Contents

RULES FOR APPROVAL OF MANUFACTURERS AND SERVICE SUPPLIERS

Part 1 GENERAL

Chapter 1 GENERAL

1.1 General

1 The "Rules for Approval of Manufacturers and Service Suppliers" (hereinafter referred to as the "Rules") applies to assessment and approval of a manufacturing works of ships, to be classed or have been classed, and of machinery, materials, etc. with which the ships are to be equipped (hereinafter referred to as the "products"), and also applies to a service supplier of a repairing service, a maintaining service, an inspecting service, a measuring service for the survey, etc. to the products.

2 Assessment and approval under the Rules are performed to confirm that a manufacturing works or a service supplier has enough capacity as follows.

(1) For a manufacturing works of products, it has enough capability to maintain such quality of its products as required by the **Rules for the Survey and Construction of Steel Ships**, and other rules of the Society.

(2) For a service supplier, it has enough capability to evaluate that the products have such quality as required by the **Rules for the Survey and Construction of Steel Ships**, and other rules of the Society.

3 Assessment and approval under the Rules apply to a manufacturing works for the specified products or a service supplier for the specified services.

4 Assessment and approval are made following an application from a manufacturer's or supplier's management. The forms to be used for such applications are **AM-TM(E)**, **AM-IW(E)**, **AM-TH(E)**, **AM-RC(E)**, **AM-VT(E)**, **AM-FE(E)**, **AM-LR(E)**, **AM-LA(E)**, **AM-ED(E)**, **AM-LM(E)**, **AM-RI(E)**, **AM-TT(E)**, **AM-CS(E)**, **AM-BW(E)**, **AM-NT(E)**, **AM-CT(E)**, **AM-HM(E)** and **AM-1E-R1**.

1.2 Definition of Terms

1 "Quality system" means a system under management in which the organizational structure, responsibilities, procedures, processes, personnel, etc. that a manufacturing works or a service supplier possesses are combined in an organic manner for the product or the service.

2 "Quality manual" means a document of procedures to perform and maintain a quality system.

3 "Manufacturer's or supplier's management" means a top management related to a quality system in a manufacturing works or a service supplier.

Chapter 2 ASSESSMENT

2.1 General

1 In case a manufacturer or a service supplier intends to obtain approval or maintain approval as a manufacturer or a service supplier under the Rules, the manufacturing works or the service supplier is to be assessed by the Society in accordance with the requirements of this Chapter.

2 In such assessment of a manufacturing works or a service supplier, an investigation on the quality system, production or service procedures, production or service facilities, operators, etc. and, an approval test or a demonstration where necessary, are carried out, and comprehensive evaluation is made.

2.2 Kinds of Assessment

The kinds of assessment is initial assessment, periodical surveillance, renewal assessment and occasional assessment.

2.3 Initial Assessments

1 In initial assessments, a manufacturing works or a service supplier will be assessed by the Society, based upon the results of a document examination and field examination as specified in the following:

2 Document examination

(1) For manufacturing works of products intended to be approved under the Rules, the following documents are to be submitted to the Society for examination to verify whether the quality system, etc. complies with the Rules.
  (a) Outline of the firms (location, history, capital, organization and management structure, number of employees, main products, standard production output, etc.) subject to approval
  (b) Manufacturing facilities (a summary of main manufacturing facilities and inspection equipment, outline of workshops and facilities for storing materials and parts, a list of orders to the subcontractors and the subcontracted products, etc.)
  (c) Outline of the products
  (d) Quality manual and its supplementary documents
  (e) Quality plan for each product
  (f) Any other data deemed necessary by the Society

(2) For service suppliers intended to be approved under the Rules, one copy each of the following documents is to be submitted to the Society for examination to verify whether the quality system, etc. complies with the Rules.
  (a) Outline of the firms (the location, history, capital, organization and management structure (including subsidiaries), number of employees, main services and their actual records, etc.) subject to approval
  (b) List of nominated agents, subsidiaries and subcontractors
  (c) Description of equipment and facilities used for the particular service for which approval is sought (measuring equipment, outline of workshops and facilities for storing materials and parts, a list of orders to the subcontractors, etc.)
  (d) For categories of service suppliers that require certification from manufacturers, manufacturer's documentary evidence that the service supplier has been certified or licensed to service the particular makes and models of equipment for which approval is sought are to be provided.
  (e) Outline (including description of service conditions or service regions) of the relevant service
  (f) Quality manual and its supplementary documents, or documented procedures (work procedures, verification procedures, recording and reporting procedures, training procedures, control procedures of measuring equipment, etc.) specified in **1.2.1 of Part 3**
  (g) List of operators/technicians/inspectors documenting name, qualifications, training and experience within the relevant service area, and training programmes for operators/technicians/inspectors

(h) Checklists of the relevant services and record formats submitted to the Society

(i) A guide for operators of the equipment needed to perform the service being provided

(j) Documented procedures for communication with the crew prior to commencing work, so that it is safe to decommission the equipment being maintained, and to provide a safe system of work in place

(k) Evidence of approval/acceptance by other bodies, if any

(l) Information on the other activities which may present a conflict of interest

(m) Record of customer claims and of corrective actions requested by certification bodies

(n) Documentation verifying that operators, technicians, and inspectors engaged in the service being approved have acknowledged the code of conduct

(o) Other documents deemed necessary by the Society

3 Field examinations

When the documents submitted for the Society review specified in **-2** above are deemed satisfactory, a field examination is to be carried out according to the following **(1)** to **(3)**:

(1) In the field examination, based on the documents that have been submitted and reviewed, the quality system, etc. of manufacturing works is investigated on site to confirm that the quality system, etc. is in conformity with the Rules.

(2) For manufacturing works to which **Chapter 4, Part 2** of the Rules applies, approval tests on the products intended to be approved are to be carried out with satisfactory results.

(3) Field examinations of service suppliers are to be as specified in the following **(a)** and **(b)**:

(a) The supplier is to be assessed in order to ascertain that they are duly organised and managed in accordance with the documents submitted in accordance with **-2** above; and

(b) Demonstration tests are to be carried out to verify that the supplier is capable of conducting the services for which approval or certification is sought. For the service supplier already certified by other QSCS certified societies, a document review of the results of demonstration tests that have already been conducted may be acceptable in lieu of actual tests.

2.4 Periodical Assessments

1 Periodical assessments are to be made of approved manufacturing works or service suppliers.

2 In the periodical assessment, it is confirmed by the Society that the approved quality system, etc. of the manufacturing works or service supplier are satisfactorily maintained.

3 The timing of periodical assessments is to be as follows:

(1) For manufacturing works of products, periodical assessment is to be carried out within a 3 *month* period before or after each anniversary date (the day corresponding to the expiry date of the certificate).

(2) For service suppliers, periodical assessment is to be carried out after 2 *years*, but before 3 *years* have passed from the initial or the renewal approval date. Periodical assessments, however, are not required for service suppliers subject to **Chapter 2, Part 3** of the Rules.

2.5 Renewal Assessments

1 Renewal assessment is to be carried out to the approved manufacturing works or service supplier by the expiry date of the approval certificate as specified in **3.3**, in case where the manufacturer's or supplier's management intends renewal of the approval.

2 In the renewal assessment, assessment is to be carried out mutatis mutandis in accordance with the requirements for initial assessments specified in **2.3** above. The details of the renewal assessment, however, may be modified when deemed acceptable by the Society. In the demonstration test for service suppliers, document reviews of the results of services undertaken since the previous approval or renewal assessment that have been recognised by a QSCS certified society may be acceptable in lieu of actual tests.

2.6 Occasional Assessments

1 In cases where an approved manufacturer or service supplier intends to alter to the details of their approval, etc., at a time other

than during a periodical assessment or renewal assessment, they are to inform the Society of their intent in a timely manner so that the Society can carry out an occasional assessment if it deems necessary.

2 In occasional assessments, it is confirmed by the Society that all the necessary items are in a satisfactory condition.

2.7 Preparations for Assessment or Surveillance, and Others

1 All preparations for assessments as specified in **2.3** through **2.6** are to be made by the manufacturing works or the service supplier. On such occasions, the management representative as specified in **2.2.1-2, Part 2** for the manufacturing works or a person familiar with the quality system for the service supplier is also to be present at the assessment.

2 In case necessary preparations have not been made or in case no responsible person specified in **-1** above is present at the assessment or the surveillance, the Society may suspend the assessment or the surveillance.

3 As a result of assessment or surveillance, in case rectification is considered necessary, the Society will notify the management accordingly. The manufacturer's or supplier's management who has received such notification is to perform corrective actions subject to confirmation by the Society.

Chapter 3 APPROVAL

3.1 Issuance of Approval Certificates and Official Announcement

3.1.1 Manufacturing works

1 As a result of initial assessment or renewal assessment, if the quality system, etc. of a manufacturing works is found in conformity with the Rules, the manufacturing works is approved and an approval certificate, which states the approval number, approval date, valid term, and the articles and approval conditions, etc., be issued to the manufacturer's management.

2 The Society officially announces a list of the approved manufacturing works.

3.1.2 Service Suppliers

1 Upon satisfactory completion of both initial assessment or renewal assessment and the demonstration test, as applicable, the Society may issue a Certificate of Approval stating that the supplier's service operation system has been found to be satisfactory and that the results of services performed in accordance with that system may be accepted and utilised by the Society's Surveyors in making decisions affecting classification or statutory certification, as relevant. The certificate is to clearly state the type and scope of services and any limitations or restrictions imposed including type of equipment and/or names of manufacturers of equipment where this is a limiting restraint.

2 The supplier may also be included in the Society's record of approved service suppliers.

3.2 Issuance of Assessment Record

As a result of the assessment or the surveillance, an assessment record stating corrective action requests on the quality system, etc. is issued to the manufacturing works or the service supplier.

3.3 Valid Term of Approval Certificates

3.3.1 Manufacturing Works

The valid term of an approval certificate is 5 *years* from the date of the initial or the renewal approval. In case where the renewal assessment is carried out within 3 *months* before the expiry date, the valid term of the certificate is 5 *years* from the expiry date.

3.3.2 Service Suppliers

1 Firms engaged in thickness measurements

For a firm engaged in thickness measurements, the valid term of an approval certificate is 3 *years* from the date of the initial or the renewal approval.

2 Other firms

For a firm other than those engaged in thickness measurements, the valid term of an approval certificate is 5 *years* from the date of the initial or the renewal approval or, where applicable, on expiry date of the approval received from an equipment manufacturer, whichever comes first.

3 Agents and Subsidiaries

The valid term of an approval of agents and subsidiaries certified according to **1.2.5-6** to **-9, Part 3** is until the expiry date of the parent company's approval.

3.4 Cancellation of Approval

1 In case an approved manufacturing works or service supplier falls under one of the following items **(1)** though **(7)**, the Society may cancel the approval. Upon such a cancellation, the Society notifies the manufacturer's or supplier's management accordingly.

(1) In case where a quality of the products or a result of the services is in doubt.

(2) In spite of request from the Society for rectification, in case appropriate corrective actions have not been taken by the date

designated by the Society.

(3) In case where the approved condition has not complied with the technical requirements concerned due to alteration of the requirements.

(4) In case assessment specified in **2.4** and **2.6** is not carried out.

(5) In case where wilful acts or omissions are ascertained.

(6) In case where any deliberate misrepresentation has been made by the manufacturer or the service supplier.

(7) In case the manufacturer's or supplier's management proposes to cancel application to the Rules.

2 A supplier whose approval was cancelled, may apply for re-approval provided it has corrected the non-conformities which resulted in cancellation. The Society may confirm it has effectively implemented the corrective action.

3 Expiration or cancellation of the parent company approval automatically invalidates approval of all agents and subsidiaries if these are certified according to **1.2.5-6** through **-9, Part 3**.

Chapter 4 MISCELLANEOUS

4.1 Fees

The fees and the travel expenses are charged in accordance with the separate provisions in case where performing the assessment or the surveillance.

4.2 Liability

The Society's liability for any loss or damage of the products under the examination will be handled based on the "**Conditions of Service for Classification of Ships and Registration of Installations**", which is separately specified.

Part 2 REQUIREMENTS FOR APPROVAL OF MANUFACTURERS

Chapter 1 GENERAL RULES

1.1 General

1.1.1 Application

1 This Part applies to manufacturing works of products.

2 Manufacturing works are to comply with the requirements in this Part as well as the requirements in **Part 1**.

1.1.2 Facilities and Personnel of the Works

1 The works is to be provided with necessary manufacturing facilities to secure quality required of the products. Appropriate environmental facilities, carrying appliances, etc. are to be maintained in workshops, also.

2 In the works, necessary inspection and test equipment together with its supplementary equipment to thoroughly perform the inspection and tests of the products are to be maintained.

3 In the works, the assignment of personnel is to be appropriate to maintain the quality required of the products.

1.1.3 Equivalency

Even in case it is difficult to conform to the requirements in this Part, if the Society admits a matter as equivalent to the requirements in this Part, the matter may be regarded as conforming to this Part.

1.1.4 Definition of Terms

1 "Internal quality audit" means systematic and independent examination the manufacturer's management performs to verify that the established quality system is operating effectively and as planned, and to determine the adequacy of that system to achieve the objectives.

2 "Rules of the Society" means technical rules of the Society such as the "**Rules for the Survey and Construction of Steel Ships**", and others.

Chapter 2 ESTABLISHMENT OF QUALITY SYSTEM

2.1 General

To maintain quality required of the products, the manufacturer's management is to clearly define its policy and objectives for, and commitment to the quality and is to establish and maintain a quality system that is in conformity with the requirements in **2.2** and **Chapter 3** hereunder. The manufacturer's management is to also prepare a documented quality manual indicating the procedures for implementing the above established quality system.

2.2 Organization and its Functions

2.2.1 Responsibility and Authority

1 The manufacturer's management is to clearly define the responsibility, authority and the inter-relation of all personnel who manage, perform and verify work affecting quality of the products. In particular, it is necessary to clearly define the above for the persons who take charge of the tasks related to the testing and inspection required by the Rules of the Society.

2 The manufacturer's management is to appoint a person responsible for quality management (hereinafter referred to as a "management representative"). The management representative is to have the organizational responsibility and authority necessary to perform and maintain the quality system, not having anything to do with any responsibility for other sections. The management representative is also to have authority to stop production in case a serious quality problem arises with the products.

2.2.2 Verification Resources

1 The manufacturer's management is to verify the quality of the products by inspection, testing, etc.. For this purpose, if necessary, persons who are not affected by the production groups shall be assigned. And these persons are to be under control of the management representative.

2 The manufacturer's management or the person authorized by him are periodically to perform the internal quality audits. As to the results of such audits, the following **(1)** to **(3)** are to be ensured.

(1) The audit results are to be reported to the manufacturer's management and departments.

(2) Based on the audit results, the manufacturer's management is to review the quality system when necessary.

(3) The audit results and the records of review of the quality system are all to be maintained.

Chapter 3 QUALITY SYSTEM REQUIREMENTS

3.1 General

The manufacturer's management is, to secure quality required of the products, to establish and maintain an appropriate quality control method in accordance with the requirements in **Chapter 2** and this Chapter.

3.2 Quality System Elements

3.2.1 Contract Review

1 Upon receiving an order, the contents of the order received are to be thoroughly reviewed, confirmed and adjusted, and the results are to be notified properly to the related sections.

2 In review of the contents of an order received, compatibility with the Rules of the Society is to be confirmed concerning construction, testing and inspection, etc. of the products.

3.2.2 Design Control

1 Requirements to be input for designing the products are to be clearly defined.

2 Personnel functions competent to verify the design are to be established and the design output is to be verified to meet all of the design input requirements.

3 The design is to be approved by the Society in case conformity with the Rules of the Society is necessary.

4 Alternations and amendments to the design are to be made appropriately and to be notified promptly to the related sections.

3.2.3 Document Control

1 Procedures for issuing, altering, abolishing, approval, distribution, etc. of the documents (quality manual, technical standards, design and manufacturing drawings, specifications, production procedures, etc.) are to be established and maintained appropriately.

2 The documents are to be controlled so that only the latest editions are available and necessary documents for surveys are to be easily presented at the request of the Surveyor.

3.2.4 Purchased and Subcontracted Products Control

1 Supplier's and subcontractor's works are to be thoroughly examined and evaluated on their quality control to verify that the purchased and subcontracted products are produced in a way that satisfies the specified requirements of the orders. The Society may examine the supplier's and subcontractor's works if necessary. However, in case purchased and subcontracted products are made subject to survey by the Society and supplied together with the product certificates issued by the Society, the above examination may be dispensed with for such suppliers and subcontractors.

2 In purchasing documents to suppliers and subcontractors, the following are to be included as the occasion demands :

(1) Specifications of the article (including technical data)

(2) Names and numbers of documents such as drawings applied to the article

(3) Manufacturing methods, procedures, installations and the personnel qualifications to be required

(4) Manufacturing processes and inspection and testing method of the articles

(5) Whether it is necessary or not to conform to the Rules of the Society

(6) Disposal method for non-conforming articles

(7) Requirements for identification of articles

(8) Requirements for storage, packaging and shipment of the articles

(9) Requirements for maintenance and presentation of quality records.

3 Concerning handling, storage, maintenance and others of purchased and subcontracted products after receipt, proper control is to be exercised.

4 Purchaser supplied articles to be incorporated into the products are to be properly verified, stored and maintained.

3.2.5 Identification of Products

The products and their important parts and materials are to be identified so that they can be traceable to the related documents

such as drawings, specifications, etc. of the product during the whole process.

3.2.6 Production Process Control

1 In processes affecting quality of the products, the work is to be carried out in accordance with the appropriate quality plans, work instructions, and others. And these quality plans, work instructions and others shall be capable of assuring the quality required of the products.

2 The processes in -1 above are to be under controlled conditions as appropriate.

3 In case of welding or heat treatment is carried out to the products, the following are to be satisfied as applicable :

(1) The procedures for welding or heat treatment to the products are to be approved by the Society.

(2) The welders are to have the qualification as a welding operator approved by the Society depending on the materials, welding procedures, etc.

4 Manufacturing methods of the products are to be approved otherwise by the Society, if required under the Rules of the Society.

5 Maintenance and inspection for manufacturing facilities is to be carried out appropriately.

3.2.7 Inspection and Testing Control

1 Receiving inspection and testing

Purchased and subcontracted products are to be inspected or otherwise verified to conform to the requirements specified at the time of orders, before they are used or processed.

2 In-process inspection and testing

(1) Inspection, tests and identification of the products are to be carried out appropriately during the processes. The inspection and tests during the process are especially to include all items that cannot be verified by the subsequent inspection and testing.

(2) The product is to be held in principle until the specified inspection and tests have been completed and the quality of the product been verified.

3 Final inspection and testing

The final inspection and tests are to be carried out to verify that the completed product is in conformity with the specified requirements. On such an occasion, it is to be confirmed that the results of specified inspection, tests, etc. in receiving and in-process inspection and testing have all been acceptable, too.

4 Inspection and testing required by the Rules of the Society

(1) In in-process and final inspection and testing of the products, all inspection and tests required by the Rules of the Society are to be included, and the inspection and testing methods as well as the evaluation criteria are subject to approval of the Society. The results of such inspection and tests are also to be confirmed by the Surveyors of the Society. On these occasions the Surveyors will be present at the inspection and tests considered necessary by the Society.

(2) Necessary preparations are to be made for the inspection or tests as specified in **(1)** above, in case the Surveyor of the Society is present. On such an occasion, personnel who has full knowledge of the inspection or tests and can supervise these preparations is also to be present at the inspection or tests.

(3) In cases where non-destructive testing is required by the Rules of the Society, the operator is to have a qualification considered appropriate by the Society.

3.2.8 Control of Inspection, Testing and Measuring Equipment

1 Inspection, testing and measuring equipment which can affect quality of the products, is to be properly selected and controlled. And these equipment is to be calibrated to the appropriate standards.

2 The standard is to be traceable to the national standard or an equivalent standard.

3 Tensile testing machines, impact testing machines and hardness testers are to be in conformity with the Rules for the Construction and Certification of Testing Machines of the Society.

3.2.9 Control of Non-conforming Products

1 Control of non-conforming products

To prevent use of products which do not conform to the specified requirements, the non-conforming products in receiving, in-process and final inspection and testing are to be properly identified, recorded, evaluated, segregated and disposed of, of which at the same time are to be notified to the relevant sections.

2 Non-conformity review and disposition

In case the following measures are taken with non-conforming products, the methods as well as the authority and the responsibility for such measures are to be clearly defined subject to approval by the Society, if necessary.

(1) In case they are reworked or repaired to meet the specified requirements.

(2) In case they are accepted without repair by concession.

(3) In case they are re-graded for alternative applications.

(4) In case they are rejected or scrapped.

3 Corrective actions

Investigation and study of the cause of non-conforming products are to be thoroughly made, and the corrective actions are to be taken to prevent recurrence.

