given in ISO 7726 and applicable DNV GL rules.

A record of equipment used for the measurements shall be kept. The records shall contain information on maintenance and calibration. Where the supplier hires equipment from external resources such equipment shall have available calibration records.

13.9.5 Procedure and instructions

The supplier shall have documented procedures and instructions to carry out service of the equipment.

Documented work procedures are at least to contain information on inspection preparation, selection and identification of vibration measurement locations, calibration checks and report preparation.

Before the measurements are carried out a measurement procedure shall be submitted to the Society for approval. The measurements should be made according to this approved measurement procedure.

13.9.6 Reporting

A climate survey report in accordance with the approved measurement procedure, see [13.8.5], shall be made for each individual ship. The report shall comprise information about the outdoor ambient temperature, the HVAC operating condition and the measured parameters in the various spaces on board. The report shall show the reading at each specified point marked on a general arrangement plan, or on accommodation drawings attached to the report. A description of any deviations from the approved measurement procedures shall be included. Further requirements to the content of the report are given in the applicable [DNVGL-RU-SHIP Pt.6 Ch.8 Sec.1 \[3.3.4\]](#).

All measurement records shall be properly documented and kept in such a way that all results can be reviewed at a later stage.

13.9.7 Verification

The Society shall verify and sign all jobs/reports performed by the service supplier

13.10 Validity

The approval will be valid for three (3) years. For cancellation of approval see IACS Z17 [8].

14 Service suppliers engaged in alignment of propulsion shafting and installation of rotating machinery

14.1 Introduction

14.1.1 Objectives

The objective of this programme is to set the specific requirements for approval of service suppliers (AoSS) engaged in shaft alignment measurements services. This include requirements to: appropriate written procedures, qualification and certification of personnel, fit-for purpose tools and equipment and

implementation of written procedures for training, performance, application, control, verification and reporting.

A service supplier will have to fulfill both the service specific requirements below and the general requirements in Section 1 of this document.

The objective of the approval of the firms is verification of the firm's processes and system related to the scope of the certification. evaluation of the personnel with regard to assigned responsibilities, adequacy of the tools and equipment furthermore, it is intend to ensured that an effective and sufficient quality management system exists.

DNV GL approval of alignment firms does not preclude class witnessing, survey or inspections where this is required by any rules or contract partner.

Guidance note:

The class program is a volunteer assessment and approval scheme, it does not state or limit the firm's obligations toward the Yard, ship owner or any other contracted party or statutory authorities.

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14.1.2 Scope

[14] provides procedures and requirements related to documentation and inspection applicable for approval of firms engaged in rotating machinery alignment and installation.

14.1.3 Application

The procedures and requirements described in this subsection are applicable for obtaining approval in accordance with DNV GL rules and standards.

This program is complemented with 5 modules which the firms may apply for one or more modules depending on the services provided by the firm.

14.2 Acceptance procedure

14.2.1 Approval request

The approval process starts with a written request from the firm. The request shall contain:

- the firm's location, postal address and contact details
- firm's official/legal name, identity or number
- the contact person's details
- summary of the company's services and the specified request for the approval modules.

14.2.2 Documentation:

Following documents shall be submitted for review:

- list of equipment and the calibration procedure, schedule and status
- qualification and recorded experience of operators and the process responsible persons
- process description for each module
- examples of measurement and calculation report.
- description and the records of technical personnel training.

14.2.3 Operators

Operators shall have sufficient training according to a defined training program providing knowledge about utilization of the tools, equipments and basic knowledge about the concept of alignment process.

14.2.3.1 Process responsible person

There shall be at least one responsible person, present on board, in charge of the alignment and measurement process with following qualifications:

- proved proficiency about the concept of the machinery alignment
- sufficient recorded experience about the alignment and installation process
- sufficient experience about utilization of equipment and the calibration procedures
- preferably experienced with alignment calculations and drafting reports
- familiar with relevant DNVGL requirements.

14.2.4 Inspection and audit

An initial assessment of the firm shall be carried out that may incorporate a physical inspection and audit in the firms premises.

Followings are to be verified during the inspection and audit:

- interview with the responsible and the process key personnel relevant to the services subject to approval
- verification and spot check of quality management documentation, (in case the firm holds ISO 9001:2015 Quality Management certificate from DNV GL this part can be waived)
- spot check of reports, equipments and the process as defined in the firms procedure documents
- below documents may be reviewed:
 - maintenance and calibration records of the equipment
 - record of the training and experience of the key personnel.

