GUIDANCE FOR THE APPROVAL AND TYPE APPROVAL OF MATERIALS AND EQUIPMENT FOR MARINE USE

Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use 2018 AMENDMENT NO.1

Notice No.60 29 June 2018
Resolved by Technical Committee on 31 January 2018

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NIPPON KAIJI KYOKAI

Notice No.60 29 June 2018
AMENDMENT TO THE GUIDANCE FOR THE APPROVAL AND TYPE APPROVAL OF MATERIALS AND EQUIPMENT FOR MARINE USE

"Guidance for the approval and type approval of materials and equipment for marine use" has been partly amended as follows:

Amendment 1-1

Part 2 EQUIPMENT

Chapter 11 has been amended as follows.

Chapter 11 BALLAST WATER MANAGEMENT SYSTEMS

11.1 General

11.1.1 Scope

This chapter applies to the procedures and testing requirements for the approval of manufacturing processes of ballast water management systems (*BWMS*) which are to be equipped on ships in accordance with the requirements of in **3.3-1(1), Part 3 of the Rules for Ballast Water Management Installations**. Furthermore, the characters in brackets ("[ ]") specified in this chapter refers to the regulation numbers used in *IMO Res. MEPC.*279(70) "*2016 Guidelines for Approval of Ballast Water Management Systems (G8)*", as amended.

11.1.2 Definitions

The definitions of terms which appear in this chapter are to be as specified in **Chapter 2, Part 1 of the Rules for Ballast Water Management Installations** and according to the following:

(1) "Ballast water performance standard" means **3.2, Part 3 of the Rules for Ballast Water Management Installations**.

(2) "Land-based testing" is a test of the *BWMS* carried out in a laboratory, equipment factory or pilot plant including a moored test barge or test ship in order to confirm that the *BWMS* meets the ballast water performance standards. [*G8* / 3.8]

(3) "Shipboard testing" ~~is~~means a full-scale test of a complete *BWMS* carried out on board a ship to confirm that the system meets the ballast water performance standards. [*G8* / 3.12]

(4) "Full-scale test" means shipboard testing carried out on a ship with ballast tanks having enough capacity for the treatment of ballast water as well as the *BWMS* without affecting normal ballast operation.

(5) "Minimum dimension" is the smallest dimension of width, length or thickness of the organisms.

(6) "Treatment Rated Capacity" (*TRC*) ~~is~~means the maximum continuous capacity expressed in cubic meters per hour for which the *BWMS* is type approved. It states the amount of ballast water that can be treated per unit time (m^3/h) by the *BWMS* to meet the ballast water performance standard. The *TRC* is to be measured at the inlet of the *BWMS*. [*G8* / 3.17]

(7) "Viable organisms" ~~are organisms and any life stages thereof that are living~~mean organisms that have the ability to successfully generate new individuals in order to reproduce the species.

[*G8* / 3.19]

(8) "Test plan" describes the detailed schedule of all testing, including environmental testing, land-based testing and shipboard testing.

(9) "Valid test cycle" means a test cycle in which all the required test conditions and arrangements, including challenge conditions, test control, and monitoring arrangements (including piping, mechanical and electrical provisions) and test analytical procedures were achieved by the testing organisation. [*G8* / 3.18]

(~~9~~10) "Invalid test cycle" ~~means the density (organisms greater than or equal to 50 μm and less than 50 μm in minimum dimension, test organisms of greater than or equal to 10 μm or more in minimum dimension) of viable organisms when both untreated and treated ballast water are uptaken at a rate equal to or less than 10 times the ballast water performance standard during shipboard testing.~~is a test cycle in which, due to circumstances outside the control of the *BWMS*, the requirements for a valid test cycle are not met. When a test cycle is invalid, it does not count as one of the required consecutive test cycles in a test and the test can be continued. [*G8* / 3.7]

(~~10~~11)"~~Unsuccessful~~Failed test cycle" ~~means shipboard test cycles other than successful test cycles, invalid test cycles and test cycles which cannot satisfy the ballast water performance standard.~~ is a valid test cycle in which the performance of the *BWMS* resulted in treated water that is determined to be non-compliant with the ballast water performance standard. A failed test cycle interrupts the required consecutive test cycles and terminates the test. [*G8* / 3.6]

(~~11~~12)"Replicate sample" means a sample which is taken by repeating the same action.