3.2.10 Quality Records

Quality records for the results in receiving, in-process and final inspection and testing, the disposition of non-conforming products, etc. are to be identifiable to the products involved and are to be kept in order, maintained and stored in such a way that they can be readily retrieval. In such records, the quality records for purchased and subcontracted products are also to be included.

3.2.11 Control of Handling, Storage, Packing and Delivery of Products

To prevent damage, staining, deterioration or misapplication of the products, handling, storage, packaging and shipment of the products are to be properly controlled.

3.2.12 Training

All personnel who are engaged in activities which can affect quality of the products are to be properly trained. On such occasions, for personnel engaged in specific assigned tasks such as welding, non-destructive testing, etc., special consideration is to be given to maintaining and improving their abilities through recognition of qualifications, etc.

3.2.13 Servicing

1 In case assembly, installation, trial, etc. are required after shipping the products out of the works, each requirement in this Part, as the occasion demands, is to correspondingly apply.

2 If necessary, informative instructions concerning technical data, handling, maintenance, repairs, etc. of the products are to be presented to users.

3 Customer complaints concerning problems in using the products are to be collected and analyzed and appropriate counter-measures are to be taken as the occasion demands.

3.2.14 Statistical Technique

To maintain quality of the products, an appropriate statistical technique is to be adopted when necessary.

3.2.15 Improvement of Quality

The manufacturer's management is to take the necessary steps to realize stable and improved quality of the products.

Chapter 4 ADDITIONAL REQUIREMENTS FOR MANUFACTURERS OF MASS PRODUCED PRODUCTS

4.1 General

4.1.1 General

Scope

(1) This chapter applies to approval assessment of machinery and equipment, which are manufactured by a mass production system (hereinafter referred to as "mass produced products"), intended to be examined and certified in accordance with a procedure suited to their production method.

(2) Manufacturing works of mass produced products are to comply with the requirements in this Chapter as well as the requirements in **Part 1**, and **Chapter 1**, **Chapter 2** and **Chapter 3** of this Part.

4.1.2 Initial Assessment

1 Document examination

Manufacturing works is to submit 3 copies each of the following documents in addition to the documents specified in **2.3-2**, **Part 1**.

(1) Data showing the principal particulars and specification of mass produced products, and sectional assembly drawings and drawings of major components

(2) Production records covering the last 2 *years*

(3) For mass produced products of novel design, documents showing the tests with their results for research and development

2 Approval tests

(1) The approval tests on the mass produced products deemed necessary by the Society are to be carried out in the presence of the Society's surveyor. The approval test procedures are to be in accordance with the requirements of **4.2** through **4.8** for each kind of the product. However, modification or omission of the tests may be accepted in consideration of the service records of the products and their construction or function.

(2) When the approval test is completed, manufacturing works is to submit 3 copies of the test result to the Society

4.1.3 Subsequent to the Approval

1 Manufacturing and examination

The manufacturing works is to manufacture (including purchase and subcontract control, process control, measuring equipment control, etc.) and examine the mass produced products in accordance with the quality system approved by the Society.

2 Stamping or marking

The quality representative of the manufacturing works is to identify each mass produced product which has passed the examination in **-1** by stamping or marking the serial number, the last date of examination and the Society's brand MR. For this purpose, the Society may entrust the quality representative with keeping the Society's stamp MR beforehand.

3 Issuance of certificate

The quality representative of the manufacturing works is to submit a test report describing the serial number, the last date of examination, principal particulars and examination results on the mass produced product, which has passed the examination in **-1**, to the Society's survey office. After checking the submitted examination report, the Society's survey office issues a certificate on each product to the manufacturing works.

4 Major Components

In case where major components are delivered by themselves, the components may be dealt with by **-1** through **-3** provided that the components are manufactured and examined under the same quality system of the completed products.

5 Alteration of the approved products

In case where a type, a specification, etc. of the approved mass produced product is altered, Occasional assessment specified in **2.6, Part 1** is to be carried out.

4.2 Reciprocating Internal Combustion Engines

4.2.1 General

1 Scope

(1) The requirements in this **4.2**, in general, apply to reciprocating internal combustion engines manufactured at the same manufacturing works.

(2) The requirements specifically prescribed in this **4.2** supersede those specified in **4.1**.

2 Definitions

(1) Mass produced reciprocating internal combustion engines to which this **4.2** applies are supposed to be manufactured in accordance with **(a)** through **(e)** below:

(a) Those mass produced under the strict quality control on materials and parts in accordance with the programme agreed by the Society

(b) Those manufactured through the use of jigs or automatic machines designed to machine parts to close tolerances for interchangeability, and which are to be verified on a regular inspection basis.

(c) Those parts taken from the stock after manufacture requiring little or no manual adjustments or finishing work in the assembly process.

(d) Those subjected to a trial run at the manufacturer for individual engines under the established testing programme.

(e) When engines selected at random are subjected to detailed tests for performance evaluation after completion of the trial run at the manufacturer specified in the **(d)** above.

(2) The major components referred to in this **4.2** are as follows:

Cylinder cover, cylinder liner, piston, piston pin, connecting rod, cylinder block, bed plate, crankshaft, cam, camshaft, camshaft driving gears, bearing (top and bottom bearings of connecting rod, main bearing), bolt (small end bolt and big end bolt of connecting rod, tension bolt, main bearing bolt, coupling bolt),pumps attached to engine(lubricating oil, cooling water, fuel oil), pipings attached to engine (starting air system, fuel injection system), coolers attached to engine (lubricating oil, cooling water, supercharged air), exhaust gas turbocharger, reduction gear, power transmission shaft and flexible coupling.

3 Equivalency

The major components produced by subcontractors who undergo the quality system of the manufacturing works or give full information about their quality control may be dealt with by this **4.2**, when deemed appropriate by the Society.

4.2.2 Initial Assessment

1 Field examination

In the field examination, it is confirmed that the manufacturing facilities and overall quality system of the manufacturing works are satisfactory, and in addition, the quality of major components are verified satisfactory. The verifications are to be made either by random sampling during the manufacturing process, by checking the examination records or by overhaul inspection after the trial run of the engine.

2 Approval tests

(1) One set of test engines selected from the production line is to be subjected to the trial run specified in **2.6.1-2, Part D of the Rules for the Survey and Construction of Steel Ships**.

(2) Additional tests

Notwithstanding the requirements of **(1)**, tests considered necessary by the Society may be additionally required.

4.2.3 Subsequent to the Approval

1 Trial run on individual engines

Notwithstanding the requirements in **4.1.3-1**, the Society's surveyor may attend a trial run on individual engines in case where the number of production of the engine is small.

2 Test report

The test report required in **4.1.3-3** is to be made for each engine and is to state the following items. However, no entry may be made on components in item **(5)** when the Society's surveyor considers it unnecessary.

(1) Intended service

(2) Serial No. of engine

(3) Type of engine

(4) Principal particulars (maximum continuous output and rpm, normal and reversing rating, number of cylinders, cylinder bore, piston stroke, indicated mean effective pressure, brake mean effective pressure, maximum pressure in cylinder, etc.)

(5) Date of the inspection and inspection records on the major components (material inspection, finishing inspection, hydrostatic test, welding inspection and others)

(6) Records of the trial run

4.3 Purifiers

4.3.1 General

1 Scope

(1) The requirements in this **4.3**, in general, apply to centrifugal cylinder type or centrifugal disc type fuel oil or lubricating oil purifiers (hereinafter referred to as the "purifier" in this **4.3**) manufactured at the same manufacturing works.

(2) The requirements in this **4.3** are not applicable to the driving electric motors and their accessories.

(3) The requirements specifically prescribed in this **4.3** supersede those specified in **4.1**.

2 Definitions

The major components referred to in this **4.3** are as follows:

(1) Cylinder type;

Frame, bowl, cover, safety device, attached pump

(2) Disc type;

Frame, bowl, vertical spindle, horizontal spindle, main gear, safety device, attached pump

4.3.2 Initial Assessment

Approval tests

(1) The approval tests are to be carried out on the purifier randomly selected one for each type from the production line.

(2) The items of the approval tests are, in general, to be as follows:

(a) Manufacturing inspection

(b) Leakage test and pressure test

(c) Operational performance test

i) Starting test

ii) Stopping test

iii) Performance test

iv) Overspeed test

v) Continuous running test

vi) Operation test of accessories

(d) Overhaul inspection

(e) Other tests as deemed necessary by the Society

4.4 Hydraulic Motors and Hydraulic Pumps

4.4.1 General

1 Scope

(1) The requirements in this **4.4**, in general, apply to hydraulic motors and hydraulic pumps, intended for steering gears, windlasses, cargo winches and other deck machinery, opening/closing appliances of watertight doors, side thrusters, and other auxiliaries for essential use, manufactured at the same manufacturing works.

(2) The requirements specifically prescribed in this **4.4** supersede those specified in **4.1**.

2 Definitions

The major components referred to in this **4.4** are as follows:

(1) Hydraulic motors and hydraulic pumps to which this **4.4** applies are those of the gear type, screw type, vane type and piston

type.

(2) The major components referred to in this 4.4 are as follows:

(a) Gear type and screw type;

Casing, cover, gear, screw, shaft, bearing and relief valve

(b) Vane type;

Casing, cover, vane, rotor, bush, cam ring, driving shaft, bearing and relief valve

(c) Axial piston type;

Driving shaft, bearing piston, rod, cylinder block, valve plate, cam plate, pump casing, bearing casing, cover, flexible shaft coupling, controller and servo system

(d) Radial piston type;

Driving shaft, crankshaft, bearing, piston, rod, side guide, cam curve, pump casting, slide block, cylinder casting, cover, relief valve and servo system

4.4.2 Initial Assessment

Approval tests

(1) The approval tests are to be carried out on the hydraulic motor and hydraulic pump randomly selected one for each type from the production line.

(2) The items of the approval tests are, in general, to be as follows:

(a) Examination of construction

(b) Pressure test

(c) Operational performance test

i) Performance test

ii) Continuous test

iii) Operation test of relief valve

(d) Overhaul inspection

(e) Other tests considered necessary by the Society

4.5 Electrical Equipment

4.5.1 General

Scope

(1) The requirements in this 4.5, in general, apply to electrical equipment having a capacity of 500*kW* (or *kVA*) or less manufactured at the same manufacturing works.

(2) The requirements in this 4.5 may apply to electrical equipment small in production number but has a sufficient past production record.

(3) The requirements in this 4.5 may apply to electrical equipment of novel design provided that the equipment is ensured, by thorough development tests, to have enough reliability equivalent to that of equipment having a sufficient past production record.

(4) The requirements specifically prescribed in this 4.5 supersede those specified in 4.1.

4.5.2 Initial Assessment

Approval tests

(1) The approval tests are to be carried out on the electrical equipment randomly selected one for each frame number or type from the production line to verify that the equipment complies with the requirements in **Part H of the Rules for the Survey and Construction of Steel Ships**.

(2) The items of the approval tests are, in general, to be as follows. However, additional test items or number of test samples may be required in case where the Society specifically deems necessary.

(a) Generators

i) Construction inspection

ii) Running test;

Temperature test, overload test, overcurrent test, commutation test, overspeed test

iii) Characteristics test;
Voltage regulation characteristics test, instantaneous voltage regulation characteristics test
iv) Insulation resistance test
v) High voltage test
vi) Vibration measurement, noise level measurement, and hydraulic test for air cooler

(b) Electric motors
i) Construction inspection
ii) Operational test;
Temperature test, overload test, overtorque test, commutation test and overspeed test
iii) Characteristics test;
Load characteristics test
iv) Insulation resistance test
v) High voltage test

(c) Controlgears for electric motors
i) Construction inspection
ii) Temperature test
iii) Operational test (including circuit inspection)
iv) Insulation resistance test
v) High voltage test

(d) Power and lighting transformer
i) Construction inspection
ii) Temperature test
iii) Insulation resistance test
iv) High voltage test
v) Induced high voltage test

(e) Switchboards
i) Construction inspection
ii) Temperature test
iii) Operational test (for main circuits)
iv) Insulation resistance test
v) High voltage test

(f) Axial flow fan driven by motor built in casing
i) Construction inspection
ii) Combined running tests;
Temperature test, air flow and static air pressure measurements, shaft power measurements, vibration and noise level measurements
iii) Insulation resistance test
iv) High voltage test

Notes:
1. Testing and inspection procedures are to be in accordance with the requirements of *JIS*, *JEC*, *JEM* or other standards or codes as deemed appropriate by the Society.
2. Overload test is to be carried out with 110 % of rated load for the period of 2 *hours* from after the temperatures of each part being saturated. No limit will be imposed for temperature rise.
3. On test items other than electrical equipment listed in **(a)** through **(f)** above, they are to be determined in a negotiation with the manufacturer.

4.5.3 Subsequent to the Approval

1 Stamping or marking

The electrical equipment which has passed the examination specified in 4.1.3-1 is to be identified as the equipment complying with

the Rules by a label indicating the serial number, the examination date, the approval number and the Society's brand NK

2 Operation test on individual equipment

Notwithstanding the requirements of **4.1.3-1**, the Society's surveyor may attend an operation test on individual equipment with a capacity of 100*kW* (or *kVA*) or more and produced in a small lot.

4.6 Exhaust Gas Turbochargers

4.6.1 General

Scope

(1) The requirements in this **4.6**, in general, apply to exhaust gas turbochargers (hereinafter referred to as the "turbochargers" in this **4.6**) manufactured at the same manufacturing works.

(2) The requirements specifically prescribed in this **4.6** supersede those specified in **4.1**.

4.6.2 Initial Assessment

Approval tests

(1) The approval tests are to be carried out on the standard turbocharger randomly selected one for each type from the production line.

(2) The tests carried out during approval tests are to be the dynamic balancing tests and the overspeed tests specified in **2.6.1-4** and **-5, Part D of the Rules for the Survey and Construction of Steel Ships**, respectively.

4.7 Air Compressors

4.7.1 General

1 Scope

(1) The requirements in this **4.7**, in general, apply to air compressors manufactured at the same manufacturing works.

(2) The requirements specifically prescribed in this **4.7** supersede those specified in **4.1**.

2 Definitions

(1) Air compressors to which this **4.7** applies are those used for compressing air for starting reciprocating internal combustion engines, controlling machinery and equipment, power sources and general service, and are of the piston type or vane type.

(2) The major components referred to in this **4.7** are as follows:

Cylinder head, cylinder, piston, piston pin, connecting rod, crankshaft, bearing (small end and big end bearing, main bearing), crankcase, suction valve, discharge valve, intercooler, after cooler, attached pump (lubricating oil and cooling water), outlet non-return valve, relief valve

4.7.2 Initial Assessment

Approval tests

(1) The approval tests are to be carried out on the air compressor randomly selected one for each type from the production line.

(2) The items of the approved tests are, in general, to be as follows:

(a) Examination of construction

(b) Pressure test and air-tightness test

(c) Operational test

i) Continuous running test (for 1 *hour*)

ii) Performance test

iii) Operational test of safety devices

(d) Overhaul inspection

(e) Other tests as deemed necessary by the Society

4.8 Water Pumps and Oil Pumps

4.8.1 General

1 Scope

(1) The requirements in this **4.8**, in general, apply to water pumps and oil pumps manufactured at the same manufacturing works.

(2) The requirements specifically prescribed in this **4.8** supersede those specified in **4.1**.

2 Definitions

(1) Water pumps to which this **4.8** applies are those used for transferring or supplying sea water, fresh water, feed water, bilge, etc., and oil pumps to which this **4.8** applies are those used for transferring and supplying fuel oil, lubricating oil, thermal oil, waste oil, etc.

(2) The major components referred to in this **4.8** are as follows:

(a) Centrifugal type;
Casing, cover, impeller, shaft, bearing, sealing device

(b) Rotating type;
Casing, cover, connecting rod, liner, vane, shaft, bearing, sealing device

(c) Reciprocating type;
Casing, cover, piston, plunger, cylinder, crankshaft, bearing, control valve, sealing device

4.8.2 Initial Assessment

Approval tests

(1) The approval tests are to be carried out on the water pump or the oil pump randomly selected one for each type from the production line.

(2) The items of the approval tests are, in general, to be as follows:

(a) Examination of construction

(b) Pressure test

(c) Operation test

(d) Continuous running test

(e) Overhaul inspection

(f) Other tests as deemed necessary by the Society

Part 3 REQUIREMENTS FOR APPROVAL OF SERVICE SUPPLIERS

Chapter 1 GENERAL

1.1 General

1.1.1 Application

1 This part applies to service suppliers listed as follows:

(1) Firms engaged in thickness measurements on ships or mobile offshore units

(2) Firms carrying out an in-water survey on ships and mobile offshore units by diver or Remotely Operated Vehicle

(3) Firms engaged in inspection and testing of radio communication equipment

(4) Firms engaged in performance testing of Voyage Data Recorders (hereinafter referred to as "*VDR*s") and Simplified Voyage Data Recorders (hereinafter referred to as "*S-VDR*s")

(5) Firms engaged in inspection and maintenance of fire fighting equipment and systems

(6) Firms engaged in servicing of life-saving appliances

(7) Firms engaged in tightness testing of closing appliances such as hatches, doors etc. with ultrasonic equipment

(8) Firms engaged in testing of coating systems (including such cases where paint manufacturers perform their own cross over testing)

(9) Firms engaged in maintenance, thorough examination, operational testing, overhaul and repair of lifeboats and rescue boats, launching appliances and release gear

(10) Firms engaged in examination of the bow doors, stern doors, side doors and inner doors of ro-ro ships

(11) Firms engaged in luminance measurements of low location lighting systems

(12) Firms engaged in sound pressure level measurements of general alarm and public address systems on board ships

(13) Firms engaged in measurements of noise level onboard ships

(14) Firms engaged in tightness testing of primary and secondary barriers of gas carriers with membrane cargo containment systems for vessels in service

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

(16) Firms engaged in cable penetration inspection on ships and mobile offshore units

(17) Firms engaged in Commissioning Testing of Ballast Water Management System (BWMS)

(18) Firms other than those listed in **(1)** to **(17)** above

2 Firms listed in **-1(1)** through **(17)** are to comply with the requirements in this Part as well as the requirements in **Part 1**.

3 Firms listed in **-1(18)** are to comply with the requirements deemed appropriate by the Society as well as the requirements in **Part 1**.

4 When several servicing stations are owned by firms listed in **-1(1)** through **(17)**, each station is to be assessed and approved, except as specified in **1.2.5-6** to **-9**.

1.1.2 Equivalency

Even in case it is difficult to conform to the requirements in this Part, if the Society admits a matter as equivalent to the requirements in this Part, the matter may be regarded as conforming to this Part.

1.1.3 Definition of Terms

1 "Internal quality audit" means systematic and independent examination the supplier's management performs to verify that the established quality system is operating effectively and as planned, and to determine the adequacy of the system to achieve the objectives.

2 "Rules of the Society" means technical rules of the Society such as the **"Rules for the Survey and Construction of Steel Ships"**, and others.

3 "Manufacturer" means a company that manufactures equipment required to be periodically serviced and/or maintained.

4 "Service supplier" or "supplier" means a person or company, not employed by an IACS Member, who at the request of an equipment manufacturer, shipyard, vessel's owner or other client acts in connection with inspection work and provides services for a ship or a mobile offshore unit such as measurements, tests or maintenance of safety systems and equipment, the results of which are used by surveyors in making decisions affecting classification or statutory certification and services.

5 "Agent" means a person or company authorised to act for or to represent a manufacturer or approved/recognized service supplier.

6 "Subsidiary" means a company partly or wholly owned by a manufacturer or approved/recognized service supplier.

7 "Subcontractor" means a person or company providing services to a manufacturer or approved/recognized service supplier, with a formal contract defining the assumption of the obligations of the service supplier.

8 "Quality System Certification Scheme (QSCS)" means a certification scheme for management systems specified by *IACS*.

1.2 Quality System

1.2.1 General

1 To maintain quality required to the services to be provided, the supplier's management is to establish and maintain a documented quality system that is in conformity with the requirements in **1.2.2** to **1.2.8**.

2 The supplier is to have a documented quality system complying with the most recent version of the *ISO* 9000 series and covering at least the following:

(1) Code of conduct for the relevant activity

(2) Maintenance and calibration of equipment

(3) Training programmes for operators, technicians and inspectors

(4) Supervision and verification to ensure compliance with operational procedures

(5) Recording and reporting of information

(6) Quality management of subsidiaries, agents and subcontractors

(7) Job preparation

(8) Periodic review of work process procedures, complaints, corrective actions, and issuance, maintenance and control of documents

1.2.2 Training

1 The supplier is responsible for the qualifications and training of its personnel to a recognised national, international or industry standards as applicable.

2 Where such standards do not exist, the supplier is to define the standards for training and qualifications of its personnel relevant to the functions each is authorised to perform.

3 The supplier's management is to establish and maintain a documented training procedure for implementing the training specified in **-1** and **-2**.