14.3 Process requirements

14.3.1 General requirements

- 1) The scope of alignment procedure for new building (hereby termed NB) installation is approved by DNV GL in advance, this shall form the basis of the alignment process.
- 2) The scope of alignment procedure for ships in service shall be pre-agreed with DNV GL on a case by case basis.
- 3) All influencing factors including environmental factors that may change the results of the measurements shall be identified and dealt with, e.g. turning gear is disengaged while performing jack load test or Crankshaft deflection.
- 4) All equipment shall be calibrated and documented according to the makers recommended intervals or on a yearly basis whichever comes earlier.

14.3.2 Module 1: Laser aided sighting:

Laser aided sighting method shall be used to verify or measure the orientation of the shafting line including the relevant position the bearings as detailed in the alignment calculations regulated by DNV GL.

In some cases (new building) the sighting is limited to the bearings in the stern tube or extended to the first temporary support in case of single bearing installations. For vessels in service, a laser alignment process to assess the tilt angle of the prime mover or the gear box may be required.

14.3.2.1 Reference line:

A reference line is defined in shaft alignment calculations to act as the baseline for the relative orientation of the shafting components, in particular the shaft line bearings. The most commonly used reference line is the centerline of the stern tube bore represented by the centerline of the aft and forward seal flanges. However if the reference line was taken differently in the original shaft alignment documents the firm shall follow the same reference.

14.3.2.2 Single slope/double sloped aft propeller shaft bearing:

The firm should have access to the original arrangement of the shafting and the bearing i.e. slope of the stern tube aft bearing and shall choose sufficient points along the bearing length in order to determine the

slope of the bearing. (Ref [DNVGL-RU-SHIP Pt.4 Ch.2 Sec.4](#) minimum 5 points in way of the aft bearing length, minimum of 3 points for each segment in a double sloped bearing and 3 points on the forward stern tube bearing). Measurement procedure shall observe the design features of design and production of the sloped bearings (i.e. aft slope of double slope bearings is normally machined in the bottom half only).

14.3.2.3 Offset:

In most of designs the inner centerline of bearings in stern tube has an offset with respect to outer diameter and will be evident in the laser readings. Offsets of other inboard bearings in the shaft line (2 measurement points in each) as well as the prime mover flywheel/gear box flange centerline also need to be measured where required by DNV GL.

14.3.2.4 Calibration and sighting of stern tube housing

The stern tube housing calibration measurement and sighting is required by DNVGL in case a bush is removed for repair. In case of class notation **"Shaft Align 1 or 2"**, [DNVGL-RU-SHIP Pt.6 Ch.2 Sec.10](#): Laser aided sighting of vertical and horizontal offsets of the stern tube housing in way of the bearings shall be submitted for review by the attending surveyor. A minimum of 5 reference points shall be used covering the aft most bearing housing and 3 reference points for the forward bearing housing. The laser reference line shall be made concentric with the stern tube and independent of the bearings. Spigots (recess) of aft and forward seal flanges are normally concentric with the stern tube bore unless machined at an offset for adjustment of seal tolerances.

14.3.2.5 Calibration of bearings and housings

- Inner diameter of the bearings and housing shall be measured in accordance with the scope defined in the rules and design.
- In addition to the dimensions, the readings shall also reflect the relevant aspects involved i.e. ovality etc.

14.3.3 Module 2: Jack load test:

Jack load tests may be required in cold and hot static conditions (ref alignment calculations/procedure and also when additionally deemed required by DNV GL). All probable and environmental influencing factors shall be identified and addressed (e.g. - turning gear disengagement).

Followings factors are to be observed for jack load test:

- the jack correction factors shall be included in the report
- the jack positions shall follow the pre-defined positions in the original shafting arrangement documentation.
- for the ship's in service when there is a risk of bent shaft the jack load measurements shall be measured in 4 shaft angles (i.e. 0°, 90°, 180° & 270 °)
- sufficient points shall be recorded to achieve a clear curve with knuckle point clearly defined and an accurate estimation of the actual load can be obtained.
- the attached example graph shall be used for reporting of the results of the jack load test.
- jacking up should be to the extent which the shaft reaches to the top bearing shell(i.e. lift the shaft to the full extent of the bearing clearance.
- load cells shall be utilized in case accurate readings and interpretations are not achieved by normal jacks hydraulic pressure readings.