(13) "Major components" means those components that directly affect the ability of the system to meet the ballast water performance standard. [*G8* / 3.9]

(14) "Representative sampling" means sampling that reflects the relative concentrations (chemicals) and numbers and composition of the populations (organisms) in the volume of interest. Samples are to be taken in a time-integrated manner and the sampling facility is to be installed in accordance with the annex, Part 1 of *IMO* resolution *MEPC*.173(58) "*Guidelines for Ballast Water Sampling (G2)*", as amended. [*G8* / 3.10]

(15) "Successful test cycle" means a valid test cycle where the *BWMS* functions to its specifications and treated water is determined to meet the ballast water performance standard. [*G8* / 3.13]

(16) "System Design Limitations of a *BWMS* (hereinafter referred to as "*SDL*")" means the water quality and operational parameters, determined in addition to the required type approval testing parameters, that are important to its operation, and, for each such parameter, a low and/or a high value for which the *BWMS* is designed to achieve the ballast water performance standard. The System Design Limitations are to be specific to the processes being employed by the *BWMS* and is not be to limited to parameters otherwise assessed as part of the type approval process. The System Design Limitations are to be identified by the manufacturer and validated under the supervision of the Society in accordance with this Guidance. [*G8* / 3.14]

(17) "Test cycle" refers to one testing iteration (to include uptake, treatment, holding and discharge as appropriate) under a given set of requirements used to establish the ability of a *BWMS* to meet the set standards. [*G8* / 3.15]

(18) "Test" means the set of required test cycles. [*G8* / 3.16]

(19) "Inline *BWMS*" means *BWMS* which treats on the way of the intake and the discharge of the ballast water.

(20) "In-tank *BWMS*" means *BWMS* which treats after the intake of the ballast water in the ballast tank.

(21) "Quality Management Plan (hereinafter referred to as "*QMP*")" means the quality control management structure and policies of the testing body (including subcontractors and outside

laboratories). [*G8* Annex / 2.1.2.1]

(22) "Quality Assurance Project Plan (hereinafter referred to as "*QAPP*")" means the methods, procedures, and quality assurance and quality control (*QA*/*QC*) protocols used by the test facility for testing *BWMS* in general. It identifies the test team members, and it includes all relevant standard operating procedures (*SOPs*), typically as appendices. [*G8* Annex / 2.1.2.2]

(23) "Test/Quality Assurance Plan (hereinafter referred to as "*TQAP*")" means plans including as follows. [*G8* Annex / 2.1.2.3]

(a) Specific details for conducting a test of a given *BWMS* at a given site and time.

(b) Detailed plans for commissioning the *BWMS*, the experimental plan, decommissioning, and reporting the results.

(c) The *TQAP* identifies all organizations involved in the test and includes the *BWMS* vendor's documentation and performance claims.

(d) The *TQAP* also identifies the data to be recorded, operational and challenge parameters that define a valid test cycle, data analyses to be presented in the verification report, and a schedule for testing. Appropriate statistical distributions should be considered and used to analyse data.

11.1.3 Requirements of International Convention

(Omitted)

11.2 Approval Application

11.2.1 Approval Application Forms

(Omitted)

11.2.2 Documents to be Submitted

1 The drawings and documents listed below are to be submitted in triplicate together with the application specified in **11.2.1**. [*G8* / 5.2, 5.5, 5.7, *G8* Annex / 1.3, 2.2]

(1) Documents describing the manufacturing plant outline

(2) Documents related to the quality control standards of *BWMS*

(3) Records of manufacture and delivery of the *BWMS*

(4) Drawings and documents for the *BWMS*

(a) Complete description ~~of the *BWMS*~~

(b) Construction drawings (with all dimensions necessary for evaluation) ~~of the *BWMS*~~

(c) Drawings of the main components (showing clearly all materials used) ~~of the *BWMS*~~

(d) Diagrammatic drawings (including the pumping and sampling facilities)

(e) Drawings for sampling facilities and documents for sampling methods

(f) Electrical and electronic wiring diagrams (including information for trouble-shooting, etc.)

(g) Operation, maintenance, emergency and trouble-shooting manuals including following items:

i) instructions for the correct operation of the *BWMS*, including procedures for the discharge of untreated water in the event of malfunction;

ii) instructions for the correct arrangement of the *BWMS*;

iii) maintenance and safety instructions and the need to keep records;

iv) trouble shooting procedures;

v) emergency procedures necessary for securing the ship;

vi) any supplementary information considered necessary for the safe and efficient operation of the *BWMS*, e.g. documentation provided for *IMO* Resolution

*MEPC.*169(57) "*Procedure for Approval of Ballast Water Management Systems that Make Use of Active Substances (G9)*", as amended; and

vii) calibration procedures;

(h) Process description of the treatment of the ballast water

~~(i) Technical installation specifications of the *BWMS*~~

(i) Hazard identification

(j) Information regarding environmental and public health impacts including:

i) identification of potential hazards to the environment based on environmental studies performed to the extent necessary to assure that no harmful effects are to be expected;

ii) sufficient information to enable the test organization to identify any potential health or environmental safety problems, unusual operating requirements (labour or materials), and any issues related to the disposal of treatment by products or waste streams;