4 The supplier's management is to establish and maintain a list of operators and supervisors documenting name, qualifications, training and experience within the relevant service area.

1.2.3 Documented Procedures to Ccontrol, Calibrate and Maintain for Measuring and Testing Equipment

The supplier's management is to establish and maintain a documented procedure to control, calibrate and maintain the equipment and facilities specified in **1.4**.

1.2.4 Work Procedures

1 The supplier's management is to establish, have and maintain documented work procedures for all services to be provided.

2 Documented procedures and instructions are to be available for the recording of damage and defects found during inspection, servicing and repair work. This documentation is to be made available upon request.

1.2.5 Subcontracting Control

1 In case where any parts of the services provided are sub-contracted, the supplier's management is to examine and evaluate the subcontractor's quality system and works to verify that the subcontractor has enough capability to provide subcontracted services with the required quality and submit information of agreements and arrangements to the Society.

2 Ordering documents are to contain data clearly necessary for the subcontracting.

3 The supplier's management is to establish and maintain a documented procedure for implementing the subcontracting control specified in **-1** and the order specified in **-2**.

4 Particular emphasis is to be given to quality management by the supplier in following-up such subcontracts.

5 Subcontractors providing anything other than equipment to also meet the requirements of this chapter and **Part 1**.

6 If a manufacturer of equipment (and/or its service supplier) applies to the Society for inclusion of its nominated agents and/or subsidiaries in the approval, then it is to have implemented a quality system certified in accordance with the most current version of *ISO* 9000 series.

7 The quality system specified in **-6** is to contain effective controls of the manufacturer's (and/or service supplier's) agents and/or subsidiaries. The nominated agents/subsidiaries are to also have in place an equally effective quality system complying with the most current version of *ISO* 9000 series.

8 The approvals of the nominated agents/subsidiaries are to be based upon an evaluation of the quality system implemented by the parent company against the most current version of *ISO* 9000 series.

9 The Society may require follow-up assessments on such agents or subsidiaries against the most current version of *ISO* 9000 series to confirm adherence to the quality system.

1.2.6 Quality Verification Measures

1 The supplier's management is to verify quality of the services provided.

2 The supplier's management is to perform the internal quality audits periodically. As to the results of the audits, the following **(1)** though **(3)** are to be ensured.

(1) The audit results are to be reported to the supplier's management and the sections audited.

(2) Based on the audit results, the supplier's management is to review the quality system when necessary.

(3) The audit results and the records of the management review are all to be maintained.

3 The supplier's management is to establish and maintain a documented procedure for implementing the verification specified in **-1** and the internal quality audit specified in **-2**.

1.2.7 Documented Procedures, etc. for Reporting to the Society

1 The supplier's management is to establish and maintain a documented procedure for reporting the results of the services provided to the Society in accordance with **1.5.2**.

2 Documented procedures and instructions are to be available for the recording of damage and defects found during inspection, servicing and repair work.

1.2.8 Relationship between Service Suppliers and Equipment Manufacturers

1 A company which works as a service station for manufacturer(s) of equipment and as a service supplier in this field, is to be assessed by the manufacturer(s) and nominated as their agent.

2 The manufacturer is to ensure that appropriate instruction manuals, material etc. are available for the agent as well as proper training of the agent's technicians.

3 Such suppliers are to be approved either on a case by case basis, or in accordance with **1.2.5-6** to **-9**.

1.3 Qualifications of Personnel

1.3.1 Qualifications of Personnel

1 The personnel is to have adequate experience and be familiar with the operation of any necessary equipment.

2 Operators/technicians/inspectors are to have had a minimum of one year tutored on-the-job training. Where it is not possible to perform internal training, a program of external training may be considered as acceptable.

1.3.2 Supervision

The supplier is to provide supervision for all services provided. The responsible supervisor is to have had a minimum of two years of experience as an operator/technician/inspector within the activity for which the supplier is approved. For a supplier consisting of one person, that person is to meet the requirements of a supervisor.

1.3.3 Personnel Records

1 The supplier is to keep records of the approved operators/technicians/inspectors.

2 The record specified in **-1** is to contain information on age, formal education, training and experience for the services for which

they are approved.

1.4 Measuring and Testing Equipment

1.4.1 Equipment and Facilities

1 The supplier is to have the necessary equipment and facilities for the service to be provided.

2 When computers are used for the acquisition, processing, recording, reporting, storage, measurement assessment and monitoring of data, the ability of computer software to satisfy the intended application is to be documented and confirmed by the service supplier. This is to be undertaken prior to initial use and reconfirmed as necessary. Commercial off-the-shelf software (e.g. wordprocessing, database and statistical programmes) in general use within their designed application range may be considered to be sufficiently validated and do not require any subsequent confirmation.

1.4.2 Records

1 The supplier is to keep and make available a record of the equipment and facilities used for the service to be provided.

2 The record specified in **-1** is to contain information on maintenance and results of calibration and verifications.

1.5 Verification and Reporting

1.5.1 Verification

1 The supplier is to verify that the services provided are carried out in accordance with approved procedures.

2 When the equipment used for providing services is found not to conform to the requirements, the Society assesses and records the validity of previous measuring results and requires the service supplier to take appropriate action on the equipment affected.

1.5.2 Reporting

1 The report is to be prepared in a form acceptable to the Society.

2 The report is to detail the results of inspections, measurements, tests, maintenance and/or repairs carried out and is also to comply with **Chapters 2** to **15** of this Part, as appropriate.

3 The report is to include a copy of the Certificate of Approval.

Chapter 2 FIRMS ENGAGED IN THICKNESS MEASUREMENTS ON SHIPS OR MOBILE OFFSHORE UNITS

2.1 General

2.1.1 Application

This chapter applies to firms engaged in carrying out thickness measurements of the structural members of ships or mobile offshore units, excluding the following types of ships:

(1) non-*ESP* Ships less than 500 *gross tonnage* and

(2) All fishing vessels.

2.2 Quality System

2.2.1 Work Procedure

The documented work procedures specified in **1.2.4** are to include information on at least the following items:

(1) Inspection preparation;

(2) Selection and identification of test locations;

(3) Surface preparation and protective coating preservation;

(4) Calibration checks; and

(5) Reporting measurement results in writing and using electronic data as well as obtaining Society surveyor verification.

2.2.2 Training Procedures

The documented training procedures specified **1.2.2** are to at least include information on ways to acquire knowledge about the following items:

(1) Common hull structures and structural members;

(2) Midship section shapes of representative ship types;

(3) Frequent locations of damage and corrosion for representative ship types; and

(4) Society requirements related to thickness measurements.

2.3 Operators and Supervisors

2.3.1 Qualification

1 Operators and supervisors carrying out thickness measurements are to have sufficient knowledge regarding at least the items in the above **2.2.2(1)** through **(4)**.

2 Operators carrying out thickness measurements are to be qualified in accordance with a recognized industrial *NDT* standard (e.g., *EN* 473 *level I* as amended or *ISO* 9712 *level I* as amended).

3 Supervisors are to be qualified in accordance with a recognized industrial *NDT* standard (e.g., *EN* 473 *level II* as amended or *ISO* 9712 *level II* as amended).

2.4 Equipment

2.4.1 Equipment

Ultra-sonic gauging equipment is, in general, to be used for thickness measurements.

2.5 Reporting to the Society

2.5.1 Verification

The supplier is to have the Surveyor verification of each separate job, documented in the report by the attending Surveyor

signature.

2.5.2 Reporting

The report shall be based on the guidelines accepted by the Society.

Chapter 3 FIRMS CARRYING OUT AN IN-WATER SURVEY ON SHIPS AND MOBILE OFFSHORE UNITS BY DIVER OR REMOTELY OPERATED VEHICLE

3.1 General

3.1.1 Application

This chapter applies to firms engaged in-water survey in lieu of a docking survey and/or the internal hull survey of compartments filled with water on ships and mobile offshore units by diver or Remotely Operated Vehicle (ROV).

3.2 Quality System

3.2.1 Work Procedures

The documented work procedures specified in **1.2.4** are to include information on at least the following items:

(1) Inspection preparation;

(2) Guidance to divers along the hull parts to be inspected;

(3) Two-way communication between divers and the Society's surveyor;

(4) Video recording and closed circuit television operation;

(5) Reporting inspection results and obtaining Society surveyor verification; and

(6) Guidance for the operation and maintenance of the ROV, if applicable

(7) Methods and equipment to ensure the ROV operator can determine the ROV location and orientation in relation to the vessel

3.2.2 Training Procedures

The documented training procedures specified in **1.2.2** are to at least include information on ways to acquire knowledge about the following items:

(1) Ship underwater structure and appendages (including propeller shafts, propeller, rudders and their bearings, etc.);

(2) Ship terminology in English;

(3) Underwater non-destructive testing in accordance with recognized national or international industrial NDT standards accepted by the Society. (This only applies to firms carrying outs in-water surveys of ships which also perform non-destructive testing.);

(4) Bearing clearance measurements for rudders and propeller shafts;

(5) Underwater video monitoring with TV-monitors on deck, as well as still picture work;

(6) Operation of underwater communication systems;

(7) Certification as a thickness measurement firm when conducting thickness measurements under water

(8) Other special equipment and tools used for in-water surveys; and

(9) Society requirements related to in-water surveys.

3.3 Diver and Supervisor

3.3.1 Qualifications

1 Divers, diving supervisors, ROV operators and ROV supervisors carrying out in-water surveys are to have sufficient knowledge of the above **3.2.2(1)** through **(9)**.

2 Divers carrying out in-water surveys are to have at least 1 *year* experience and participated in 10 different assignments as an assistant diver.

3 Diving supervisors are to have at least 2 *years* of experience as a diver in carrying out in-water surveys.

4 ROV operators carrying out in-water surveys are to have at least 1 *year* experience in carrying out in-water surveys by ROV.

5 ROV supervisors are to have at least 2 *years* of experience as a ROV operator in carrying out in-water surveys.

3.4 Equipment

3.4.1 Equipment

The supplier is to possess the equipment listed in the following **(1)** through **(7)**:

(1) Closed circuit colour television with sufficient illumination equipment;

(2) Still photography camera;

(3) Video recording device connected to the closed circuit television;

(4) Two-way communication between diver and surface staff;

(5) Equipment for carrying out thickness measurements, non-destructive testing and measurements, *e.g.* clearances, indents, etc.;

(6) Equipment for cleaning of the hull; and

(7) ROV and adequate controls or programming for the ROV functions required, if applicable.

3.5 Reporting to the Society

3.5.1 Verification

The supplier is to have the Surveyor verification of each separate job, documented in the report by the attending Surveyor signature.

Chapter 4 FIRMS ENGAGED IN INSPECTION AND TESTING OF RADIO COMMUNICATION EQUIPMENT

4.1 General

4.1.1 Application

This chapter applies to the following firms:

(1) Suppliers engaged in inspection, testing, and/or measurement of radio equipment aboard ships or mobile offshore units for compliance with *SOLAS* regulations;

(2) Suppliers engaged in annual testing of 406 *MHz* satellite *EPIRB*s for compliance with *SOLAS* regulation IV/15.9; and

(3) Suppliers involved in inspection, performance testing and maintenance of Automatic Identification Systems (*AIS*). The supplier is to be familiar with the equipment with which it will be involved, such as being a service agent for the equipment manufacturer.

4.2 Quality System

4.2.1 Work Procedures and Instructions

The supplier is to have documented work procedures, as required by **1.2.4**, and instructions containing at least the information on the following **(1)** to **(3)**. The procedures and instructions are also to be kept and be available at all times.

(1) how to prepare testing, examination/inspection of radio equipment;

(2) how to carry out testing, examination/inspection of radio equipment, including instruction for how to operate each item of testing, examination/inspection equipment; and

(3) how to report the results of testing, examination/inspection of radio equipment to Society surveyors and receiving surveyor verification of said results.

4.2.2 Documented Training Procedures

1 The documented training procedure required by **1.2.2** is to contain information on the items listed in **4.2.3(1)** to **(9)** as well as the following **(1)** and **(2)**. In addition, the supplier is to provide the latest versions of all relevant documents.

(1) Radiotelephony; and

(2) Global Maritime Distress and Safety System.

2 In accordance with the procedure specified in **-1**, inspection instructions issued by the Society are to be furnished to radio inspectors without fail.

4.2.3 Reference Documents

The supplier is to have access to the documents listed in the following **(1)** to **(9)**:

(1) *SOLAS* Convention (as amended);

(2) *A*.789(19) (as amended);

(3) *MSC*/*Circ*.1040/*Rev*.1 (as amended);

(4) *MSC*.1/*Circ*.1252 (as amended);

(5) *SN*/*Circ*.227, *SN*/Circ.227/*Corr*.1 and *SN*/Circ.245 (as amended);

(6) *ITU Radio Regulations*;

(7) *IMO* Performance Standards for the equipment for which the service supplier is approved;

(8) Flag State Administration requirements; and

(9) Requirements of the Rules of the Society related to communication equipment, such as **the Rules for Radio Installations**.

4.3 Radio Inspectors and Supervisors

4.3.1 Qualifications, etc.

1 Radio inspectors carrying out inspections of radio equipment are to satisfy the requirements in the following **(1)** to **(7)**, with regard to competence and experience.

(1) Radio inspectors are to have passed the internal training of the supplier in Radiotelephony, GMDSS, and initial and renewal surveys, as applicable.

(2) Either of the following **(a)** or **(b)** is to be fulfilled:

(a) The radio inspector holds evidence that he followed a technical course relevant to radio equipment approved by the relevant Administration; or

(b) The radio inspector has a minimum 1 *year's* technical school training;

(3) The radio inspector is to have at least 1 *year's* experience as an assistant radio inspector;

(4) The radio inspector is to have passed the internal training of the supplier regarding *SOLAS* Convention, *ITU Radio Regulations* and *IMO* Assembly Resolution concerning performance standards, and to be familiar with these technical requirements; and

(5) The radio inspector is to preferably hold an appropriate National Radio Operators Certificate, recognised by the *ITU*, such as a *GMDSS* General Operator's Certificate (*GOC*) or a *GMDSS* Radioelectronic Certificate (*REC*);

(6) The radio inspector is to be aware of any local conditions for radio signal propagation, of regional radio stations and their facilities, and of the *GMDSS* infrastructure; and

(7) The radio inspector is to be able to understand English.

2 Supervisors for inspections of radio equipment are to satisfy the requirements in the following **(1)** to **(4)**:

(1) The supervisor is to have a minimum of 2 *years* education from a technical school relevant to radio;

(2) The supervisor is to preferably have a General Operator's Certificate (*GOC*) or a *GMDSS* Radioelectronic Certificate (*REC*), recognised by the *ITU*, to operate or test radio transmitters;

(3) The supervisor is to be aware of any local conditions for radio signal propagation, of regional radio stations and their facilities, and of the *GMDSS* infrastructure; and

(4) The supervisors is to have a minimum of 2 *years* experience as radio inspector.

4.4 Equipment

4.4.1 Equipment

1 The supplier is to have the major and auxiliary equipment required for correctly performing the inspection. A record of the equipment used is to be kept. The record is to contain information on manufacturer and type of equipment, and a log of maintenance and calibrations.

2 A standard which is relevant to the radio equipment to be tested is to be available for the equipment and is to be cited in the inspection report.

3 For equipment employing software in conjunction with the testing/examination, this software is to be fully described and verified.

4 The supplier is to have at least the equipment listed in the following **(1)** to **(6)**:

(1) Equipment for measuring frequency, voltage, current and resistance;

(2) Equipment for measuring output, reflect effect and modulation on *VHF* and *MF*/*HF*;

(3) Synchroscope;

(4) Acid tester for checking specific gravity of lead batteries;

(5) Tester for checking of correct output from free-float satellite *EPIRB*; and

(6) Equipment for testing the performance of Automatic Identification Systems (*AIS*).

Chapter 5 FIRMS ENGAGED IN PERFORMANCE TESTING OF VDRS AND S-VDRS

5.1 General

5.1.1 Application

This chapter applies to firms engaged in testing and servicing of voyage data recorders (*VDR*) and simplified voyage data recorders (*S-VDR*) in accordance with *SOLAS* regulation V/18.8 and *MSC*.1/*Circ*.1222 (as amended), as applicable.

5.1.2 Approval

1 The supplier is to provide evidence that he has been authorised or licensed by the equipment's manufacturer to service the particular makes and models of equipment for which approval is sought.

2 Where the supplier is also the manufacturer of the voyage data recorder (*VDR*) or simplified voyage data recorder (*S-VDR*) and has elected to apply *MSC*.1/*Circ*.1222 (as amended) in its entirety for the purpose of acting as a service supplier engaged in annual performance testing, the following **(1)** to **(4)** are to apply:

(1) The manufacturer is responsible for appointing manufacturer's authorised service stations to carry out annual performance testing;

(2) The manufacturer is required to be an approved supplier and is to satisfy the requirements for suppliers engaged in annual performance testing of voyage data recorders (*VDR*) and simplified voyage data recorders (*S-VDR*), as applicable;

(3) The manufacturer's authorised service station is not required to be an approved supplier; and

(4) The manufacturer is to demonstrate that *MSC*.1/*Circ*.1222 (as amended) is applied in its entirety.

5.2 Quality System

5.2.1 Work Procedures and Instructions

The supplier is to have documented work procedures, as required by 1.2.4, and instructions containing at least the information specified in the following **(1)** to **(4)**.

(1) Information related to preparing for the performance testing of *VDR*s and *S-VDR*s;

(2) Information related to implementing the performance testing of *VDR*s and *S-VDR*s;

(3) Information related to reporting the results of the performance testing of *VDR*s and *S-VDR*s and receiving surveyor verification of said results; and

(4) Information related to issuing service record certificates.

5.2.2 Documented Training Procedures

The documented training procedure required in 1.2.2 is to contain information on the items listed in 5.2.3(1) to **(6)** as well as the following **(1)** to **(3)**. In addition, the supplier is to provide the latest versions of all relevant documents.

(1) The Society's Rules related to *VDR*s as well as inspection instructions issued by the Society;

(2) The *SOLAS* Convention (as amended); and

(3) Procedures for the continuous education and training of suppliers.

5.2.3 Reference Documents

The supplier is to have access to the documents and applicable industry performance standards listed in the following **(1)** to **(6)**:

(1) *SOLAS* regulation V/18.8 (as amended);

(2) *MSC*.1/*Circ*.1222 (as amended)

(3) *A*.861(20) (as amended by *MSC*.214(81) and *MSC*.333(90), etc.);

(4) *MSC*.163(78) (as amended by *MSC*.214(81), etc.);

(5) Performance standards such *IEC* 61996 (as amended) and *IEC* 61996-2(as amended); and

(6) The following documents related to the *VDR*s which are to be subjected to performance testing:

(a) installation manual;

(b) operation and maintenance manual;

(c) information for use by an investigation authorities; and

(d) any documentation specified in the authorisation or license from the equipment manufacturer.

5.3 Operators and Supervisors

5.3.1 Qualifications, etc

In addition to **1.3.1**, operators are to have conducted performance tests at least once before.

5.4 Equipment

5.4.1 Equipment

The supplier is to have the equipment specified in the following **(1)** to **(3)** available for carrying out of performance testing of *VDR*s and/or *S-VDR*s as well as any other equipment as specified in the authorisation or license from the equipment manufacturer:

(1) instruments for measuring frequency, voltage, current and resistance;

(2) playback hardware of recorded data, speakers, printers and memories; and

(3) playback software of recorded data.

5.5 Reporting to the Society

5.5.1 Test Report

1 The supplier is to issue a certificate of compliance as specified in *SOLAS* regulation V/18.8 (as amended).

2 Annual performance testing of *VDR* and *S-VDR* is to be recorded in the form of the model test report given in the Appendix to *MSC*.1/*Circ*.1222 (as amended, signed and stamped by the supplier and attached to the annual performance test certificate.

3 Where the supplier is also the manufacturer of the voyage data recorder (*VDR*) or simplified voyage data recorder (*S-VDR*) and has selected to apply *MSC*.1/*Circ*.1222 (as amended) in its entirety for the purpose of acting as a service supplier engaged in annual performance testing, the manufacturer is to make arrangements for the following **(1)** to **(3)**:

(1) review of the manufacturer's authorised service station annual performance test report;

(2) analysis of the recorder's 12 hour log; and

(3) checking of the master record/database for the recorder.

5.6 Issuance of Certificates

5.6.1 Issuance of Certificates to Shipowners/Operators

Issue of the annual performance test certificate to the shipowner/operator within 45 days of completion of the annual performance test.