14.3.4 Module 3: Gap and Sag measurements

Gap and sag measurements shall only be carried out by dial gauges or devices using equivalent principles (feeler gauges are not allowed).

The measurements shall be carried out to satisfy alignment calculations regulated in accordance with applicable DNV GL rules while also considering

The followings are to be observed and reflected in the report:

- the condition of the vessel (afloat, propeller immersion etc.)
- temporary supports are in place

- installation of engine, gearbox and intermediate bearing(s) are finalized or otherwise agreed with DNVGL surveyor.

14.3.5 Module 4: Fastening arrangement

- The foundation for propulsion, power generation and steering shall be approved by class before implementation.
- Resin casting compounds shall be type approved according to [DNVGL-CP-0432](#) *Pourable compounds for foundation chocking*.
- Resilient mounts shall be type approved according to [DNVGL-CP-0144](#) *Flexible mounts used for propulsion or auxiliary machinery*.
- Detailed procedures of the chock fastening process shall be included.

14.3.6 Module 5: Strain gauge measurements

Strain gauges can be utilized for verification of shaft alignment in static (using turning gear) and running condition, in both vertical and horizontal plane. In such cases the measurement program shall be submitted for approval. The strain gauge measurement is considered as a supplementary module for inboard alignment verification in addition to Jack load and Gap and Sag measurements.

14.3.7 Reporting:

In addition to the requirements mentioned under each module for reporting, the followings shall be observed:

- All machinery and environmental conditions e.g.
 - The measurement conditions where applicable shall be stated in the report i.e. :
 - vessel's temperature (hot, cold state)
 - engine condition (hot/cold with crankcase temperature)
 - on blocks (dry dock),
 - loaded, light ship or on ballast condition,
 - vessel's trim angle of listed,
 - propeller fully immersed, partially immersed
- The draft report should be presented to the attending surveyor.

14.4 Validity

The approval certificate remains valid for 3 years unless if any evidence proves that the firm fails to comply with class requirements.

The certificate can be renewed based on a renewal assessment.

APPENDIX C GUIDELINES FOR THE TECHNICAL INSPECTION OF RADIO INSTALLATIONS ONBOARD SHIPS FITTED FOR COMPLIANCE WITH GMDSS

1

The guidelines apply to cargo ships above 300 tons gross and to all passenger ships irrespective of size, dynamically supported crafts, and high speed and light craft (DNVGL-RU-HSLC).

Terms and definitions

DSC	digital selective calling
EPIRB	emergency position indicating radio beacon
EPIRB testing device	device designed for monitoring transmitted frequencies and the verification of correct coding of the float-free satellite EPIRBS
GMDSS	global maritime distress and safety system
MMSI	maritime mobile service identity
NAVTEX	system for reception of messages to seafarers related to safety at sea using NBDP
NBDP	narrow band direct printing (radio telex)
NICA	nickel-cadmium
NIFE	nickel-ferro
Scanning watch receiver	receiver continuously scanning dedicated frequencies used solely for safety purposes
SES	ship earth station

2 Introduction

The intention of the guidelines is to enable the radio inspectors contracted by DNV GL to carry out the radio inspections in a unified and correct manner on ships of any flag.

2.1 Performance of radio inspection

The technical radio inspection shall always be performed by a qualified radio inspector from an approved local radio inspection service supplier, hereafter referred to as radio inspector.

Radio inspection should be carried out using suitable test equipment capable of performing all the relevant measurements required by these guidelines.

2.2 Interpretations

The radio inspector may occasionally observe that compliance with GMDSS requirements are met in different ways. Therefore, in order to avoid any confusion that may arise, IMO has made a set of clarifications. Relevant IMO clarifications are added where appropriate, also referring to relevant regulation of the 1974 SOLAS convention as amended. DNV GL statutory interpretations for SOLAS IV, as amended, contains also useful information.

3 Documentation

3.1 Initial inspection

For the radio installations of cargo ships the examination of plans and designs should consist of:

- Examining the plans for the provision and positioning of the radio installation including sources of energy and antennas (SOLAS 74/88-II-1/43, IV/6 and 14).
- Examining the plans for the provision and positioning of the radio life-saving appliances (SOLAS 74/88III/6). For the radio installations, including radio life-saving appliances, of cargo ships the inspection during construction and after installation should consist of:
- Examining the position, physical and electromagnetic protection and illumination of each radio installation (SOLAS 74/88-IV/6).