(k) Information regarding *SDL* including:

i) the identification of all known parameters to which the design of the *BWMS* is sensitive;

ii) for each parameter the manufacturer should claim a low and/or a high value for which the *BWMS* is capable of achieving the ballast water performance standard; and

iii) the proposed method for validating each claimed system design limitation should be set out, together with information on the source, suitability and reliability of the method;

(l) Software change handling and revision control document including:

i) change handling procedure stipulated by the manufacture;

ii) revision control procedure stipulated by the manufacture (In case of the revision, reason for modification, specification of the proposed change, authorization of modification; and test record are to be described.);

(m) A description of *BWMS* side streams (e.g. filtered material, centrifugal concentrate, waste or residual chemicals) including a description of the actions planned to properly manage and dispose of such wastes

(5) Record of the "Basic and Final Approval of Active Substances and Preparations" (in cases where the system results in changes to the chemical composition of the treated water)

(6) Approval test plan (including information on the place and scheduled date of the test)

(7) Test records (if any preliminary tests were carried out)

(8) Evidence of successful compliance with the environmental testing specified in **11.5.4**

(~~8~~9) Other information deemed necessary by the Society

2 (Omitted)

3 (Omitted)

11.3 Preliminary Review

11.3.1 Approval of Test Plan

(Omitted)

11.3.2 Confirmation Survey of Manufacturing Factory or Facility

When judged necessary, the Society may carry out a confirmation survey of the facilities, manufacturing techniques, and product quality control as well as an internal inspection of the manufacturing factory or facility based upon the data specified in **11.2** in order to verify the

factory's or facility's ability to manufacture the ~~ballast water treatment system~~*BWMS* at a stable quality.

11.3.3 Approval Testing for the Testing Facility

(1) The testing facility is to demonstrate its competency in conducting valid type approval tests in following two ways: [*G8* Annex / 2.1.1]
   (a) have implemented a rigorous quality control/quality assurance program, approved, certified and audited by an independent accreditation body, or to the satisfaction of the Administration,
   (b) be able to demonstrate its ability to conduct valid test cycles with appropriate challenge water, sample collection, sample analysis, and method detection limits. It is the responsibility of the Administration, or its authorized delegate, to determine the acceptability of the test facility.

(2) The test facility's quality control/quality assurance program is to consist of followings: [*G8* Annex / 2.1.2]
   (a) *QMP* specified in **11.1.2(21)**
   (b) *QAPP* specified in **11.1.2(22)**
   (c) *TQAP* specified in **11.1.2(23)**

(3) The testing facility performing the *BWMS* tests is to be independent. It is not to be owned or affiliated with the manufacturer or vendor of any *BWMS*, by the manufacturer or supplier of the major components of that equipment. [*G8* Annex / 2.1.3]

11.3.4 Cautions During the Readiness Evaluation

During the readiness evaluation the major components specified in **11.1.2(13)** of the *BWMS* is to be identified. Major components are considered to be those components that directly affect the ability of the system to meet the ballast water performance standard. Upgrades or changes to major components are not to take place during type approval testing. A change to a major component is to require a new submission of the test proposal and is to involve a new evaluation and repeating of the land-based and shipboard tests. [*G8* Annex / 1.10]

11.4 Requirements of Construction and Performance

11.4.1 Ballast Water Management System (*BWMS*)

(1) The *BWMS* is to be designed and constructed: [*G8* / 4.5]
   (a) for robust and suitable operation in the shipboard environment;
   (b) for the service for which it is intended;
   (c) to mitigate any danger to persons on board when installed. Equipment that could emit dangerous gases/liquids shall have at least two independent means of detection and shutdown of the *BWMS* (i.e. hazardous gas level reaching lower explosive limits (*LEL*) or level of toxic concentrations that can result in severe effects on human health); and
   (d) with materials compatible for the substances used, purpose which it is intended, the working conditions to which it will be subjected and the environmental conditions on board.

(~~1~~2) The *BWMS* is not to contain or use any substance of a dangerous nature, unless adequate ~~arrangements for storage, application, mitigation, and safe handling,~~ risk mitigation measures are incorporated for storage, application, installation, and safe handling, acceptable to the Society~~, are provided to mitigate any hazards introduced thereby~~. [*G8* / 4.6]

(~~2~~3) In case of any failure compromising the proper operation of the *BWMS*, audible and visual alarm signals are to be given in all stations from which ballast water operations are controlled.