Chapter 6 FIRMS ENGAGED IN INSPECTION AND MAINTENANCE OF FIRE FIGHTING EQUIPMENT AND SYSTEMS

6.1 General

6.1.1 Application

This chapter applies to firms engaged in inspections and maintenance of the following fire fighting equipment and systems and breathing apparatuses:

(1) Fixed fire-extinguishing systems;

(2) Portable fire extinguishers;

(3) Self contained breathing apparatuses;

(4) Emergency escape breathing devices; and

(5) Fire detection and alarm systems

6.1.2 Approval

1 Firms engaged in inspection and maintenance of fixed fire extinguishing systems, portable fire extinguishers and fire detection and alarm systems

(1) Suppliers are to have professional knowledge of the following **(a)** to **(c)**:

(a) fire theory;

(b) fire-fighting and fire-extinguishing appliances sufficient to carry out the maintenance and/or inspection; and

(c) necessary evaluations of the condition of fire-fighting and fire-extinguishing appliances.

(2) Suppliers are to have an understanding of the various types of fires and the extinguishing media to be used on them.

(3) Suppliers who wish to be approved for performing inspection and maintenance of fixed fire-extinguishing systems, are to have an understanding of the principles involved with gas, foam, deluge, sprinkler or water-mist systems, as relevant for the approval being sought.

2 Firms engaged in inspections and maintenance of breathing apparatus

(1) Suppliers are to have the documents containing and have knowledge of the items specified in the following **(a)** and **(b)**:

(a) the equipment and systems sufficient to carry out the inspections and testing of self-contained breathing apparatus to identify standards; and

(b) necessary evaluations of the conditions of self-contained breathing apparatuses.

(2) Suppliers are to have an understanding of the operational requirements involved with self-contained breathing apparatuses and how these are to be maintained.

(3) Suppliers are to demonstrate the necessary safety requirements applicable to self-contained breathing apparatuses.

6.2 Quality System

6.2.1 Work Procedure

The documented work procedure required in 1.2.4 is at least to contain information on items listed in the following **(1)** to **(6)**:

(1) The preparing and implementing of inspections and maintenance of fire fighting equipment and systems;

(2) The recording of conditions of defects found during inspections and maintenance;

(3) The reporting the results of inspections and maintenance and verification by a Society's surveyor;

(4) The issuing of inspection and maintenance record certificates;

(5) References to the Manufacturer's servicing manuals, servicing bulletins, instructions and training manuals, as appropriate, and to international requirements; and

(6) Requirements related to markings and their method of application to the equipment/system.

6.2.2 Training Procedures

The documented training procedure required by 1.2.2 is to contain information on the items listed in 6.3.1 and 6.2.3.

6.2.3 Reference Documents

1 Reference documents by firms engaged in inspections and/or maintenance of fixed fire extinguishing systems, portable fire extinguishers and fire detection and alarm systems

Suppliers are to have access to the documents listed in the following **(1)** to **(14)**:

(1) Manufacturer's servicing manuals, servicing bulletins, instructions and training manuals, as appropriate

(2) Type Approval certificates showing any conditions that may be appropriate during the servicing and/or maintenance of fire-extinguishing equipment and systems

(3) *MSC*.1/*Circ*.1318 (as amended)

(4) *SOLAS* (as amended)

(5) *International Code for Fire Safety Systems* (as amended);

(6) *ISO* 6406 (as amended)

(7) Documentation specified in the authorisation or license from the equipment manufacturer;

(8) *MSC*.1/*Circ*.670 (as amended)

(9) *MSC*.1/*Circ*.798 (as amended)

(10) *MSC*.1/*Circ*.1312 (*MSC*.1/*Circ*.1312/*Corr*.1 and as amended)

(11) *MSC*.1/*Circ*.1432 (*MSC*.1/*Circ*.1516 and as amended)

(12) *A*.951(23) (as amended)

(13) *MSC*.1/*Circ*.1370 (as amended)

(14) Guidelines adopted by *IMO* for fire extinguishing equipment and systems specifically intended for service by service suppliers

2 Reference documents by firms engaged in the inspection and maintenance of breathing apparatuses

Suppliers are to have access to the documents listed in the following **(1)** and **(2)**:

(1) Manufacturers' servicing manuals, servicing bulletins, instructions and training manuals, as appropriate; and

(2) Type Approval certificates showing any conditions which may be appropriate during the servicing and/or maintenance of self-contained breathing apparatuses.

6.3 Operators and Supervisors

6.3.1 Training

Operators and supervisors are to have sufficient knowledge as to the following **(1)** to **(5)**:

(1) Construction and services of fire fighting equipment and systems and breathing apparatus;

(2) Operational methods of the equipment used for inspection and maintenance;

(3) *SOLAS* (as amended) and *MSC*.1/*Circ*.1432 (as amended, including the amendments by *MSC*.1/*Circ*.1516);

(4) Flag Administration requirements; and

(5) Requirements and inspection and maintenance instructions issued by the Society.

6.3.2 Qualifications, etc.

1 As for competence and experience, operators are to comply with the requirements specified in the following **(1)** and **(2)**:

(1) Operators are to have qualifications for the inspection and maintenance of fire fighting equipment and systems and breathing apparatuses approved by the authorities concerned; and

(2) Operators are to have at least 1 *year* experience of on-the-job training for inspection and maintenance.

2 Supervisors carrying out inspection and maintenance are to have at least 2 *year* experience as an operator.

6.4 Equipment

6.4.1 Equipment

1 If suppliers undertake shore-based inspecting and maintenance, they are to maintain and implement procedures for workshop cleanliness, ventilation and arrangement, with due cognisance of the spares and extinguishing media being stored, to ensure safe and effective working procedures.

2 If suppliers undertake inspecting and maintenance onboard, they are to provide the appropriate facilities to either complete the work onboard or remove the necessary items to their workshops.

3 Suppliers are to have the equipment for inspection and maintenance specified in the following **(1)** to **(5)**:

(1) General
- (a) Reflecting mirrors and lighting to inspect inside of the fire extinguishers;
- (b) Pressure gauges;
- (c) Cylinder dryers;
- (d) Gases (carbon dioxide, halon and nitrogen) filling equipment;
- (e) Contents of filling;
- (f) Sufficient and appropriate spare parts;
- (g) Sufficient and appropriate tools;
- (h) Various scales to weigh items;
- (i) Means to hydrostatic pressure test components/systems/storage bottles;
- (j) Liquid/gas, flow meters, as appropriate;
- (k) Pressure gauges or manometers; and
- (l) Specific equipment as may be specified by Manufacturer.

(2) Fixed fire-extinguishing systems
- (a) Gas level meters or measuring scales
- (b) Tools for ventilation test
- (c) Chemical analysis equipment (in the case of foam concentrates)

(3) Portable fire extinguishers
- (a) Equipment for fixing fire extinguishers, such as a clamp
- (b) Spanners to open and close caps
- (c) Caps of fire extinguishers for the pressure test
- (d) Pumps for the hydraulic pressure test
- (e) Testing bays
- (f) Level measuring equipment for bottles
- (g) Recharging facilities for pressurized bottles, extinguishers and cartridges

(4) Self contained breathing apparatus
- (a) Equipment for checking air quality
- (b) Recharging facilities for breathing apparatuses

(5) Fire detection and alarm systems
- (a) Equipment for operation tests
- (b) Tools for inspections of electrical equipment, such as a tester

Chapter 7 FIRMS ENGAGED IN SERVICING LIFE-SAVING APPLIANCES

7.1 General

7.1.1 Application

This chapter applies to firms engaged in the servicing of the life-saving appliances listed below:

(1) Inflatable liferafts

(2) Inflatable lifejackets

(3) Hydrostatic release units

(4) Marine evacuation systems

7.2 Quality System

7.2.1 Work Procedures and Instructions

The supplier is to have documented work procedures, as required by **1.2.4**, and instructions containing at least the information specified in the following **(1)** to **(4)**. Where inflatable liferafts are subject to extended service intervals in accordance with the requirements of *SOLAS* Regulation III/20.8.3 (as amended), *MSC*.1/*Circ*.1328 (as amended) is to be followed in addition to *A*.761(18) (as amended by *MSC*.55(66), etc.).

(1) Information related to how to carry out services of life-saving appliances, including the preparation and implementation of such services ;

(2) Information related to recording the conditions of defects found during servicing;

(3) Information related to report the results of servicing to Society surveyors and receiving surveyor verification of said results; and

(4) Information related to the issuing service record certificates.

7.2.2 Documented Training Procedures

The documented training procedure required by **1.2.2** is to contain information on the items listed in **7.2.3(1)** to **(6)** as well as the following **(1)** to **(5)**. In addition, the supplier is to provide the latest versions of all relevant documents.

(1) The construction and service of the life-saving appliances;

(2) The operational methods of the equipment used to service life-saving appliances;

(3) The *SOLAS* Convention (as amended) and the *LSA* Code (as amended);

(4) Special requirements of the concerned flag administration (if any); and

(5) The Society's Rules related to life-saving appliances as well as inspection instructions for life-saving appliances issued by the Society.

7.2.3 Reference Documents

The supplier is to have access to the documents listed in the following **(1)** to **(6)**:

(1) *A*.761(18) (as amended by *MSC*.55(66), etc.)

(2) *MSC*.55(66) (as amended)

(3) *MSC*.1/*Circ*.1328 (as amended)

(4) Manufacturer's servicing manuals, servicing bulletins, instructions and training manuals, as appropriate

(5) Type Approval certificates, showing any conditions that may be appropriate during the servicing and/or maintenance of inflatable liferafts, inflatable lifejackets, and hydrostatic release units

(6) Chapter IV of the *LSA* Code (as amended) and *SOLAS Conference Resolution* 4 (1995) regarding marine evacuation systems

7.3 Operators and Supervisors

7.3.1 Qualifications, etc.

The supplier is to provide evidence that it has been authorised or licensed to service the particular makes and models of equipment for which approval is sought by the equipment's manufacturer.

7.4 Equipment

7.4.1 Equipment

The supplier is to have the equipment for servicing of the life-saving appliances specified in the following **(1)** to **(6)**, in addition to any equipment required after taking into account *A.*761(18) (as amended by *MSC.*55(66), etc.). Where inflatable liferafts are subject to extended service intervals, *MSC.*1/*Circ.*1328 (as amended) is also to be followed.

(1) Pressure gauges
(2) Thermometers
(3) Barometers
(4) Air pumps capable of air cleaning and drying (including all necessary high-pressure hoses and adapters)
(5) A weight scale for inflation gas cylinders
(6) Inflation gases

Chapter 8 FIRMS ENGAGED IN TIGHTNESS TESTING OF CLOSING APPLIANCES SUCH AS HATCHES, DOORS ETC. WITH ULTRASONIC EQUIPMENT

8.1 General

8.1.1 Application

This chapter applies to firms engaged in the ultrasonic tightness testing of closing appliances such as hatches, doors etc.

8.2 Quality System

8.2.1 Work Procedures

The documented work procedures specified in 1.2.4 are to contain information on at least the following items:

(1) Preparation of ultrasonic tightness testing of hatches, doors etc;

(2) Manuals of the hatches, doors etc construction for operators;

(3) Adjustment and operation of the ultrasonic test equipment;

(4) Maintenance of the ultrasonic test equipment;

(5) Criteria for evaluating test results; and

(6) Reporting test results and obtaining Society surveyor verification.

8.2.2 Training Procedures

The documented training procedures specified in 1.2.2 are to include information on ways to acquire knowledge about the following items:

(1) Operation of ultrasonic test equipment

(2) The designs, functions and sealing features for each type of closing appliance, such as hatches and doors, etc.

(3) Theoretical and practical aspects of the onboard operation of ultrasonic test equipment

(4) Safe onboard work operations;

(5) Society requirements and inspection instructions for the ultrasonic tightness testing of hatches, doors etc.

8.3 Operators and Supervisors

8.3.1 Qualifications

1 Operators and supervisors carrying out ultrasonic tightness testing of hatches are to have sufficient knowledge as to the above 8.2.2(1) through **(5)**.

2 Operators carrying out the ultrasonic tightness testing of closing appliances, such as hatches and doors, etc., are to have the following competence and experience:

(1) Suitable qualifications determined by relevant public organizations or those considered equivalent thereto; and

(2) Experience operating and maintaining various closing appliances, such as hatches and doors, etc.

3 Supervisors carrying out the ultrasonic tightness testing of hatches, doors etc with ultrasonic equipment are to have 2 *years* or more experience as an operator.

8.4 Equipment

8.4.1 Equipment

1 Suppliers are to have equipment for the ultrasonic testing of closing appliances, such as hatches and doors, etc., which complies with the following functional requirements:

(1) The transmitter is to indicate a uniform value at any point in a tested area under the condition in which the closing appliance, such as a hatch, and door, etc. is completely open.

(2) The measurement sensitivity of the receiver is to be adjustable.

(3) The receiver is to be provided with an audible signal and a visual readout in decibels.

2 The ultrasonic test equipment is to be deemed appropriate by the Society for the purpose of detecting leakages in closing appliances such as hatches and doors, etc..

3 At least once every two years, calibration tests are to be carried out by the manufacturer or laboratories authorized by the manufacturer.

Chapter 9 FIRMS ENGAGED IN TESTING OF COATING SYSTEMS

9.1 General

9.1.1 Application

This chapter applies to firms engaged in testing of coatings systems according to *IMO PERFORMANCE STANDARD FOR PROTECTIVE COATINGS* (Resolution *MSC*.215(82) (as amended) and Resolution 288(87) (as amended)) and the relevant *IACS* unified interpretation.

9.2 Quality System

9.2.1 Work Procedure

The documented work procedure required in 1.2.4 is at least to contain information on items listed in the following **(1)** to **(4)**:

(1) Preparation of the testing of coating systems

(2) Implementation of the testing of coating systems

(3) Criteria for the test results of coating systems

(4) Issue of statement of compliance

9.2.2 Training Procedures

The documented training procedure required by 1.2.2 is to contain information on the items listed in 9.4.1. Suppliers are to provide the latest versions of all relevant reference documents.

9.3 Initial Assessment

9.3.1 Initial Assessment

1 Initial Assessment

Suppliers are to submit 3 copies each of the following documents in addition to the documents specified in 2.3-2, Part 1.

(1) A detailed list of the Laboratory test equipment for the *IMO* Resolution *MSC*.215(82) or *MSC*.288(87) as may be amended coating approval;

(2) A detailed list of reference documents comprising a minimum those referred to in *MSC*.215(82) or *MSC*.288(87) as may be amended that are available in the laboratory;

(3) Details of testing panel preparation, procedure of test panel identification, coating application, test procedures and a sample test report (Report forms for the test procedures of the coating qualification and crossover tests for seawater ballast tanks, etc. are to be as referred to **Form 9-1** and 9-2.);

(4) Details of exposure method and site for weathering primed test panels;

(5) A sample daily or weekly log/form for recording test condition and observations including unforeseen interruption of the exposure cycle with corrective actions;

(6) Details of any sub-contracting agreements if available; and

(7) Comparison test report with an approved coating system or laboratory if available.

9.3.2 Audit

Audits of the test laboratories are to be based on this procedure and the standards listed in the *IMO* Resolution *MSC*.215(82) as amended and/or *MSC*.288(87) as amended for the coating approval.

9.4 Operators and Supervisors

9.4.1 Training

1 Operators and supervisors are to have sufficient knowledge of the following **(1)** and **(2)**:

(1) *MSC*.215(82) or *MSC*.288(87) as may be amended; and

(2) Operational methods of the equipment used for the testing of coating systems.

9.5 Equipment

9.5.1 Equipment

1 Suppliers are to have the equipment for testing of coating systems for seawater ballast tanks, etc. specified in the following **(1)** to **(5)**:

(1) Tanks for testing simulated ballast tank coatings (Equipment for wave movement simulation is not necessary for firms only engaged in cross over testing.);

(2) Condensation chambers (not necessary for firms only engaged in cross over testing);

(3) Infrared (IR) identification equipment;

(4) Detector; and

(5) Tensile testing machines.

2 Suppliers are to have the equipment for testing of coating systems for cargo oil tanks specified in the following **(1)** to **(5)**:

(1) Gas-tight cabinet test equipment;

(2) Immersion test equipment;

(3) Infrared (*IR*) identification equipment;

(4) Detector; and

(5) Tensile testing machines.

Form 9-1

EXAMPLE COATING PRODUCER

BALLAST TANK COATING TEST OF 2 * 160 µm EXAMPLE EPOXY PAINT ON EXAMPLE SHOP PRIMER

Table of contents

1 SUMMARY

The coating system, 2 * 160 µm Example Epoxy Paint from Example Coating Producer, applied to Example zinc silicate shop primed panels has been tested in accordance with the IMO Performance Standard for protective Coatings /1/. The coating was applied after 2 months weathering of the shop primer.
The results from the testing show that the Example Epoxy Paint from Example Coating Producer has passed all the requirements given in the Performance Standard for Protective Coatings /1/.

2 SCOPE OF WORK

The following work and tests have been performed:

- Identification of the coating system
- Film thickness measurements and pin hole detection on panels before testing
- 180 days testing in condensation chamber
- 180 days testing in wave tank
- 180 days testing in heating cabinet
- Evaluation of results after testing, including blister detection, undercutting from scribe, adhesion and coating flexibility
- Evaluation of cathodic protection during testing (wave tank)

3 Work carried out prior to exposure

3.1 Identification

The coating system was identified by infrared scanning (by means of a ….(name and model of the instrument)) and by determination of specific gravity (according to ISO 2811 -1) by means of an Pyknometer (name and model of the instrument) .

3.2 Surface preparation

Surface preparation was carried out according to the data given in Table B-1 Appendix B.

3.3 Application

3.3.1 Application procedure

Example zinc silicate shop primer was applied to the blast cleaned panels according to the data given in Table 2. The shop primed panels were then exposed out-door for 2 months. The environmental data for the exposure period is given in Appendix A.

Two coats (specified dry film thickness 160 µm per coat) of Example Epoxy Paint were applied to the weathered and cleaned zinc silicate shop primed panels. The application data are given in Table B-2 Appendix B.

3.3.2 Coding

The panels were coded as shown in Figure B-1 in Appendix B.

3.4 Dry film thickness

The dry film thickness measurements were carried out by means of a (name and model of the instrument) dry film thickness unit before testing. Templates, as given in Figure B-2 in Appendix B, were used for the measurements. The results from the measurements are given in Table B-3 in Appendix B.

3.5 Pin hole detection

Pin hole detection was performed on the coated test panels before testing. The detection was carried out by means of a (name and model of the instrument) Pinhole detector at 90 volts.

4 EXPOSURE

The testing was carried out according to the IMO Performance Standard for Protective Coatings /1/. The exposure was started 02.11.07 and terminated 14.06.08.

5 TESTS CARRIED OUT AFTER EXPOSURE

Evaluation of blisters and rust, adhesion, undercutting from scribe and flexibility was carried out according to specifications and standards referred to in the IMO Performance Standard /1/.

6 TEST RESULTS

The results of the product identification are given in Table 1.
The results of the examination of the coated test panels are schematically given in Table 2 and more detailed in Appendix B. Pictures of the panels after exposure are enclosed as Appendix C.

Table 1 Results of analyses (Product identification)

Product	Batch no.	IR identification (main components)	Specific gravity (g/cm^3)
Example, part A	123	Ethyl silicate	0.93
Example, part B	234	NA*	2.21
Example Epoxy Paint Grey, base	345	Epoxy	1.48
Example Epoxy Paint hardener	456	Amide	0.96
Example Epoxy Paint Buff, base	567	Epoxy	1.47

* Identified and spectres stored. No generic correlation to the spectres in the data base found.

Table 2 Results of examination of the coated test samples

Test parameter	Acceptance criteria	Test results	Passed / failed
Pin holes (no)	No pinholes	0	Passed
Blisters and rust (all panels)[1)]	No blisters or rust	0	Passed
Adhesion values (MPa) – wave tank panels[2)]	>3.5 adhesive failure >3.0 cohesive failure	Average: 5.4 Maximum: 7.4 Minimum: 4.2 70 – 80 % cohesive failure 20 – 30 % adhesive failure	Passed
Adhesion values (MPa) – condensation chamber panels[3)]	>3.5 adhesive failure >3.0 cohesive failure	Average: 5.6 Maximum: 6.9 Minimum: 4.1 70 – 80 % cohesive failure 20 – 30 % adhesive failure	Passed
Undercutting from scribe (mm) - average maximum values wave tank panels[4)]	< 8	3.5	Passed
Cathodic disbondment (mm) – Wave tank bottom panel[5)]	< 8	7.2	Passed
Current demand (mA/m^2) – bottom panel[5)]	< 5	3.3	Passed
U-beam[1)]	No degradation (defects, cracking or detachment at the angle or weld)	No degradation	Passed

1) Details of blister and rust and u-beam in Table B-4 Appendix B.
2) Details of Pull-off adhesion test, wave tank and heat exposed panels in Table B-5 Appendix B.
3) Details of Pull-off adhesion test, condensation chamber in Table B-6 Appendix B.
4) Details of physical testing in Table B-7 Appendix B.
5) Details of Cathodic Protection in Table B-8 Appendix B.