Guidance note:

If public correspondence from the communication workstation might cause audible or visual interference to the navigator, such communication shall be performed from another place or room in the ship.

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- Confirming the provision of equipment for the radio installation with due regard to the declared sea areas in which the ship will trade and the declared means of maintaining availability of functional requirements (SOLAS 74/88-III/6, IV/7 to 11, 14 and 15).
- Confirming the ability to initiate the transmission of ship-to-shore distress alerts by at least two separate and independent means, each using a different radio communication service, from the position from which the ship is normally navigated (SOLAS 74/88-IV/4, 7 to 11).

3.2 Ships in service

Prior to the technical inspection, it shall be checked that the radio equipment fitted is in accordance with the information stated in Form R – record of equipment.

Identification of radio equipment and the result of the inspection shall be recorded in the relevant survey report forms CRC 629a and CRC 630a.

4 Antennae

4.1 Examining all antennae, including:

- visually checking all antennae, including INMARSAT antennas, and feeders for satisfactory siting and absence of defects (SOLAS 74/88-IV/14)
- checking insulation and safety of all antennae.

Guidance note:

- 1) check for protection against inadvertent touching by the ship's staff
- 2) check for possible mutual electrical interference:
 - vertical separation and safe distances with respect to transmitting and receiving antennae
 - free line of sight – INMARSAT antennae.

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5 Inspection of the reserve source of energy and automatic battery charger(s)

5.1 Reserve source of energy is a battery

- Checking its siting and installation (SOLAS 74/88-IV/13).

Guidance note:

Lead-acid accumulator batteries and NiCd batteries must not be located in the same battery compartment.

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- Where appropriate, checking its condition by specific gravity measurement or voltage measurement.

Guidance note:

- For lead accumulators specific gravity readings between 1.24 and 1.30 are acceptable. Readings below 1.24 indicates defective charger/ wrong setting on charger, or that the battery needs to be replaced. Variations in the specific gravity between the battery cells (variation in specific gravity of 0.03 or more) indicates a defective cell, and hence that the battery must be replaced.
- For alkali accumulators, including sealed accumulators, a voltage reading of 1.2 V per cell at maximum discharge current is acceptable.
- If there is doubt as to the condition of accumulators and whether the capacity requirement has been met, the accumulators must be replaced or alternatively undergo capacity testing.

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- With the battery off charge, and the maximum required radio installation load connected to the reserve source of energy, checking the battery voltage and discharge current.
- Checking there is sufficient capacity to operate the basic or duplicated equipment for 1 hour or 6 hours, as appropriate (SOLAS 74/88-IV/13), and:
- Checking that the charger(s) are capable of re-charging the reserve battery to the required capacity within 10 hours (SOLAS 74/88-IV/13).
- Inspecting mechanical condition of accumulators, connections, cables, fuse circuits etc.
- The battery compartment shall be inspected for mechanical defects and sufficient ventilation. Where outdoors wooden or composite battery compartments are used, the accumulator specifications regarding the ability to withstand extreme temperature variations to be checked.

5.2 Automatic chargers

Maintenance voltage for lead accumulators shall be 26.8 V, *boost* 28.8 V. When using NiCd accumulators, 28 V and 32 V, respectively.

5.3 General

The following items shall be checked:

- That dedicated AC and DC fuses/circuit breakers for both basic and duplicated GMDSS equipment are provided.
- That the main DC supply line from the radio battery is provided with fuses/circuit breaker – alternatively has been protected by separate and secured pipes.
- That the basic and duplicated GMDSS equipment are electrically separated. A 'line by line black-out test' should be carried out.

6 Inspection of maritime VHF

6.1 The examination should include

- Checking for operation on channels 6, 13 and 16 (SOLAS 74/88-IV/7 and 14).
- Frequency tolerance, transmission line quality and radio frequency power output (SOLAS 74/88-IV/14).
- For correct operation of all controls including priority of control units in conning positions (SOLAS 74/88-IV/14).
- The operation of the VHF control unit(s) or portable VHF equipment provided for navigational safety (SOLAS 74/88-III/6).
- For correct operation by on-air contact with a coast station or other ship.
- That the equipment operates from the main, emergency (if provided) and reserve sources of energy (SOLAS 74/88-IV/13).