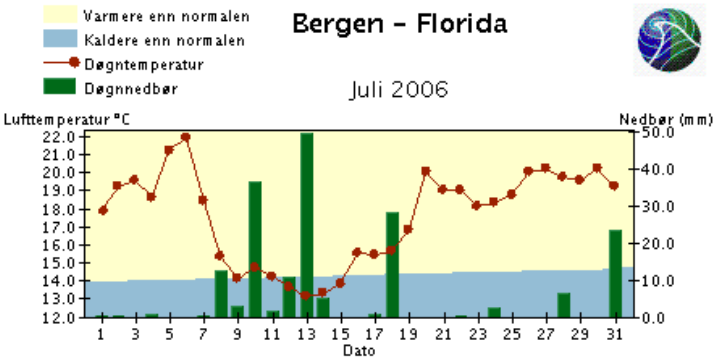
7 CONCLUSION

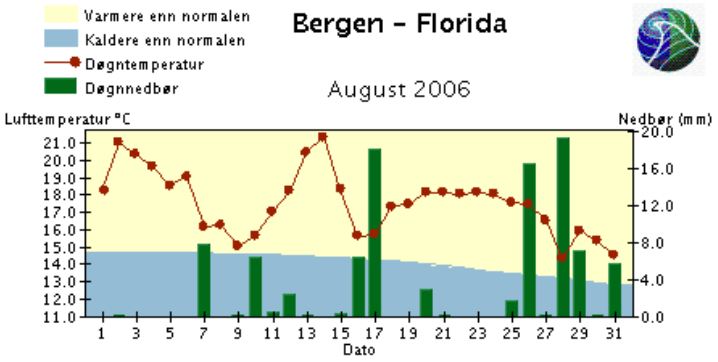
The results from the testing show that Example Epoxy Paint from Example Coating Producer has passed all the requirements given in the Performance Standard for Protective Coatings /1/.

8 REFERENCES

/1/ MSC 215 (82) :2006 Performance Standard for Protective Coatings for dedicated sea water ballast tanks in all types of ships and double-side skin spaces of bulk carriers

9 APPENDIX A - ENVIRONMENTAL DATA - WEATHERING OF SHOP PRIMED PANELS





10 APPENDIX B - DETAILS OF SURFACE PREPARATION, APPLICATION AND TEST RESULTS

Table B-1 Surface preparation data.

Surface preparation date	November 2007 The prepared panels were stored at ambient in- door conditions until use
Surface preparation method	Blast cleaning
Blasting standard	Sa 2 ½
Abrasive used	AlSil A3+ steel shot
Roughness (µm)	R_{max} 50 -75
Water soluble salts	32, 38 and 40 mg / m^2 Spot check performed on 3 out of 30 panels produced at the same time
Dust and abrasive inclusions	No dust or abrasive inclusions observed by visual examination.
Treatment of shopprimer after weathering	Low pressure washing
Water soluble salts after treatment of shopprimer	Spot check 28, 41 and 38 mg / m^2

Table B-2 Application data.

Coating data:	Shop primer	1st coat	2nd coat
Paint system:	Example red	Example Epoxy Paint Al Grey	Example Epoxy Paint Buff
Manufacturer:	Example Coating Producer		
Date	20.11.07	22.01.08	23.01.08
Time	10:00	10:00	10:00
Batch No. curing agent			
Batch No. base			
Thinner name (if used)			
Batch No. thinner (if used)			
Equipment used	Graco King 68:1	Graco King 68:1	Graco King 68:1
Air pressure (bar)	100	170	170
Size nozzle (inches)	0.021	0.021	0.021
Fan width (º)	60	60	60
Mix. ratio (volume)	A: B = 3:1	3:1	3:1
Volume solid (volume)	30 ± 2	80	80
Wet film thickness (µ)	55-70	275	275
Dry film thickness (µ)	15-25	See Table 3	See Table 4
Thinner (%)	0	0	0
Air temperature (ºC)	25	25	25
Humidity (% RH)	78	80	82
Steel temp. (ºC)	25	25	25
Dew point (ºC)	20	20	20

Present at application of shop primer: nn – MM Group (painter) and mm – laboratory. Present at application of test coating: kk - Example Coating Producer, nn – MM Group, and mm – laboratory.

Comments:

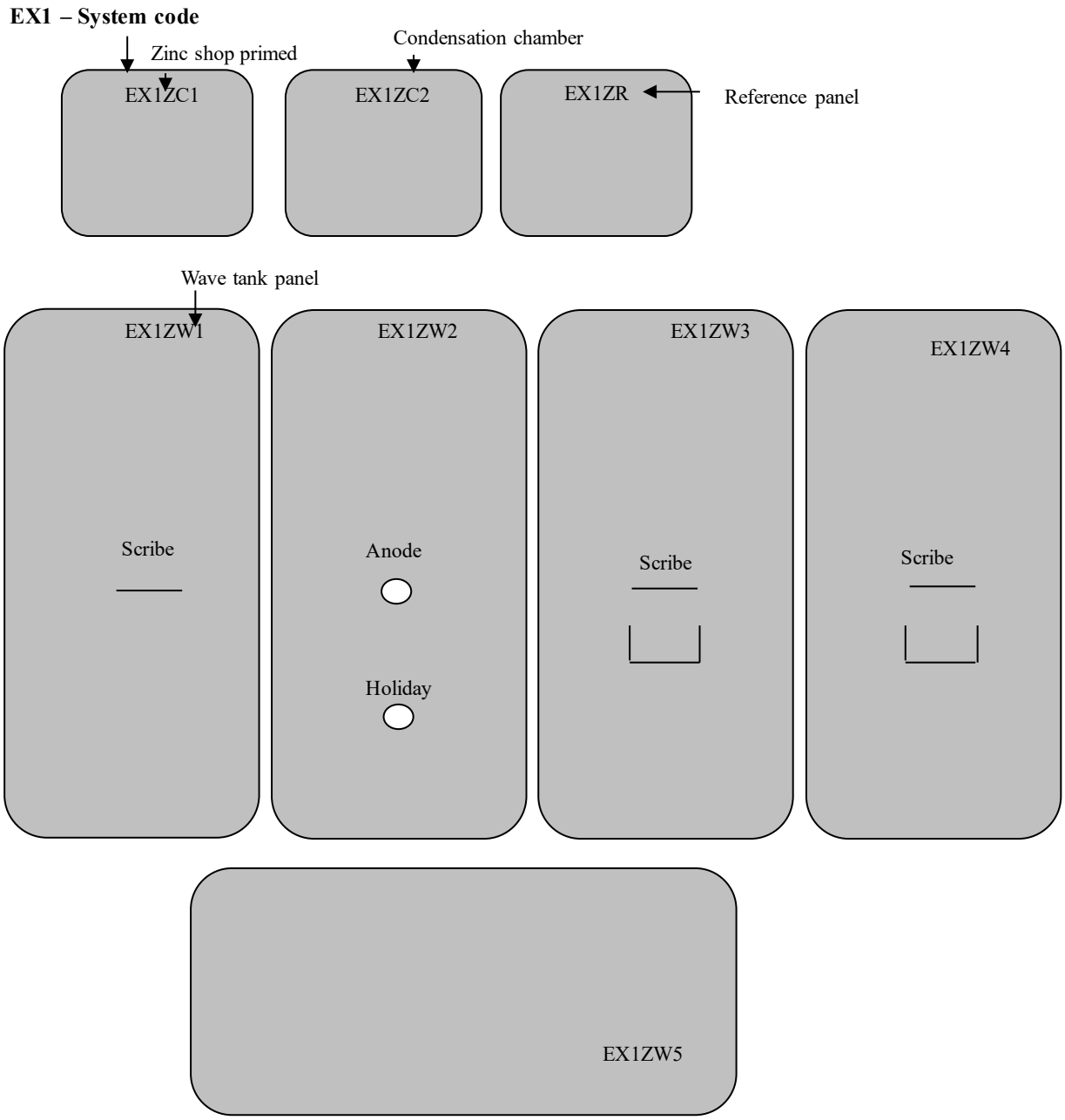


Figure B-1 Coding.

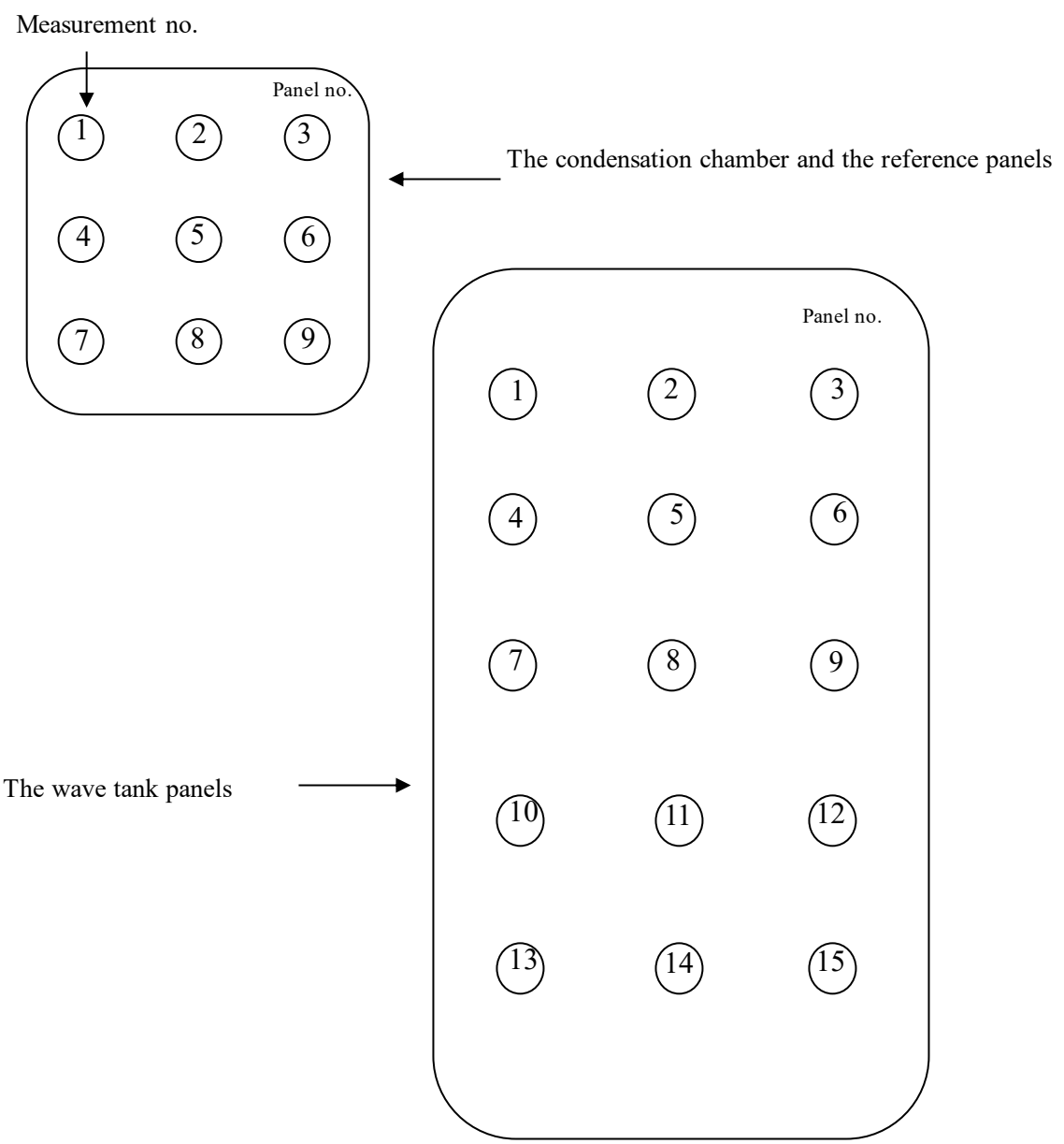


Figure B-2 Thickness measurement locations.

Table B-3 Total Dry Film Thickness – Example Epoxy Paint (20 µm subtracted for shop primed substrate).

Measure ment	Panel no EX1-								
	ZW1	ZW2	ZW3	ZW4	ZW5	ZC1	ZC2	ZR	Total
1	332	330	338	322	324	325	320	354	
2	324	356	362	360	388	360	322	320	
3	320	320	328	326	336	342	334	322	
4	320	344	368	320	320	330	340	364	
5	352	356	412	350	326	346	358	336	
6	340	320	340	320	320	362	342	342	
7	320	326	366	356	320	340	330	320	
8	380	348	428	398	348	358	320	346	
9	338	320	380	364	330	338	322	320	
10	320	319	356	338	316				
11	342	360	408	456	340				
12	316	320	326	324	324				
13	320	344	356	332	320				
14	366	424	410	380	366				
15	342	348	330	350	346				
Max	380	424	428	456	388	362	358	364	456
Min	316	319	326	320	316	325	320	320	316
Average	**335**	**342**	**367**	**353**	**335**	**345**	**332**	**336**	**344**
StDev	19	27	34	37	20	13	13	17	27

Table B-4 Development of blisters and rust after exposure.

Code	Description	Blister size	Blister density	Rust	Other defects
EX1ZW1	Top wave tank panel with scribe	0	0	0	0
EX1ZW2	Bottom wave tank panel with anode	0	0	0	0
EX1ZW3	Side wave tank panel with scribe and U-beam Cooling	0	0	0	0
EX1ZW4	Side wave tank panel with scribe and U-beam No cooling	0	0	0	0
EX1ZW5	Panel exposed to 70 ºC air (heating chamber)	0	0	0	0
EX1ZC1	Condensation chamber	0	0	0	0
EX1ZC2	Condensation chamber	0	0	0	0

Table B-5 Results of the Pull-off adhesion test, wave tank and heat exposed panels.

Panel no.	Adhesion strength (MPa)	Fracture
Top wave tank panel with scribe W1	4.5	30 % B, 20 % C, 30 % C/D, 20 % D
	5.2	20 % B, 30 % C, 30 % C/D, 20 % D
	4.8	30 % B, 20 % C, 20 % C/D, 30 % D
Bottom wave tank panel with anode W2	5.3	30 % B, 20 % C, 20 % C/D, 30 % D
	4.2	30 % B, 20 % C, 30 % C/D, 20 % D
	6.1	20 % B, 30 % C, 30 % C/D, 20 % D
Side wave tank panel with scribe and U-beam Cooling W3	7.0	20 % B, 30 % C, 30 % C/D, 20 % D
	4.6	30 % B, 20 % C, 20 % C/D, 30 % D
	5.3	30 % B, 20 % C, 30 % C/D, 20 % D
Side wave tank panel with scribe and U-beam No cooling W4	5.3	30 % B, 20 % C, 30 % C/D, 20 % D
	7.4	20 % B, 30 % C, 30 % C/D, 20 % D
	5.1	30 % B, 20 % C, 20 % C/D, 30 % D
Panel exposed to 70 ºC air (heating chamber) W5	4.6	30 % B, 20 % C, 20 % C/D, 30 % D
	6.6	30 % B, 20 % C, 30 % C/D, 20 % D
	5.3	20 % B, 30 % C, 30 % C/D, 20 % D
Average	5.4	70 – 80 % Cohesive failure, 20 – 30 % Adhesive
Max	7.4	
Min	4.2	

A/B Fracture between the steel surface and 1st coat (shop primer).

B Fracture in the 1st coat.

B/C Fracture between the 1st and 2nd coat.

C Fracture in the 2nd coat.

C/D Fracture between the 2nd and 3rd coat.

D Fracture in the 3rd coat

-/Y Fracture between the outer coat and the glue.

Table B-6 Results of the Pull-off adhesion test, condensation chamber and reference panels.

Condensation chamber panel C1	6.1	20 % B, 30 % C, 30 % C/D, 20 % D
	4.1	30 % B, 20 % C, 20 % C/D, 30 % D
	6.9	30 % B, 20 % C, 30 % C/D, 20 % D
Condensation chamber panel C2	4.6	30 % B, 20 % C, 30 % C/D, 20 % D
	5.2	20 % B, 30 % C, 30 % C/D, 20 % D
	6.4	30 % B, 20 % C, 20 % C/D, 30 % D
Average	5.6	70 – 80 % Cohesive failure, 20 – 30 % Adhesive
Max	6.9	
Min	4.1	
Reference panel (not exposed) R	4.1	30 % B, 20 % C, 20 % C/D, 30 % D
	4.5	30 % B, 20 % C, 30 % C/D, 20 % D
	5.0	20 % B, 30 % C, 30 % C/D, 20 % D

A/B Fracture between the steel surface and 1st coat (shop primer).

B Fracture in the 1st coat.

B/C Fracture between the 1st and 2nd coat.

C Fracture in the 2nd coat.

C/D Fracture between the 2nd and 3rd coat.

D Fracture in the 3rd coat

-/Y Fracture between the outer coat and the glue.

Table B-7 Results of physical testing.

Panel	Undercutting from scribe (mm)*	Flexibility**	Comment
Top wave tank panel EX1ZW1	5.7	150 mm	≤ 2 % elongation
Cooled side wave tank panel EX1ZW3	2.2	NA	
Not cooled side wave tank panel EX1ZW4	2.6	NA	
Average	3.5		
Reference panel (not exposed) EX1ZR	Not applicable	75 mm	≤ 4 % elongation

* *Evaluated by scraping with knife.*

** *Flexibility[1)] modified according to panel thickness (3 mm steel, 300 µm coating, 150 mm cylindrical mandrel gives 2% elongation) for information only;1) Reference standards: ASTM D4145:1983. Standard Test Method for Coating Flexibility of Prepainted Sheet.*

Undercutting from scribe:

"Rinse the test panel with fresh tap water immediately after exposure, blowing off residues of water from the surface using compressed air if necessary, and inspect for visible changes. Carefully remove any loose coating using a knife blade held at an angle, positioning the blade at the coating/substrate interface and lifting the coating away from the substrate." (From ISO 4328-8:2005, section 5.3.1.)

"Calculate the degree of delamination d, in millimetre using the equation d=(d1-w)/2 where d1 is the mean overall width of the zone of delamination, in millimetres; w is the width of the original scribe, in millimetres." (From ISO 4328-8:2005, section 6.1.)

"Calculate the degree of corrosion c, in millimetre using the equation c=(wc-w)/2 where wc is the mean overall width of the zone of corrosion, in millimetres; w is the width of the original scribe, in millimetres." (From ISO 4328-8:2005, section 6.2.)

Additionally IACS interpretation of IMO PSPC: Undercutting from scribe can be either corrosion of the steel substrate or delamination between the shop primer and the epoxy coating (compability test). For PSPC maximum width is used (MSC.215(82), Appendix 1, section 2.2.6 and not mean overall width as in the ISO standard. The average of the three maximum records (three panels with scribe) is used for acceptance and shall be less than 8 mm for epoxy based systems to be acceptable. Cohesive adhesion failure in the shop primer is not to be included as part of the delamination.

Table B-8 Results of Cathodic Protection (CP).

Panel	Cathodic disbondment (mm)	Blisters / rust	Zinc anode weight loss (g)	Current demand (mA/ m^2)
EX1ZW2	7.2	0	1.2345	3.32

Exposure time: *120 days (Total time 180 days. Each cycle consists of 2 weeks seawater immersion and 1 week exposure in air)*

Utilisation factor: *0.8*

Consumption rate for Zn-anodes: *11.3 kg/A year*

Cathodic protection; disbonding from artificial holiday:

"On completion of the test, thoroughly rinse the panel with tap water, taking care not to damage the coating." (From ISO 15711:2003)

"Assess loss of adhesion at the artificial holiday by using a sharp knife to make two cuts through the coating to the substrates, intersection at the holiday. With the point of the knife, attempt to lift and peel back the coating from around the holiday. Record whether the adhesion of the coating to the substrate has been reduced and the approximate distance, in millimetres, that the coating can be peeled." (From ISO 15711:2003)

Additionally IACS interpretation of IMO PSPC: Repeat the cutting and lifting all around the artificial holiday to find the maximum loss of adhesion. Disbonding from artificial holiday can be either loss of adhesion to the steel substrate or between the shop primer and the epoxy coating and shall be less than 8 mm for epoxy based systems to be acceptable (compability test). Cohesive adhesion failure in the shop primer is not to be included as part of the loss of adhesion.

11 APPENDIX C – PHOTO DOCUMENTATION

(It should be overview pictures of the panels and close up pictures of the undercutting from scribe and the disbonding from artificial holiday)

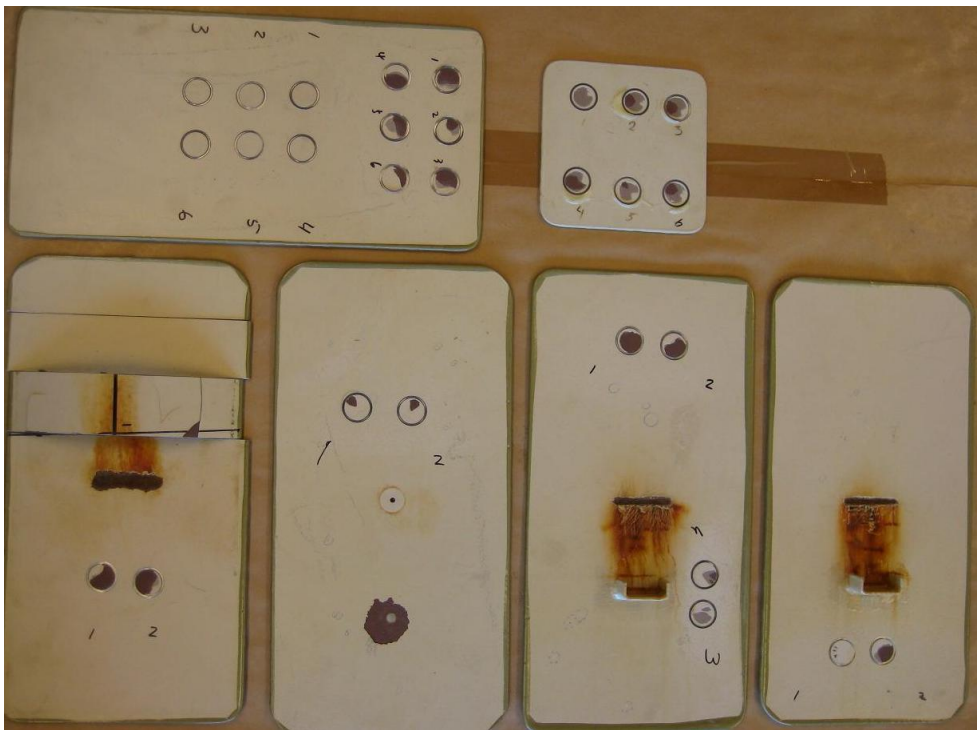


Figure C-1 Overview picture of the panels after exposure in the wave tank and the heating chamber. Reference panel not exposed on the top right. Picture taken after examination (example picture not connected to example results in this model report).

Picture missing

Figure C-2 Overview picture of the panels exposed in condensation chamber (example picture not connected to example results in this model report).

Figure C-3 Scribe area of top wave tank panel before removing of loose coating (example picture not connected to example results in this model report).

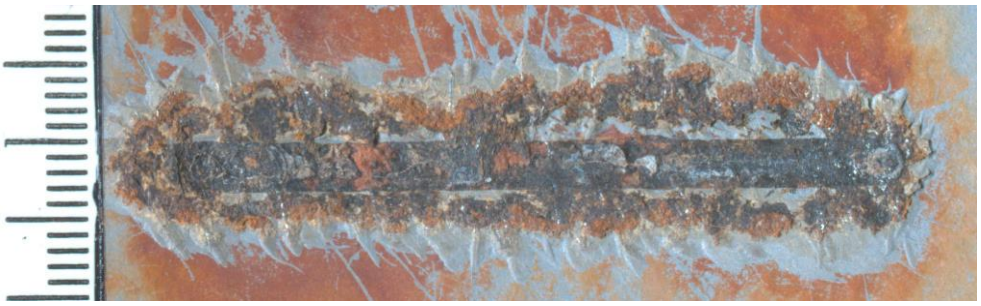


Figure C-4 Undercutting from scribe, top wave tank panel (example picture not connected to example results in this model report).

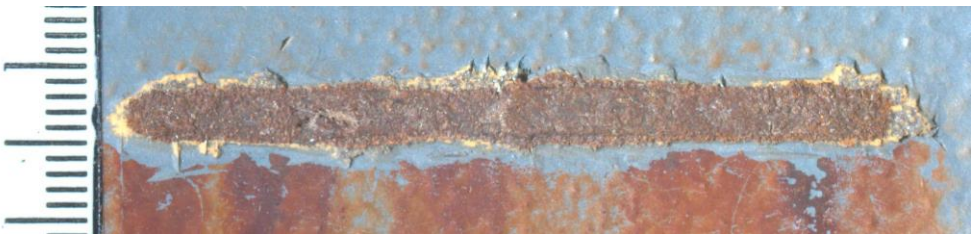


Figure C-5 Undercutting from scribe, side wave tank panel without cooling (example picture not connected to example results in this model report).

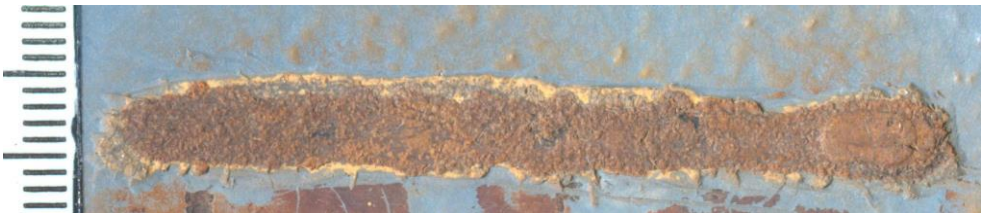


Figure C-6 Undercutting from scribe, side wave tank panel with cooling (example picture not connected to example results in this model report).

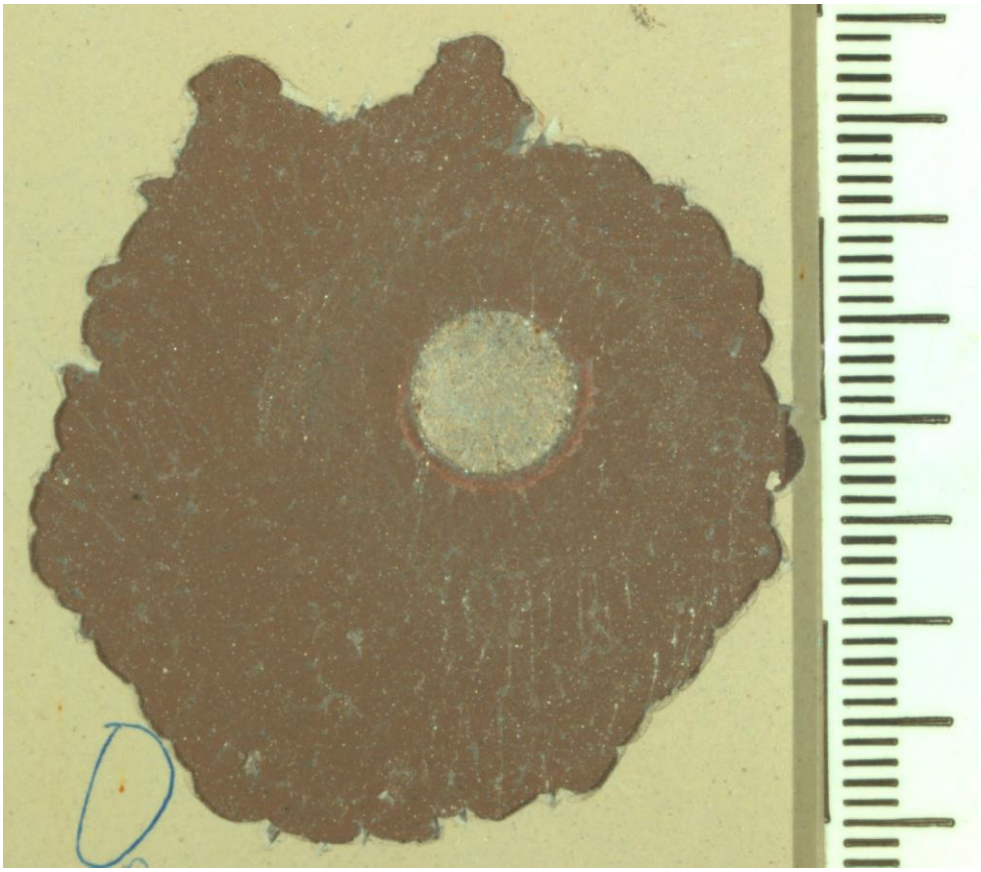


Figure C-7 Disbonding from artificial holiday, bottom wave tank panel (example picture not connected to example results in this model report).

12 APPENDIX D - INFRARED SCANNING CHARTS

Figure D-1

Figure D-2

Figure D-3

Figure D-4

Figure D-5

Figure D-6

Form 9-2

EXAMPLE COATING PRODUCER

BALLAST TANK COATING TEST OF 2 * 160 µm EXAMPLE EPOXY PAINT ON EXAMPLE SHOP PRIMER

Table of contents

1 SUMMARY

The coating system, 2 * 160 µm Example Epoxy Paint from Example Coating Producer, applied to Example zinc silicate shop primed panels has been tested in accordance with the IMO Performance Standard for protective Coatings /1/, section 1.7 of appendix 1 to annex 1 without wave movement (crossover test). The coating was applied after 2 months weathering of the shop primer.

The results from the testing show that the Example Epoxy Paint from Example Coating Producer has passed all the requirements given in the Performance Standard for Protective Coatings /1/.

2 SCOPE OF WORK

The following work and tests have been performed:

- Identification of the coating system
- Film thickness measurements and pin hole detection on panels before testing
- 180 days testing in wave tank conditions, but without wave movement
- Evaluation of results after testing, including blister detection, disbonding from artificial holiday and adhesion

3 WORK CARRIED OUT PRIOR TO EXPOSURE

3.1 Identification

The coating system was identified by infrared scanning (by means of a ….(name and model of the instrument)),and by determination of specific gravity (according to ISO 2811 -1) by means of an Pyknometer (name and model of the instrument).

3.2 Surface preparation

Surface preparation was carried out according to the data given in Table B-1 Appendix B.

3.3 Application

3.3.1 Application procedure

Example zinc silicate shop primer was applied to the blast cleaned panels according to the data given in Table 2. The shop primed panel were then exposed out-door for 2 months. The environmental data for the exposure period is given in Appendix A.

Two coats (specified dry film thickness 160 µm per coat) of Example Epoxy Paint were applied to the weathered and cleaned zinc silicate shop primed panel. The application data are given in Table B-2 Appendix B.

3.3.2 Coding

The panel were coded as shown in Figure B-1 in Appendix B.

3.4 Dry film thickness

The dry film thickness measurements were carried out by means of a (name and model of the instrument) dry film thickness unit before testing. Templates, as given in Figure B-2 in Appendix B, were used for the measurements. The results from the measurements are given in Table B-3 in Appendix B.

3.5 Pin hole detection

Pin hole detection was performed on the coated test panel before testing. The detection was carried out by means of a (name and model of the instrument) Pinhole detector at 90 volts.

4 EXPOSURE

The testing was carried out according to the IMO Performance Standard for Protective Coatings /1/. The exposure was started 02.11.07 and terminated 14.06.08.

5 TESTS CARRIED OUT AFTER EXPOSURE

Evaluation of blisters and rust, adhesion, undercutting from scribe and flexibility was carried out according to specifications and standards referred to in the IMO Performance Standard /1/.

6 TEST RESULTS

The results of the product identification are given in Table 1.
The results of the examination of the coated test panels are schematically given in Table 2 and more detailed in Appendix B. Pictures of the panels after exposure are enclosed as Appendix C.

Table 1 Results of analyses (Product identification)

Product	Batch no.	IR identification (main components)	Specific gravity (g/cm^3)
Example, part A	123	Ethyl silicate	0.93
Example, part B	234	NA*	2.21
Example Epoxy Paint Grey, base	345	Epoxy	1.48
Example Epoxy Paint hardener	456	Amide	0.96
Example Epoxy Paint Buff, base	567	Epoxy	1.47

*Identified and spectres stored. No generic correlation to the spectres in the data base found.

Table 2 Results of examination of the coated test samples

Test parameter	Acceptance criteria	Test results	Passed / failed
Pin holes (no)	No pinholes	0	Passed
Blisters and rust[1)]	No blisters or rust	0	Passed
Adhesion values (MPa)[2)]	>3.5 adhesive failure >3.0 cohesive failure	Average: 5.2 Maximum: 6.1 Minimum: 4.2 70 – 80 % cohesive failure 20 – 30 % adhesive failure	Passed
Cathodic disbondment (mm)[3)]	< 8	7.2	Passed
Current demand (mA/m^2) [3)]	< 5	3.3	Passed

1) Details of blister and rust Table B-4 Appendix B.

2) Details of Pull-off adhesion test in Table B-5 Appendix B.

3) Details of Cathodic Protection in Table B-6 Appendix B.

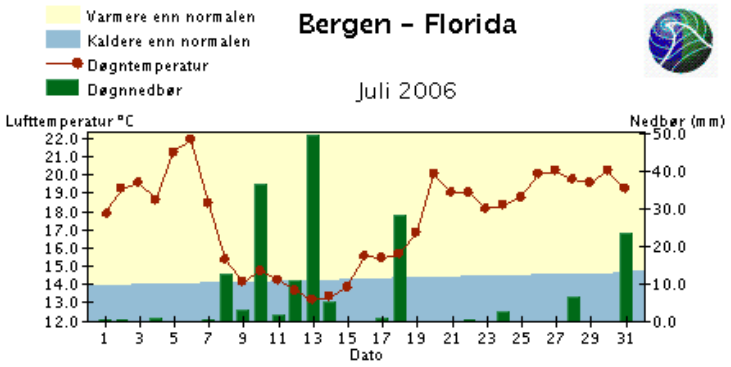
7 CONCLUSION

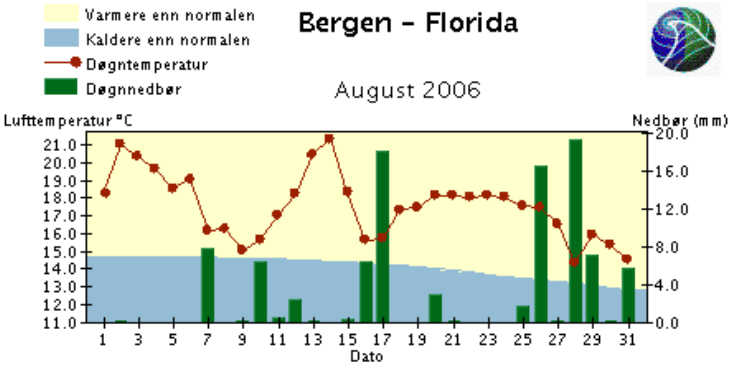
The results from the testing show that Example Epoxy Paint from Example Coating Producer has passed all the requirements for the crossover test given in the Performance Standard for Protective Coatings /1/.

8 REFERENCES

/1/ MSC 215 (82) :2006 Performance Standard for Protective Coatings for dedicated sea water ballast tanks in all types of ships and double-side skin spaces of bulk carriers

9 APPENDIX A - ENVIRONMENTAL DATA - WEATHERING OF SHOP PRIMED PANELS





10 APPENDIX B - DETAILS OF SURFACE PREPARATION, APPLICATION AND TEST RESULTS

Table B-1 Surface preparation data.

Surface preparation date	November 2007 The prepared panels were stored at ambient in- door conditions until use
Surface preparation method	Blast cleaning
Blasting standard	Sa 2 ½
Abrasive used	AlSil A3+ steel shot
Roughness (µm)	R_{max} 50 -75
Water soluble salts	32, 38 and 40 mg / m^2 Spot check performed on 3 out of 30 panels produced at the same time
Dust and abrasive inclusions	No dust or abrasive inclusions observed by visual examination.
Treatment of shopprimer after weathering	Low pressure washing
Water soluble salts after treatment of shopprimer	Spot check 28, 41 and 38 mg / m^2

Table B-2 Application data.

Coating data:	Shop primer	1st coat	2nd coat
Paint system:	Example red	Example Epoxy Paint Al Grey	Example Epoxy Paint Buff
Manufacturer:	Example Coating Producer		
Date	20.11.07	22.01.08	23.01.08
Time	10:00	10:00	10:00
Batch No. curing agent			
Batch No. base			
Thinner name (if used)			
Batch No. thinner(if used)			
Equipment used	Graco King 68:1	Graco King 68:1	Graco King 68:1
Air pressure (bar)	100	170	170
Size nozzle (inches)	0.021	0.021	0.021
Fan width (º)	60	60	60
Mix. ratio (volume)	A: B = 3:1	3:1	3:1
Volume solid (volume)	30 ± 2	80	80
Wet film thickness (µ)	55-70	275	275
Dry film thickness (µ)	15-25	See Table 3	See Table 4
Thinner (%)	0	0	0
Air temperature (ºC)	25	25	25
Humidity (% RH)	78	80	82
Steel temp. (ºC)	25	25	25
Dew point (ºC)	20	20	20

Present at application of shop primer: nn – MM Group (painter) and mm – laboratory. Present at application of test coating: kk - Example Coating Producer, nn – MM Group, and mm – laboratory.

Comments:

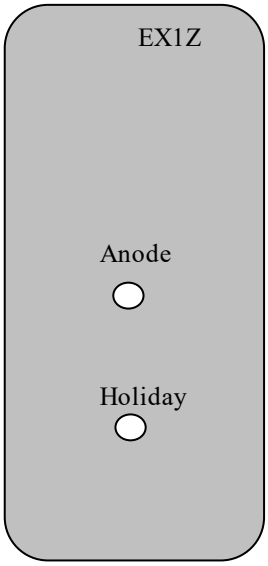


Figure B-1 Coding.

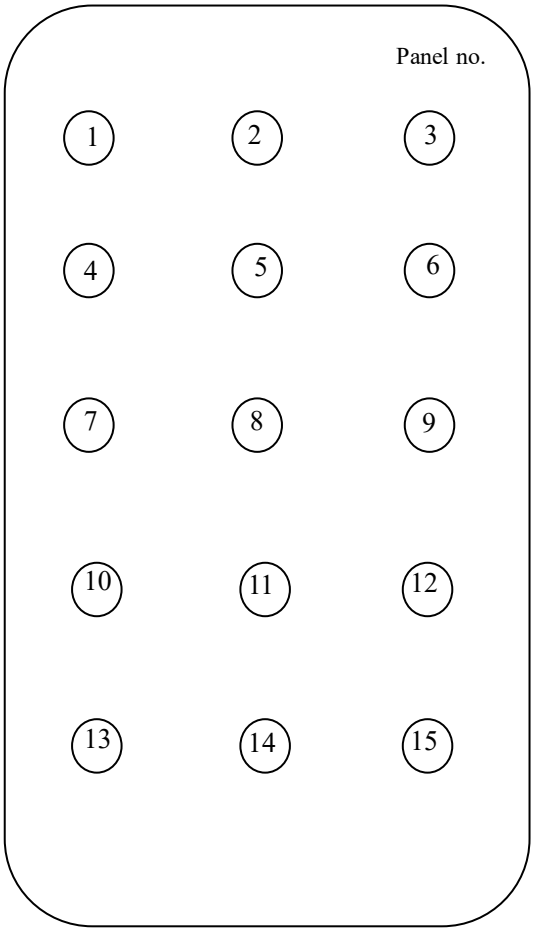


Figure B-2 Thickness measurement locations.

Table B-3 Total Dry Film Thickness – Example Epoxy Paint
(20 µm subtracted for shop primed substrate).

Measurement	Panel no EX1ZW2
1	330
2	356
3	320
4	344
5	356
6	320
7	326
8	348
9	320
10	319
11	360
12	320
13	344
14	424
15	348
Max	424
Min	319
Average	342
StDev	27

Table B-4 Development of blisters and rust after exposure.

Code	Description	Blister size	Blister density	Rust	Other defects
EX1ZW2	Bottom wave tank panel with anode	0	0	0	0

Table B-5 Results of the Pull-off adhesion test, wave tank and heat exposed panels.

Panel no.	Adhesion strength (MPa)	Fracture
Bottom wave tank panel with anode W2	5.3	30 % B, 20 % C, 20 % C/D, 30 % D
	4.2	30 % B, 20 % C, 30 % C/D, 20 % D
	6.1	20 % B, 30 % C, 30 % C/D, 20 % D
Average	5.2	70 – 80 % Cohesive failure, 20 – 30 % Adhesive
Max	6.1	
Min	4.2	

A/B	Fracture between the steel surface and 1st coat (shop primer).
B	Fracture in the 1st coat.
B/C	Fracture between the 1st and 2nd coat.
C	Fracture in the 2nd coat.
C/D	Fracture between the 2nd and 3rd coat.
D	Fracture in the 3rd coat
-/Y	Fracture between the outer coat and the glue.

Table B-8 Results of Cathodic Protection (CP).