6.2 VHF DSC controller

The examination should include:

- Performing an off-air check confirming the correct maritime mobile service identity is programmed in the equipment (SOLAS 74/88-IV/14).
- Checking for correct transmission/receiving by means of a routine or test call to a coast station, other ship, onboard duplicate equipment or special test equipment.
- Checking that the equipment is capable of automatically including the ship's position in the distress alert and that such data is provided from an external/internal GPS receiver (SOLAS Reg. IV/18).

6.3 VHF channel 70 DSC watch receiver

Clarification:

The requirement may be met by:

- a separate VHF channel 70 DSC watch receiver, or
- a dedicated VHF channel 70 DSC watch receiver combined with the VHF radiotelephone, or
- a standard VHF radiotelephone permanently locked on channel 70.

6.4 Power supply

Checking that the equipment operates from the main, emergency (if provided) and reserve sources of energy (SOLAS 74/88-IV/13). Tick off as appropriate.

6.5 Alarm

Checking the audibility of the VHF/DSC alarm.

7 MF or MF/HF radiotelephone equipment including DSC and NBDP

7.1 The examination should include

- Checking that the equipment operates from the main, emergency (if provided) and reserve sources of energy (SOLAS 74/88-IV/13).
- Checking the antenna tuning in all appropriate bands.
- Checking the equipment is within frequency tolerance on all appropriate bands (SOLAS 74/88-IV/14).

- Checking for correct operation by contact with a coast station and/or measuring transmission line quality and radio frequency output.
- Checking receiver performance by monitoring known stations on all appropriate bands.
If control units are provided outside the navigating bridge, checking the control unit on the bridge has first priority for the purpose of initiating distress alerts (SOLAS 74/88-IV/9, 10, 11 and 14).
- Checking that the equipment is capable of automatically including the ship's position in the distress alert and that such data is provided from an external/internal GPS receiver (SOLAS Reg. IV/18).

7.2 Examining the MF or MF/HF DSC controller(s), including

- checking that the equipment operates from the main, emergency (if provided) and reserve sources of energy (SOLAS 74/88-IV/13)
- confirming that the correct maritime mobile service identity is programmed in the equipment
- checking the off-air self test programme.
- checking operation by means of a test call on MF and/or HF to a coast radio station if the rules of the port permit the use of MF/HF transmissions (SOLAS 74/88-IV/9, 10 and 11)
- checking that the equipment is capable of automatically including the ship's position in the distress alert and that such data is provided from an external/internal GPS receiver (SOLAS Reg. IV/18).

7.3 Examining the MF or MF/HF DSC watch receiver(s), including

- confirming that only distress and safety DSC frequencies are being monitored (SOLAS 74/88-IV/9 to 12)
- checking that a continuous watch is being maintained whilst keying MF/HF radio transmitters (SOLAS 74/88 IV/12)
- checking for correct operation by means of a test call from a coast station or other ship.

Clarification:

This requirement can be met by:

- a separate MF/HF DSC scanning watch receiver for distress and safety DSC frequencies only, or
- a dedicated MF/HF DSC scanning watch receiver for distress and safety DSC frequencies only combined with the MF/HF radiotelephone
- if MF mode DSC only is required, a separate MF DSC watch receiver locked on 2187.5 KHz or a dedicated 2187.5 KHz watch receiver combined with the MF radiotelephone installation will suffice.

If DSC operation is desirable on other frequencies, an additional scanning receiver shall be provided.

7.4 Examining the MF/HF radiotelex equipment, including

- confirming that the correct selective calling number is programmed in the equipment
- checking correct operation by inspection of recent hard copy or by a test with a coast radio station (SOLAS 74/88 IV/10 and 11).

Guidance note:

A test of the telex may be performed by sending the telex message to the vessels INMARSAT-C installation (i.e. through the INMARSAT system).

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7.5 Power supply

Checking that the equipment operates from the main, emergency (if provided) and reserve sources of energy (SOLAS 74/88-IV/13). Tick off as appropriate.

7.6 MF or MF/HF DSC alarm

Checking the audibility of the MF or MF/HF DSC alarm.

8 INMARSAT ship earth station

8.1 INMARSAT ship earth station

Examining the INMARSAT ship earth station(s), including:

- Checking that the equipment operates from the main, emergency (if provided) and reserve sources of energy.