Panel	Cathodic disbondment (mm)	Blisters / rust	Zinc anode weight loss (g)	Current demand (mA/ m^2)
EX1ZW2	7.2	0	1.2345	3.32

Exposure time: *120 days (Total time 180 days. Each cycle consists of 2 weeks seawater immersion and 1 week exposure in air)*

Utilisation factor: *0.8*

Consumption rate for Zn-anodes: *11.3 kg/A year*

Cathodic protection; disbonding from artificial holiday:

"On completion of the test, thoroughly rinse the panel with tap water, taking care not to damage the coating." (From ISO 15711:2003)

"Assess loss of adhesion at the artificial holiday by using a sharp knife to make two cuts through the coating to the substrates, intersection at the holiday. With the point of the knife, attempt to lift and peel back the coating from around the holiday. Record whether the adhesion of the coating to the substrate has been reduced and the approximate distance, in millimetres, that the coating can be peeled." (From ISO 15711:2003)

Additionally IACS interpretation of IMO PSPC: Repeat the cutting and lifting all around the artificial holiday to find the maximum loss of adhesion. Disbonding from artificial holiday can be either loss of adhesion to the steel substrate or between the shop primer and the epoxy coating and shall be less than 8 mm for epoxy based systems to be acceptable (compability test). Cohesive adhesion failure in the shop primer is not to be included as part of the loss of adhesion.

11 APPENDIX C – PHOTO DOCUMENTATION

(It should be overview picture of the panel and close up picture of the disbonding from artificial holiday)

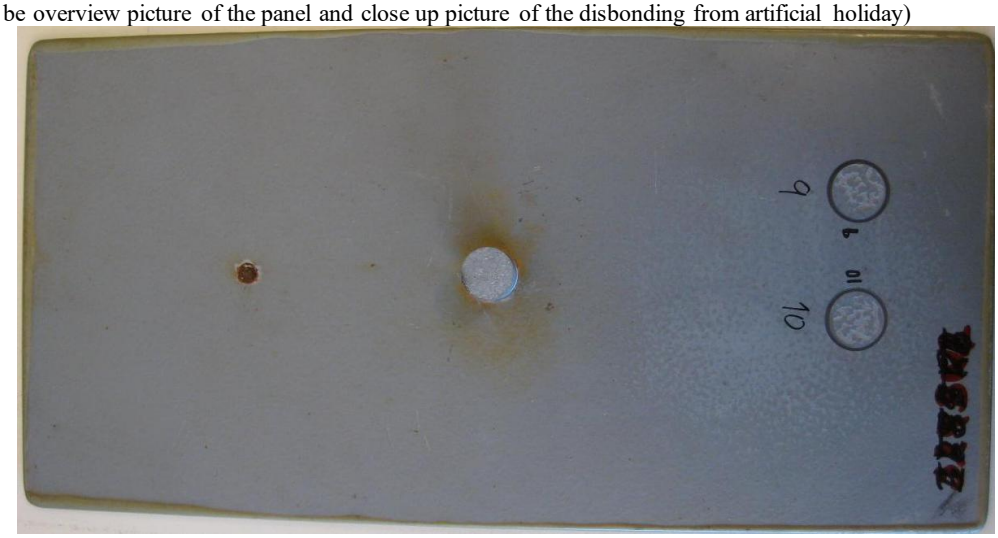


Figure C-1 Disbonding from artificial holiday, bottom wave tank panel (example picture not connected to example results in this model report).

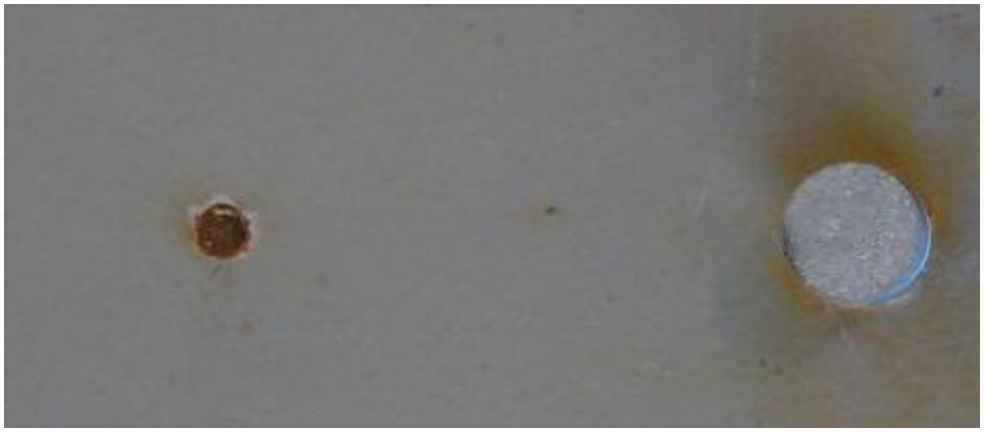


Figure C-2 Disbonding from artificial holiday, bottom wave tank panel (example picture not connected to example results in this model report).

12 APPENDIX D - INFRARED SCANNING CHARTS

Figure D-1

Figure D-2

Figure D-3

Figure D-4

Figure D-5

Figure D-6

Chapter 10 FIRMS ENGAGED IN MAINTENANCE, THOROUGH EXAMINATION, OPERATIONAL TESTING, OVERHAUL AND REPAIR OF LIFEBOATS, RESCUE BOATS, FAST RESCUE BOATS, LAUNCHING APPLIANCES, AND RELEASE GEAR

10.1 General

10.1.1 Application

This chapter applies to firms engaged in the maintenance, thorough examination, operational testing, overhaul and repair of the life-saving appliances listed below:

(1) Lifeboats (including free-fall lifeboats) and all rescue boats (including inflated rescue boats and fast rescue boats)

(2) Launching appliances and on-load and off-load release gear for lifeboats (including primary and secondary means of launching appliances for free-fall lifeboats), rescue boats, fast rescue boats and davit-launched liferafts.

10.1.2 Approval

1 The contents of this procedure apply equally to manufacturers or ship's operator when they are acting as authorized suppliers.

2 Any supplier engaged in maintenance, thorough examination, operational testing, repair and overhaul of lifeboats, rescue boats, launching appliances and release gear carried out in accordance with *SOLAS* regulation III/20 (as amended) are to be approved for these operations for each make and type of equipment for which they provide the service in accordance with *MSC*.402(96) (as amended).

Such approval is to include, as a minimum, the following:

(1) Employment and documentation of personnel certified in accordance with a recognized national, international or industry standard as applicable, or an equipment manufacturer's established certification program. In either case, the certification program is to be based on the provisions of **10.3.1** for each make and type of equipment for which service is to be provided.

(2) Compliance with provisions of **10.2.3**, **10.5.1** and **10.6.1**.

3 In cases where the related equipment manufacturer is no longer in business or no longer provides technical support, suppliers may be approved for the equipment on the basis of prior approval for the equipment and/or long term experience and demonstrated expertise as an approved service provider.

10.2 Quality System

10.2.1 Work Procedures

The supplier is to have documented work procedures, as required by **1.2.4**, containing information for at least the following **(1)** to **(4)**:

(1) Information related to preparing and implementing the service of lifeboats, rescue boats, launching appliances, and release gear

(2) Information related to recording the conditions of defects found during servicing

(3) Information related to reporting the results of servicing to Society surveyors and receiving surveyor verification of said results

(4) Information related to issuing service record certificates and statement.

10.2.2 Documented Training Procedures

The documented training procedure required by **1.2.2-3** is to contain information on the items listed in **10.3.1-2(1)(a)** to **(g)** as well as **10.2.3(1)** to **(4)**. In addition, the supplier is to provide the latest versions of all relevant documents.

10.2.3 Reference Documents

The supplier is to have access to the documents listed in the following **(1)** to **(4)**:

(1) *MSC*.402(96) (as amended);

(2) *A*.689(17) (as amended) and for life-saving appliances installed on board on or after 1 July 1999, *MSC*.81(70), as amended;

(3) For repair work involving disassembly or adjustment of on-load release mechanisms and davit winches, availability of manufacturer's instructions (including updates, amendments and safety notices); and

(4) Type approval certificate showing any conditions that may be appropriate during the servicing and/or maintenance of lifeboats, launching appliances and on-load release gear.

10.3 Operators and Supervisors

10.3.1 Qualifications, etc.

1 Certification of Personnel

Personnel for the work specified in **10.1.1** are to be certified by the manufacturer or service supplier for each make and type of the equipment to be worked on. Approved Service Supplier is allowed to certify its own personnel (i.e. employed by the same service supplier) only.

2 Education and training of personnel

(1) The education for initial certification of personnel is to be documented and address, as a minimum the following **(a)** to **(g)**:

(a) Causes of lifeboat and rescue boats accidents;

(b) Relevant rules and regulations, including international conventions, as well as flag administration requirements and the Rules of the Society related to the servicing of lifeboats, rescue boats, fast rescue boats, launching appliances and release gear, and the inspection instructions for said devices issued by the Society;

(c) Design and construction of lifeboats (including free-fall lifeboats), rescue boats and fast rescue boats including launching appliances and on load release gear;

(d) Education and practical training in the procedures specified in paragraph 6 of *MSC*.402(96) (as amended) for which certification is sought;

(e) Detailed procedures for thorough examination, operational testing, repair and overhaul of lifeboats (including free-fall lifeboats), rescue boats and fast rescue boats, launching appliances and on load release gear, as applicable; and

(f) Procedures for issuing a report of service and statement of fitness for purpose based on paragraph 5.3 of *MSC*.402(96) (as amended);

(g) Work, health and safety issues while conducting activities on board.

(2) The training for the personnel is to include practical technical training on thorough examination, operational testing, maintenance, repair and overhaul techniques using the equipment for which the personnel are to be certified. The technical training is to include disassembly, reassembly, correct operation and adjustment of the equipment. Classroom training is to be supplemented by field experience in the operations for which certification is sought, under the supervision of a certified person.

3 Issuance of personnel certification

(1) Prior to issuance of personnel certification, a competency assessment is to be satisfactorily completed, using the equipment for which the personnel are to be certified.

(2) Upon completion of training and competency assessment, a certificate is to be issued defining the level of qualification and the scope of the certification (i.e. makes and types of equipment and specifically state which activities (annual thorough examination and operational tests; 5-year thorough examination, overhaul; overload operational tests; repairs) are covered by the certification). The expiry date is to clearly be written on the certificate and is to be three years from the date of issue. The validity of any certificate is to be suspended in the event of any shortfall in performance and only revalidated after a further competency assessment.

4 Competency assessment for renewal of certification

A competency assessment is to be conducted to renew the certification. In cases where refresher training is found necessary, a further assessment is to be carried out after completion.

10.4 Equipment and Facilities for Service

10.4.1 Equipment and Facilities for Service

For the purpose of servicing life-saving appliances, the supplier is to have access to the following equipment and facilities:

(1) Sufficient tools, and in particular any specialized tools specified in the manufacturer's instructions, including portable tools as needed for work to be carried out on board ship;

(2) Access to appropriate parts and accessories for repairing and maintenance, as applicable; and

(3) For servicing and repair work involving disassembly or adjustment of on-load release mechanisms, genuine replacement parts as specified or supplied by the equipment manufacturer.

10.5 Reporting

10.5.1 Reporting

The report is to conform to the requirements in paragraph 5.3 of *MSC*.402(96) (as amended). When thorough examinations, operational testing, annual servicing, overhaul and repair are completed, a statement confirming that the lifeboat arrangements remain fit for purpose is to be promptly issued by the manufacturer or authorized service supplier which carried out them. A copy of valid documents of the personnel certification and the supplier authorization as appropriate are to be included with the statement.

Chapter 11 FIRMS ENGAGED IN EXAMINATION OF THE BOW DOORS, STERN DOORS, SIDE DOORS AND INNER DOORS OF RO-RO SHIPS

11.1 General

11.1.1 Application

1 This chapter applies to firms engaged inspection of securing and locking devices, hydraulic operating system, electric control system for the hydraulics, electric indicator systems, and supporting, securing and locking devices and tightness testing.

2 The supplier is to be certified to the most current version of *ISO* 9000 series.

11.2 Quality System

11.2.1 Work Procedures

The documented work procedures specified in 1.2.4 are to include information on at least the following items:

(1) Drawings and documents, including the Operating and Inspection Manual;

(2) The service history of the doors; and

(3) Checklist which has been found acceptable by the Society.

11.2.2 Training Procedures

The documented training procedures specified in by 1.2.2 is to include information on ways to acquire knowledge about the following items:

(1) International Convention on the Safety of Life at Sea (*SOLAS*) 74/78 (as amended);

(2) *ISO* 9002 (as amended); and

(3) *IACS UR Z* 24 (as amended).

11.2.3 Reference Documents

Suppliers are to have access to the documents listed in the above 11.2.2(1) to **(3)**.

11.3 Operators and Supervisors

11.3.1 Qualifications

1 Operators carrying out non-destructive tests (*NDT*) are to be qualified to a recognised National or International Standard for the methods used.

2 Supervisors carrying out tests are to have the following competence and experience**:**

(1) Supervisors are to have had a minimum of two years of experience as operators/technicians/inspectors within the activity.

(2) Supervisors are to have a minimum two years related education from a technical school.

11.4 Equipment

11.4.1 Equipment

1 Suppliers engaged in the inspection of supporting securing and locking devices, as well as hinges and bearings are to possess the following equipment for use in said inspections:

(1) Equipment for measuring clearances (i.e. feeler gauges, vernier calipers, micrometers).

(2) Equipment for non-destructive tests (i.e. dye penetrant, magnetic particle inspection)

2 Suppliers engaged in tightness testing are to possess ultrasonic leak detectors or the equivalent for use in said testing.

3 Suppliers engaged in the inspection of hydraulic operating systems are to possess the following equipment for use in said ispections:

(1) Pressure gauges; and

(2) Particle counters for analysing the quality of hydraulic fluid.

4 Suppliers engaged in the inspection of electric control systems and indicator systems are to possess the following equipment for use during said inspections:

(1) Digital multi-meters, and

(2) Earth fault detectors.

Chapter 12 FIRMS ENGAGED IN LUMINANCE MEASUREMENTS OF LOW LOCATION LIGHTING SYSTEMS

12.1 General

12.1.1 Application

This chapter applies to firms engaged in luminance measurements on board ships of low location lighting systems using photo luminescent materials and evacuation guidance systems.

12.2 Quality System

12.2.1 Work Procedure

The documented work procedure required in 1.2.4 is to at least contain information on items listed in the following **(1)** and **(2)**:

(1) Inspection preparation; and

(2) Selection and identification of test locations.

12.2.2 Training Procedures

The documented training procedure required by 1.2.2 is to contain information on the items listed in 12.3.1 and 12.2.3. Suppliers are to provide the latest versions of all relevant reference documents.

12.2.3 Reference Documents

Suppliers are to have access to the documents listed in the following **(1)** to **(5)**:

(1) *SOLAS* regulation II-2/13.3.2.5 (as amended);

(2) Chapter 11 of *Fire Safety Systems Code* (as amended);

(3) *A.*752(18) (as amended);

(4) *ISO* 15370-2010 (as amended); and

(5) *MSC/Circ.*1168 (as amended).

12.3 Operators and Supervisors

12.3.1 Qualifications, etc.

1 Operators and supervisors are to have sufficient knowledge of the following **(1)** to **(4)**:

(1) *SOLAS* regulation II-2/13.3.2.5 (as amended);

(2) *A.*752(18) (as amended);

(3) *ISO* 15370-2010 (as amended); and

(4) Chapter 11 of *Fire Safety Systems Code* (as amended).

2 Operators are to be able to document theoretical and practical training onboard in using the equipment specified in 12.4.

12.4 Equipment

12.4.1 Equipment

Suppliers are to have the measuring instruments used for inspections of low location lighting systems and evacuation guidance systems. Such measuring instruments are to incorporate a fast-response photometer head with *CIE* (International Commission on Illumination) photopic correction and have a measurement range of at least 10^{-4} cd/m^2 to 10 cd/m^2.

12.5 Demonstration

12.5.1 Verification

Suppliers are to receive surveyor verification for each separate measurement and have the surveyor sign each report of measurement results.

12.5.2 Reporting

Reports are to be made in accordance with *Annex C* of *ISO* 15370-2010 (as amended).

Chapter 13 FIRMS ENGAGED IN SOUND PRESSURE LEVEL MEASUREMENTS OF GENERAL ALARM AND PUBLIC ADDRESS SYSTEMS ON BOARD SHIPS

13.1 General

13.1.1 Application

This chapter applies to firms engaged in sound pressure level measurements of general alarm and public address systems on board ships.

13.2 Quality System

13.2.1 Work Procedures

The supplier is to have documented work procedures, as required by 1.2.4, containing at least information on inspection preparation, calibration, selection and identification of test locations.

13.2.2 Documented Training Procedures

The documented training procedure required by 1.2.2 is to contain information on the items listed in 13.2.3(1) to **(7)**. In addition, the supplier is to provide the latest versions of all relevant documents.

13.2.3 Reference Documents

The supplier is to have access to the documents listed in the following **(1)** to **(7)**:

(1) *SOLAS* regulation III/4 (as amended);

(2) *SOLAS* regulation III/6 (as amended);

(3) Paragraph 7.2, Chapter VII of the *LSA* Code (as amended);

(4) *A*.830(19) (as amended);

(5) *IEC* 60651 (2001-10) (as amended);

(6) *IEC* 61672 (as amended); and

(7) *IEC* 61260 (as amended).

13.3 Operators

13.3.1 Qualification, etc.

1 Operators are to have adequate knowledge of the applicable international requirements: *SOLAS* regulations III/4 and III/6 (as amended), paragraph 7.2, Chapter VII of the *LSA* Code (as amended), and *A*.830(19) (as amended).

2 Operators are to be able to document a theoretical and practical training onboard in using equipment specified.

13.4 Equipment

13.4.1 Equipment

The measuring instrument is to be an integrating sound level meter with frequency analysis capabilities complying with *IEC* 60651 (as amended), and *IEC* 61672 (as amended), class 1, at least an A-weighting frequency response curve and 1/3 octave and 1 octave band filters, complying with *IEC* 61260 (as amended), as appropriate for the measurements to be carried out. In addition, microphones are to be of the random incidence type, complying with *IEC* 60651 (as amended).

13.5 Reporting to the Society

13.5.1 Verification

The supplier is to have the Surveyor's verification of each separate job, documented in the report by his signature.

13.5.2 Reporting

The report is to describe, as a minimum, the environmental conditions of the tests and, for each test location, the ambient noise level or the speech interference level, as appropriate for the measurements to be carried out. The report is to conform to any other specific requirement of the Society.

Chapter 14 FIRMS ENGAGED IN MEASUREMENTS OF NOISE LEVEL ONBOARD SHIPS

14.1 General

14.1.1 Application

This chapter applies to firms engaged in measurements of noise level onboard ships.

14.2 Quality System

14.2.1 Work Procedures

1 Suppliers are to have documented work procedures and instructions to carry out service of the equipment specified in **14.4**.

2 Suppliers are to have documented work procedures, as required by **1.2.4**, containing at least the information specified in the following **(1)** to **(4)**:

(1) Inspection preparation;

(2) Selection and identification of sound level measurement locations;

(3) Calibration checks; and

(4) Report preparation.

14.2.2 Training Procedures

The documented training procedure required by **1.2.2** is to contain information on the items listed in **14.3.1** and **14.2.3**. Suppliers are to provide the latest versions of all relevant reference documents.

14.2.3 Reference Documents

Suppliers are to have access to the documents listed in the following **(1)** to **(4)**:

(1) *SOLAS* regulation II-1/3-12 (as amended);

(2) *IMO Code on Noise Levels on Board Ships* (*A.*468(XII) and *IMO Res. MSC.*337(91)) (as amended);

(3) *A.*343(IX) (as amended); and

(4) Rules of the Society.

14.3 Operators and Supervisors

14.3.1 Training

Operators and supervisors are to have sufficient knowledge of the following **(1)** and **(2)**:

(1) Sound measurements and handling of measurement equipment; and

(2) The applicable international requirements (*SOLAS* regulation II-1/3-12 (as amended) and *IMO Code on Noise Levels on Board Ships* (as amended)).

14.3.2 Qualification, etc.

1 As for competence and experience, operators are to comply with the requirements specified in the following **(1)** to **(3)**:

(1) Operators are to have at least 1 *year* experience, including participation in a minimum of 5 measurement campaigns as an assistant operator;

(2) Operators are to have passed training concerning the procedures specified in *IMO Code on Noise Levels on Board Ships*; and

(3) Operators are to be able to document theoretical and practical training onboard in using the equipment specified in **14.4**.

2 Supervisors are to have a minimum of 2 *years* of experience as an operator in sound pressure level measurements.

14.4 Equipment

14.4.1 Equipment

1 Suppliers are to have the equipment for measurements of noise level onboard ships specified in the following **(1)** to **(4)**:

(1) Sound Level Meters

Measurement of sound pressure levels is to be carried out using precision integrating sound level meters. Such meters are to be manufactured to *IEC* 61672-1(2002-05) (as amended), type/class 1 standard as applicable, or to an equivalent standard acceptable to the Society. Class/Type 1 sound level meters manufactured according to *IEC* 651/*IEC* 804 (as amended), may be used until 1 July 2016.

(2) Octave Filter Sets

When used alone, or in conjunction with a sound level meter, as appropriate, an octave filter set is to conform to *IEC* 61260 (1995) (as amended), or an equivalent standard acceptable to the Society.