8.2 Examination of the distress function should include

- checking the distress function by means of an approved test procedure where possible (SOLAS 74/88-IV/10, 11, 12 and 14)
- checking for correct operation by inspection of recent hard copy or by link test.

8.3 Automatic position updating support

Checking that the equipment is capable of automatically including the ship's position in the distress alert and that such data is provided from an external/internal GPS receiver (SOLAS Reg. IV/18).

9 Float-free satellite EPIRB

9.1 Examining the 406 MHz satellite EPIRB (SOLAS 74/88 IV/7 and 14) or 1.6 GHz INMARSAT including

The items listed in form CRC 630a *Annual testing of 406 MHz EPIRBs* to be attended to, filled in, signed and left onboard for documentation. A copy to be given to DNV GL attending surveyor (follow annexed to the report form CRC 629a).

Guidance note:

If the float-free satellite EPIRB is used as the secondary means of alert (see record of equipment, form R) the EPIRB can be accepted if it is installed in the vicinity of the bridge, e.g. in the wings, on top of the wheelhouse, if accessible by stairs, or if its activation is possible by remote control from the position from which the ship is normally navigated.

Where intended for remote activation, the EPIRB should be installed so that it has unobstructed hemispherical line of sight to the satellites.

See also DNV GL statutory interpretations for SOLAS, as amended.

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10 Enhanced group call (EGC) receiver

10.1 Examining the EGC receiver should include

- checking for correct operation and area by monitoring incoming messages or by inspecting recent hard copy
- running the self-test programme if provided.

11 HF MSI with direct-printing (NBDP) receiver

If appropriate, examining the radio equipment for receipt of maritime safety information by HF NBDP (SOLAS 74/88 Rs.IV/7, 12 and 14) including:

- checking for correct operation by monitoring incoming messages or inspecting recent hard copy
- running the self-test programme if provided.

Guidance note:

The surveyor shall check that the MF/HF/DSC/NBDP equipment is capable of receiving MSI.

Refer to IMO "GMDSS MASTER PLAN" regarding HF MSI transmitting station's schedules and frequencies.

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12 NAVTEX receiver

If appropriate, examining the NAVTEX equipment (SOLAS 74/88-IV/7, 12 and 14) including:

- checking for correct operation by monitoring incoming messages or inspecting recent hard copy
- running the self-test programme if provided.

13 Two-way VHF radiotelephone apparatus

SOLAS III/6.2.1, IV/4

- 1) checking for correct operation on channel 16 and one other channel by testing with another fixed or portable VHF
- 2) checking the battery charging arrangement where rechargeable batteries are used

Guidance note:

Sealed batteries should normally be provided. If sealed batteries are not provided, documentation should be available so it may be verified that the equipment was installed prior to 1996-11-23. See also guidance note in CRC629a.

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- 3) checking expiry date of primary battery where used
- 4) checking outside markings; ship's name and call sign to be permanently fixed and clearly readable.

14 Radar transponders

(SOLAS 74/88, III/6, IV/7 and 14)

- 1) checking position, mounting and monitoring response on the ship's 9 GHz (x-band) radar. Manufacturer's test procedure to be followed
- 2) checking battery expiry date
- 3) checking outside markings, ship's name and call sign to be permanently fixed and clearly readable.

Guidance note:

One radar transponder shall be mounted in each free-fall life boat, if provided.

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15 Methods of maintenance

Check Flag info for special national requirements with regards to carriage of spare parts.

15.1 Test equipment

Examining the test equipment and spares carried to ensure carriage is adequate and in accordance with the sea areas in which the ship trades and the declared options for maintaining availability of the functional requirements (SOLAS 74/88-IV/15).

16 Handbooks and documentation

16.1 Examination of documentation

For the radio installations, including those used in life-saving appliances, the check that documentation, etc., has been placed on board should consist of:

- checking for a valid radio licence issued by the flag administration (ITU RR Art.18).

OBSERVE

Flag restrictions regarding the validity of the safety radio certificate in case of outdated radio license, please contact DNV GL surveyor for information and handling.

- checking the carriage of up-to-date ITU publications (ITU RR App.11).

Guidance note:

The required publications are:

- list of coast stations
- list of ship stations
- list of radio determination and special services stations
- list of call signs and numerical identities
- manual for use by the maritime mobile and maritime mobile-satellite services.