(3) Sound Calibrators

Sound calibrators are to comply with the standard *IEC* 60942 (2003-01) (as amended), and are to be approved by the manufacturer of the sound level meter used.

(4) Microphone wind screen

A microphone wind screen is to be used when taking readings outside, e.g. on navigating bridge wings or on deck, and below deck where there is any substantial air movement. The wind screen is not to affect the measurement level of similar sounds by more than 0.5 *dB*(*A*) in "no wind" conditions.

2 Sound calibrators and sound level meters are to be verified at least every two years in accordance with **An2.2.2, Annex 2.3.1-2, Part B of the Rules for the Survey and Construction of Steel Ships** by a national standard laboratory or a competent laboratory accredited according to *ISO* 17025 (2005), as amended. A record with a complete description of the equipment used is to be kept, including a calibration log.

14.5 Reporting to the Society

14.5.1 Verification

Suppliers are to receive surveyor verification for each separate measurement and have the surveyor sign each report of measurement results.

14.5.2 Reporting

A noise survey report is to be made for each ship. The report is to comprise information on the noise levels in the various spaces on board. The report is to show the reading at each specified measuring point. The points are to be marked on a general arrangement plan, or on accommodation drawings attached to the report, or are to otherwise be identified. The noise survey report is to be made in accordance with Form 1 of **Annex 2.3.1-2, Part B of the Survey and Construction of Steel Ships**.

Chapter 15 FIRMS ENGAGED IN TIGHTNESS TESTING OF PRIMARY AND SECONDARY BARRIERS OF GAS CARRIERS WITH MEMBRANE CARGO CONTAINMENT SYSTEMS FOR VESSELS IN SERVICE

15.1 General

15.1.1 Application

This chapter applies to firms engaged in the following tightness testing of the primary and secondary barriers of gas carriers with membrane cargo containment systems for vessels in service:

(1) Global vacuum testing of primary and secondary barriers;

(2) Acoustic emission testing; and

(3) Thermographic testing.

15.1.2 Authorization

The supplier as to the following **15.1.1(1)** and **(3)** is to be authorized by the system designer to carry out the testing.

15.2 Quality System

15.2.1 Work Procedures

1 Suppliers engaged in the global vacuum testing of primary and secondary barriers are to carry out the testing in accordance with cargo containment system designer's procedures as approved by the Society.

2 Suppliers engaged in acoustic emission (*AE*) testing are to comply with the followings:

(1) The supplier is to have documented procedures based upon recognized national or international industrial standards to perform ultrasonic leak test using AE sensors for the secondary barrier of membrane cargo containment systems;

(2) The procedures following **1.2.4** are to include details of personnel responsibilities and qualification, instrumentation, test preparation, test method, signal processing, evaluation and reporting; and

(3) The differential pressure during testing should not exceed the containment system designer's limitations.

3 Suppliers engaged in thermographic testing are to carry out the testing in accordance with the cargo containment system designer's procedures as approved by the Society.

15.3 Operators and Supervisors

15.3.1 Qualifications

1 Suppliers engaged in acoustic emission (*AE*) testing

(1) Operators carrying out AE testing are to have the following competence and experience:

(a) Operators are to be certified to a recognized national or international industrial standard (e.g., Level I, *ISO*-9712 (as amended) or *SNT-TC-1A* (as amended)); and

(b) Operators are to have adequate knowledge of ship structures sufficient to determine sensor placement.

(2) Supervisors carrying out AE testing are to have the following competence and experience:

(a) Supervisors are to be certified to a recognized national or international industrial standard (e.g., Level II, *ISO*-9712 as amended or *SNT-TC-1A* as amended); and

(b) Supervisors are to have had one year of experience as an operator.

2 Suppliers engaged in thermographic testing

(1) Operators carrying out thermographic testing are to have the following competence and experience:

(a) Operators are to be certified to a recognized national or international industrial standard (e.g., Level I, *ISO*-9712 (as amended) or *SNT-TC- 1A* (as amended)) with additional certification in infrared/thermal testing. *SNT-TC- 1A* certified personnel is to provide evidence that training on Level I or above has been administered by an independent training body

centrally certified to ASNT or a comparable nationally recognized certification scheme.

(b) Operators are to have adequate knowledge of ship structures sufficient to determine position for each identified image, and of the containment system to understand the basis of the testing.

(2) Supervisors carrying out thermographic testing are to have the following competence and experience:

(a) Responsible supervisors are to be certified to a recognised national or international industrial standard (e.g., Level II, *ISO*-9712 (as amended) or *SNT-TC-1A* (as amended)) with additional certification in infrared/thermal testing. *SNT-TC- 1A* certified personnel is to provide evidence that training on Level II or above has been administered by an independent training body centrally certified to ASNT or a comparable nationally recognized certification scheme.

15.4 Equipment

15.4.1 Equipment

1 Equipment used for global vacuum testing of primary and secondary barriers is to be maintained and calibrated in accordance with recognized national or international industrial standards.

2 Equipment used for acoustic emission testing is to be maintained and calibrated in accordance with recognized national or international industrial standards or equipment manufacturer recommendations.

3 Equipment use for thermographic testing is to be as follows:

(1) Thermal cameras and sensors are to be in accordance with system designer procedures with regards to sensitivity, accuracy and resolution; and

(2) Equipment is to be in accordance with recognized standards (*IEC*, etc.) with regards their safety characteristics for the use in hazardous areas (i.e., in gas explosive atmospheres) as well as be maintained and calibrated in accordance with the manufacturer recommendations.

15.5 Evaluation of Testing

15.5.1 Evaluation of Acoustic Emission (AE) Testing

Evaluation of acoustic emission (*AE*) testing is to be carried out by a supervisor or an individual certified to a recognized national or international industrial standard (e.g., Level II, *ISO*-9712 (as amended) or *SNT-TC-1A* (as amended)) and have one year experience at Level II.

15.5.2 Evaluation of Thermographic Images

Evaluation of thermographic images is to be carried out by a supervisor or an individual certified to a recognized national or international industrial standard (e.g., Level II, *ISO*-9712 (as amended) or *SNT-TC-1A* (as amended)) with additional certification in infrared/thermal testing. *SNT-TC-1A* certified personnel is to provide evidence that training on Level II or above has been administered by an independent training body centrally certified to ASNT or a comparable nationally recognized certification scheme.

15.6 Reporting to the Society

15.6.1 Reporting

1 Reports for global vacuum testing of primary and secondary barriers are to contain the following:

(1) Date of test;

(2) Identity of test personnel;

(3) Vacuum decay data for each tank; and

(4) Summary of test results.

2 Reports for acoustic emission testing are to contain the following:

(1) Date of test;

(2) Supervisor and operator(s) certifications;

(3) Description of time and pressure of each cycle of the test; and

(4) List and sketch detailing location of possible defects.

3 Report for thermographic testing is to contain the following:

(1) Date of test;

(2) Supervisor and operator(s) certifications;

(3) Differential pressures of all phases;

(4) List and sketch detailing location of thermal indications;

(5) Thermographic images of all phases of testing for thermal indications; and

(6) Evaluation of thermal images indicating possible leaks.

Chapter 16 FIRMS ENGAGED IN SURVEY USING REMOTE INSPECTION TECHNIQUES AS AN ALTERNATIVE MEANS FOR CLOSE-UP SURVEY OF THE STRUCTURE OF SHIPS AND MOBILE OFFSHORE UNITS

16.1 General

16.1.1 Application

1 This chapter applies to firms engaged in survey using remote inspection techniques as an alternative means for close-up survey of the structure of ships and mobile offshore units.

2 Firms carrying out in-water close-up survey by Remotely Operated Vehicles are to comply with the requirements in **Chapter 3** as well as the requirements in this Part.

16.1.2 Definition

1 "Close-up survey" is a survey where the details of structural components are within the close visual inspection range of the surveyor, i.e. preferably within reach of hand.

2 "Remote Inspection Techniques" is a means of survey that enables examination of any part of the structure without the need for direct physical access of the surveyor. Remote Inspection Techniques may include the use of:

(1) Unmanned Aerial Vehicles (UAV)
(2) Drones
(3) Unmanned robot arm
(4) Remotely Operated Vehicles
(5) Climbers
(6) Other means acceptable to the Society

16.2 Quality System

16.2.1 Work Procedures

1 Suppliers are to have documented work procedures and guidelines for how to plan, carry out and report inspections, how to handle/operate the equipment specified in **16.4** as well as the collection and storage of data.

2 Suppliers are to have documented work procedures, as required by **1.2.4**, containing at least the information specified in the following **(1)** through **(10)**:

(1) Requirements for preparation of inspection plans when UAV are part of the equipment flight plans shall be included;
(2) Operation of the remotely operated platforms;
(3) Operation of lighting;
(4) Calibration and operation of the data collection equipment;
(5) Two-way communication between the operator, platform, surveyor, other personnel such as support staff and the ship's officers and crew;
(6) Guidance of the operator to provide complete coverage of the structure to be inspected;
(7) Guidance for the maintenance of the remotely operated platforms, data capture and storage devices and display screens, as applicable;
(8) Requirements for the collection and validation of data;
(9) If data is to be stored, then requirements for location attribution (geo-tagging), validation and storage of data; and
(10) Requirements for the reporting of inspections, including the recording of damages and defects found during inspection and repair work.

16.3 Operators and Supervisors

16.3.1 Training Procedures

The documented training procedures specified in 1.2.2 are to at least include information on ways to acquire knowledge about the following items:

(1) Marine and/or offshore nomenclatures;

(2) The structural configuration of relevant ships types and mobile offshore units, including internal structure;

(3) The remote inspection equipment and its operation;

(4) Survey plans for examination of hull spaces of various configurations, including appropriate flight plans if using a UAV; and

(5) Thickness measurement and non-destructive tests in accordance with a recognized National or International Industrial NDT Standard when these are part of the service.

16.3.2 Qualifications

1 As for competence and experience, operators are to comply with the requirements specified in the following **(1)** and **(2)**:

(1) Operators are to be certified to a recognized national or international industrial standard; and

(2) Operators are to have at least 1 *year* experience and participated in 5 different assignments as an assistant carrying out inspection of ship's and/or mobile offshore unit's structure.

2 As for competence and experience, supervisors are to comply with the requirements specified in the following **(1)** and **(2)**:

(1) Supervisors are to be certified to a recognized national or international industrial standard; and

(2) Supervisors carrying out inspection of ship's and/or mobile offshore unit's structure are to have at least 2 *years* of experience as an operator.

16.4 Equipment

16.4.1 Equipment

The supplier is to possess the equipment listed in the following **(1)** through **(8)**:

(1) Remotely operated platform with data capture devices capable of operation within an enclosed space;

(2) Means of powering the platforms with sufficient capacity to complete the required inspections, including spare batteries if applicable;

(3) Data collection devices which may include cameras capable of capturing in high definition both video images and still images;

(4) Illumination equipment;

(5) High definition display screen with live high definition feed from inspection cameras when this is part of the remote inspection techniques;

(6) Means of communication;

(7) Data recording devices, as applicable; and

(8) Equipment for carrying out thickness gauging and/or non-destructive testing, as relevant to the work to be performed when this is part of the service)

16.4.2 Records

The supplier is to possess the equipment listed in the following **(1)** through **(6)**:

(1) Records of training;

(2) Operator statutory and regulatory certificates and licenses;

(3) Equipment register for UAVs, robots, data collection devices, data analysis devices and any associated equipment necessary to perform inspections;

(4) Equipment maintenance manuals and records / logbook;

(5) Records of calibration; and

(6) UAV/Robot operation logbook.

16.5 Reporting to the Society

16.5.1 Verification

The supplier is to have the Surveyor verification of each separate job, documented in the report by the attending Surveyor signature.

Chapter 17 FIRMS ENGAGED IN WATERTIGHT CABLE PENETRATION INSPECTION ON SHIPS AND MOBILE OFFSHORE UNITS

17.1 General

17.1.1 Application

This chapter applies to firms engaged in the inspection of watertight cable penetrations (including penetrating cable types, dimensions, fill ration and insulation details, as applicable) on ships and mobile offshore units for compliance with the relevant approval certificates and product installation manuals made by manufacturers.

17.1.2 Approval

1 The procedures of this chapter apply equally to manufacturers or shipyards when they are acting as service suppliers.

2 Any service supplier engaged in the inspection of watertight cable penetrations is to be qualified in such inspections for each make and type of equipment for which they provide said service and provide manufacturers with documentary evidence that they have been so authorised or certified in accordance with an established system for training and authorisation.

3 In cases where an equipment manufacturer is no longer in business or no longer provides technical support, service suppliers may be authorised for the equipment on the basis of prior authorisation for the equipment as well as their long-term experience and demonstrated expertise as an authorised service provider.

17.2 Quality Systems

17.2.1 Qualifications and Education, etc. for Personnel

1 Certification of personnel

Personnel are to be trained and qualified in accordance with a recognised national, international or industry standard as applicable, or a manufacturer's established certification program. In either case, the certification program is to be based on the provisions of this chapter for each make and type of equipment for which service is to be provided.

2 Education and training of personnel

(1) The education for initial certification of personnel is to be documented and address, as a minimum, the following **(a)** to **(d)**:

(a) procedures and instructions for the inspection of watertight cable penetrations;

(b) common problems found with the initial installation and in-service inspections of watertight cable penetrations;

(c) relevant rules and regulations, including international conventions; and

(d) procedures for reporting on initial installation and in-service inspections of watertight cable penetrations in the watertight cable penetration register.

(2) Education and training for personnel are to include practical technical training on actual inspection using the watertight cable penetrations for which the personnel are to be certified. The technical training is to include disassembly, reassembly and adjustment of the equipment. Classroom training is to be supplemented by field experience in the operations for which certification is necessary, under the supervision of an experienced senior certified person.

3 Initial certification and renewal of certification

At the time of initial certification and at each renewal of certification, the supplier is to provide documentation to verify an individual's satisfactory completion of a competency assessment using the equipment for which the personnel are certified.

4 Training for renewal of certification

The service supplier is to require refresher training as appropriate to renew the certification.

17.2.2 Requirements for firms

1 The service supplier is to have access to the following **(1)** and **(2)**:

(1) manufacturer servicing manuals, servicing bulletins, instructions and training manuals as appropriate; and

(2) type approval certificates showing any conditions that may be appropriate during the installation or maintenance of the watertight cable penetration.

2 The service supplier is to have access to sufficient tools, in particular any specialized tools as needed, for work to be carried out on board ship.

17.3 Reporting

17.3.1 Reporting

On completion of inspection, the service supplier is to issue a report confirming the condition of the watertight cable penetration. In addition, the service supplier is to record the results of the inspection in the watertight cable penetration register.

Chapter 18 FIRMS ENGAGED IN COMMISSIONING TESTING OF BALLAST WATER MANAGEMENT SYSTEM (BWMS)

18.1 General

18.1.1 Application

1 This chapter applies to firms engaged in the services specified in the following **(1)** and **(2)** during commissioning testing of ballast water management systems (hereinafter referred to as "*BWMS*") for statutory purposes. Service suppliers are expected to be able to perform both the following services.

(1) Sampling and analysis of ballast water

(2) Verification of self-monitoring equipment

2 Attention is to be paid to complying with the applicable national regulations, if any.

18.1.2 General Qualifications for Service Suppliers

1 Service suppliers are to be familiar with *BWMS* operations (including features and limits of each treatment technology and self-monitoring parameters).

2 Service suppliers are (irrespective of **1.2.8-1**) to be independent of *BWMS* manufacturers or suppliers (including shipyards).

3 Service suppliers may be required to present their confidential internal procedures for conducting the indicative testing to a Society surveyor.

4 Service suppliers are to have documents that prove the requirements for operators are satisfied in accordance with **18.3.1**.

5 Commissioning testing of *BWMS* is to be performed by the operators qualified in accordance with **18.3**.

18.2 Quality Systems

18.2.1 Work Procedures

At least the items specified in the following **(1)** to **(4)** are to be included in work procedures in accordance with **1.2.4**:

(1) procedures outlining how ballast water sampling and analysis is conducted with respect to each size class of organisms;

(2) procedures for assessment of *BWMS* correct operations;

(3) procedures for documenting and reporting *BWMS* correct operations; and

(4) operating procedures for equipment used for tests (including its calibration, adjustment and maintenance).

18.2.2 Training Procedures

At least the items specified in **18.3.1** are to be included in training procedures in accordance with **1.2.2**.

18.2.3 Reference Documents

Service suppliers are to have access to the documents listed in the following **(1)** to **(8)**, as may be amended.

(1) *Res*. *MEPC*.300(72)

(2) *Res*. *MEPC*.173(58)

(3) *BWM*.2/*Circ*.42/Rev.2

(4) *BWM*.2/*Circ*.70/Rev.1

(5) *BWM*.2/*Circ*.61

(6) *BWM*.2/*Circ*.69

(7) *Res*. *A*.1156(32) (as amended)

18.3 Operators

18.3.1 Training and Qualifications

1 Operators are to satisfy the following **(1)** to **(3)**.

(1) being able to demonstrate the knowledge in the use of different ballast water testing equipment for the purpose of assessing biological efficacy;

(2) having documented evidence of sufficient engineering and biological knowledge to conduct the commissioning testing; and

(3) having the knowledge of the documents referred to as **18.2.3(3)** and **(4)**.

2 In addition to **-1** above, operators who perform the analysis of ballast water as specified in **18.1.1(1)** are to satisfy the following **(1)** to **(5)**:

(1) be trained in the proper use of portable indicative analysis equipment (review of training records and/or interviews may be conducted to confirm the proper use of equipment during the testing);

(2) be trained in the proper use of detailed analysis methods and equipment in case the service supplier offers detailed analysis (review of training records and/or interviews may be conducted to confirm the proper use of equipment during the testing);

(3) be familiar with the design concepts of the sampling devices as per the document referred to as **18.2.3(2)** installed on the vessel's *BWMS* and well understanding the need for maintaining such sampling devices clean and free of contaminants and the importance of controlling the ballast water sample flow rates from them (to avoid organism mortality in the sample);

(4) be familiar with the technologies utilized by the indicative sampling equipment and understanding water quality issues that are both conducive to successful use of the equipment and circumstances that could challenge the use of the equipment; and

(5) be trained in the proper disposal procedures for water samples following the commissioning testing.

3 In addition to **-1** above, the operators who perform the verification of self-monitoring parameters of the *BWMS* as specified in **18.1.1(2)** are to satisfy the following **(1)** to **(3)**:

(1) having the knowledge of *SDL* referred to in **2.1.1(26), Chapter 2, Part 1 of Rules for Ballast Water Management Installations**, self-monitoring parameters (such as flow rate, pressure, Total Residual Oxidants (*TRO*), *UV* intensity etc.) and how the *BWMS* notifies the operator in case it is operated outside its *SDL*. This knowledge is relevant for evaluating whether the self-monitoring equipment of the *BWMS* indicates correct operation of the *BWMS*;

(2) in case the service suppliers are not present during ballasting operations, the service suppliers are to have knowledge of how to access the *BWMS* log to evaluate its proper operation during such operations; and

(3) having a procedure and knowledge to assess the applicable self-monitoring parameters such as flow rate, pressure, Total Residual Oxidants (*TRO*), *UV* intensity etc) of the *BWMS*, taking into account its *SDL*.

18.4 Records and Reporting

18.4.1 Records

Service suppliers are to maintain a record of the following:

(1) Operation of the *BWMS* during test period, including any recorded data or operator observations associated with the performance deviations, alarms or abnormal/unexpected operations; and

(2) Applicable self-monitoring parameters

18.4.2 Reporting

1 Service suppliers are to provide reports detailing the results of sampling and analysis of ballast water and assessment of self-monitoring parameters during commissioning testing.

2 Information and reference to the acceptance documents for the equipment used for the testing should be included in the report.

3 The format of the report is to be acceptable to Society and contain the following information as a minimum:

(1) Manufacturer's name of the *BWMS*

(2) Model name of the *BWMS*

(3) *SDL* and the *BWMS* technology limiting operating conditions

(4) Operation required (e.g., ballasting, de-ballast, circulation, one pass, in tank, etc)

(5) Treatment rated capacity of the *BWMS* (m^3/h)

(6) Relevant performance parameters (e.g. flow rate, pressure, Total Residual Oxidants (*TRO*), *UV* intensity, *UV* dose, or other relevant parameters)
(7) Alarms developed during the testing
(8) Installation location the *BWMS*
(9) Type Approval issued by and Certificate No . of the *BWMS*
(10) Installation date of the *BWMS*
(11) Method used for the testing
(12) Results of sample analysis (includes the record as specified in **18.4.1** and the raw data generated from the used testing equipment)
(13) Flow rate of ballast pump and volume of ballast tanks, used for the testing
(14) Comments/Notes (information on filter and other major components and process measurements etc.)