Regarding what editions are the latest, please refer to ITU list of coast stations (back cover), which lists the various publication dates.

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- checking the carriage of operating manuals for all equipment (SOLAS 74/88-IV/15)
- checking the carriage of service manuals for all equipment when at-sea maintenance is the declared option (SOLAS 74/88-IV/15).

16.2 Radio record

Checking the radio record (log) for correct entries (SOLAS 74/88-IV/17 and ITU RR App.11).

16.3 Radio operator's certificates

Checking the radio operator's certificates of competence (SOLAS 74/88-IV/16 and ITU RR Art.47).

OBSERVE

Flag restrictions regarding the validity of the radio certificate in cases where the holder does not possess GOC issued by the flag authorities, please contact DNV GL surveyor for information and handling.

17 Signs and labels

Checking that signs/labels indicating the ship's name, call sign, MMSI number and telex identification are permanently posted and is clearly readable for the operator using the relevant GMDSS equipment.

18 Special requirements for passenger vessels

This section applies to:

- all passenger ships
- HSLC, of which keels were laid (or at a similar stage of construction) on or after 2002-07-01.

The following shall be checked by the radio inspector:

- 1) Check that all two-way communication equipment capable of transmitting the ships position is continuously and automatically updated with the ships position from the ships navigation receiver (i.e. GPS).
- 2) Activation of the EPIRB to be possible from the conning position. This will require remote activation of the EPIRB, or alternatively the provision of two EPIRBs (as the EPIRB also shall be located where it may float freely, should the vessel sink).
- 3) If possible, verify that the distress panel and distress alarm panel are operating satisfactory.
- 4) Check that VHF operating on the aeronautical distress frequencies (121.5 MHz and 123.1 MHz FM) are operational and in good working order, and are available on the navigation bridge.
- 5) Verify that one of the officers onboard holding valid GOC is especially assigned to perform radio communication duties only during distress incidents.

APPENDIX D GUIDELINES FOR THE TECHNICAL INSPECTION OF AUTOMATIC IDENTIFICATION SYSTEM ONBOARD SHIPS FITTED FOR COMPLIANCE WITH SOLAS V

1

The guidelines apply to cargo ships above 300 GT engaged on international voyages, cargo ships above 500 GT not engaged on international voyages and all passenger ships irrespective of size, dynamically supported crafts, mobile offshore units and high speed light crafts (DNVGL-RU-HSLC).

Terms and definitions:

AIS = automatic identification system

UPS = uninterrupted power supply.

2 Introduction

The intention of the guidelines is to enable the AIS inspectors contracted by DNV GL to carry out the initial, annual and renewal AIS inspections in a unified and correct manner on ships of any flag.

2.1 Performance of AIS inspection

The technical AIS inspection shall always be performed by a qualified AIS inspector from an approved AIS inspection firm, hereafter referred to as AIS inspector (a list of DNV GL approved AIS inspection service suppliers can be on the DNV GL website: <https://approvalfinder.dnvgl.com>), who has adequate knowledge of the current SOLAS conventions and associated performance standard, and the latest radio regulations as appropriate.

AIS inspection should be carried out using suitable test equipment capable of performing all the relevant measurements required by these guidelines.

3 Documentation

For the AIS installation the examination of plans and designs should consist of:

- Antenna layout, initial configuration report, interconnection diagrams, provision of the pilot plug and power supply arrangements (SOLAS 74 as amended regulations II-1/4 and V/19; and SN/Circ.227).

4 Antennae

4.1 General installation requirements in SN/Circ.227

The AIS installation should generally comply with SN/Circ.227. The AIS inspector may occasionally observe that compliance with AIS antennae installation requirements as defined by SN/Circ.227 are difficult to meet (especially for ships in service). Hence:

- 1) For initial inspections: The AIS inspector shall check that the antennae installation is in accordance with the plans approved by DNV GL or flag.
- 2) For periodical and renewal inspections: If the antennae arrangement does not meet the installation requirements in SN/Circ.227 and if no evidence exists that either DNV GL or the flag have accepted/approved the installation then the AIS inspector shall evaluate the arrangement in order to conclude whether or not improvement can be achieved by rearranging the antennae installation and if such rearrangement is practical.

- 3) If, for any technical or practical reasons, it is not possible to comply with all antennae arrangement requirements in SN/Circ.227 then the AIS inspector shall find out which antennae may cause the greatest risk of interference with the AIS operation; and check the AIS performance towards a vessel traffic centre (VTC) or another ship station while those interfering antennae are transmitting. A test towards a VTC would be preferable.

4.2 Examining the AIS-VHF and AIS-GPS antennae, including:

- visually checking all antennae, and feeders for satisfactory siting and absence of defects
- checking insulation and safety of all antennae.

4.3 Inspection of the source of power

- checking that the AIS is supplied by the mains and emergency source of power
- checking that the AIS is also supplied by an UPS if IMO SN Circ.227 is made mandatory by the flag state.

Note:

AIS shall not be supplied by the radio batteries, unless stated otherwise by the flag.

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4.4 Functional testing

- checking the proper location of the AIS and provision of pilot plug near pilots operating position
- checking the correct programming of the ships static information (all static information)
- checking the ability of the AIS to receive ships dynamic information from the appropriate sensors
- checking the ability to correctly input the ships voyage related data
- carrying out a performance test of the equipment including radio frequency measurements, transmitting output, polling information, read data, send data and AIS response to *virtual vessels*, and
- carrying out an on-air test that the unit is working correctly using for example an appropriate vessel traffic service (VTS) station or a suitable test equipment.

CHANGES – HISTORIC

March 2018 edition

Changes March 2018

<i>Topic</i>	<i>Reference</i>	<i>Description</i>
Tightness testing of hatches and doors	App.A [2]	Inserted general reference to IACS UR Z17 in addition to requirements normally applied to the ultrasonic measurement equipment.
In-water survey of ships and mobile offshore units	App.A [3]	Inserted reference to IACS UR Z17 in addition to requirements to reporting.
Examination of Ro-Ro ships bow, stern, side and inner doors	App.A [8]	Inserted reference to IACS UR Z17 for requirements to approval of service suppliers.
Approval of service suppliers procedure for COMF measurements	App.B [13]	Added service for service suppliers engaged in noise, vibration and/or indoor climate measurements according to DNV GL's comfort class onboard ships.

July 2016 edition

Main changes July 2016

• Appendix A Special requirements for categories of service suppliers listed in IACS UR Z17

The following services have been added with additions and/or clarifications to IACS UR Z17:

- Thickness measurements on ships
- Inspection and maintenance of fire extinguishing equipment and systems
- Service of inflatable liferafts, inflatable lifejackets, hydrostatic release units, inflatable rescue boats, marine evacuation systems
- Inspection and testing of radio communication equipment and Automatic Identification Systems (AIS)
- Inspections and maintenance of self-contained breathing apparatus
- Annual performance testing of Voyage Data Recorders (VDR) and simplified Voyage Data Recorders (S-VDR)
- Inspection of low location lighting systems using photo luminescent materials and evacuation guidance systems used as an alternative to low-location lighting systems
- Sound pressure level measurements of public address and general alarm systems on board ships
- Testing of coating systems in accordance with IMO Resolution MSC.215(82) as amended and IACS UI SC223 and/or MSC.288(87) as amended
- Servicing and maintenance of lifeboats, launching appliances, on-load release gear and davit-launched liferaft automatic release hooks
- Measurements of noise level on board ships
- Tightness testing of primary and secondary barriers of gas carriers with membrane cargo containment systems for vessels in service

- Appendix B Special requirements for categories of service suppliers not listed in IACS UR Z17

The following services have been added:

- Service suppliers engaged in testing of navigational equipment and systems
- Service suppliers engaged in preparation of Inventory of Hazardous Materials (IHM)
- Service suppliers engaged in inspection and testing of centralised gas welding and cutting equipment
- Service suppliers engaged in Non-Destructive Testing (NDT) on classification projects
- Service suppliers firms engaged in condition monitoring of machinery on board ships and mobile offshore units
- Service suppliers engaged in resin casting of chock foundations, stern tubes, etc.
- Service suppliers engaged in testing of ballast water management systems (environmental testing)
- Service suppliers engaged in testing of ballast water management systems (land-based and shipboard testing)
- Laboratories engaged in mechanical and analytical testing
- Laboratories engaged in corrosion testing of corrosion resistant steels

- New

- Appendix C Guidelines for the technical inspection of radio installations onboard ships fitted for compliance with GMDSS
- Appendix D Guidelines for the technical inspection of automatic identification system onboard ships fitted for compliance with SOLAS V

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