[*G8* / 4.7]

(~~3~~4) All working parts of the *BWMS* that are liable to wear or to be damaged are to be easily accessible for maintenance. [*G8* / 4.8]

(~~4~~5) To avoid any incorrect operation of the *BWMS*, its specifications and construction are to be as follows.

(a) Every access of *BWMS* beyond the essential requirements of **(~~3~~4)** above is to require the breaking of a seal. [*G8* / 4.9.1]

(b) The *BWMS* is to be so constructed that a visual alarm is always activated whenever *BWMS* is in operation for purposes of cleaning, calibration or repair, and these events are to be recorded by the control and monitoring equipment. [*G8* / 4.9.2]

~~(c) In the event of an emergency, suitable by-passes or overrides to protect the safety of the ship and personnel are to be installed.~~

(~~d~~c) ~~The installations specified **(c)** above are to activate an audible and visual alarm, and the event is to be recorded by the control equipment.~~The *BWMS* is to be provided with the necessary connections to ensure that any bypass of the *BWMS* will activate an alarm, and that the bypass event is recorded by the control and monitoring equipment. [*G8* / 4.9.3]

(6) The *BWMS* is to be provided with simple and effective means for its operation and control. It is to be provided with a control system that should be such that the services needed for the proper operation of the *BWMS* are ensured through the necessary arrangements. [*G8* / 4.11]

(7) The *BWMS* is to, if intended to be fitted in hazardous area locations, comply with **Part H of the Rules for the Survey and Construction of Steel Ships**. Any electrical equipment that is part of the *BWMS* is to be based in a non-hazardous area, or is to comply with **Part H of the Rules for the Survey and Construction of Steel Ships**. Any moving parts, which are fitted in hazardous areas, are to be arranged so as to avoid the formation of static electricity. [*G8* / 4.12]

(8) The *BWMS* is not to endanger the health and safety of the crew, interact negatively with the ship's systems and cargo or produce any adverse environmental effects. The *BWMS* is not to create long term impacts on the safety of the ship and crew through corrosive effects in the ballast system and other spaces. [*G8* / 4.13]

(9) It is to be demonstrated by using mathematical modelling and/or calculations, that any up or down scaling of the *BWMS* will not affect the functioning and effectiveness on board a ship of the type and size for which the equipment will be certified. In doing so, the manufacturer of the equipment is to take into account the relevant guidance developed by the Organization. [*G8* / 4.14]

(10) Scaling information is to allow the Society to verify that any scaled model is at least as robust as the land-based-tested model. It is the responsibility of the Society to verify that the scaling used is appropriate for the operational design of the *BWMS*. [*G8* / 4.15]

(11) The design of the *BWMS* is to account for the fact that, regardless of the *BWMS* technology employed, viable organisms remaining after treatment may reproduce in the interval between treatment and discharge. [*G8* / 4.4]

(12) At a minimum, the shipboard test unit is to be of a capacity that allows for further validation of the mathematical modelling and/or calculations for scaling, and preferably selected at the upper limit of the rated capacity of the *BWMS*, unless otherwise approved by the Administration. [*G8* / 4.16]

~~**11.4.2 Ballast Water Treatment Equipment**~~

~~(1) Ballast water treatment equipment is to be robust and suitable for working in the shipboard environment, is to be of a design and construction adequate for the service for which it is intended and is to be so installed and protected as to reduce to a minimum any danger to persons onboard, due regard being paid to hot surfaces and other hazards. The design is to~~

~~have regard to materials used in construction, the purpose for which the equipment is intended, the working conditions to which it will be subjected and the environmental conditions on board.~~

~~(2) Ballast water treatment equipment is to be provided with simple and effective means for its operation and control. It is to be provided with a control system that is to be such that the services needed for the proper operation of the ballast water treatment equipment are ensured through the necessary automatic arrangements.~~

~~(3) Ballast water treatment equipment and its relevant electrical equipment are to be of explosion-protected type, if intended to be fitted in locations where flammable atmospheres may be present. Any moving parts fitted in such locations are to be arranged so as to avoid the formation of static electricity.~~

11.4.~~3~~2 Control and Monitoring Equipment

(1) The *BWMS* is to incorporate control equipment that automatically monitors and adjusts necessary treatment dosages or intensities or other aspects of *BWMS* of the vessel, which while not directly effecting treatment, are nonetheless required for proper administration of the necessary treatment. [*G8* / 4.18]

(2) ~~Control equipment is to incorporate a continuous self-monitoring function during the period in which the *BWMS* is in operation.~~The control and monitoring equipment is to record the operation condition automatically, and the proper functioning or failure of the *BWMS*. Where practical, system design limitation parameters are to be monitored and recorded by the *BWMS* to ensure proper operation. [*G8* / 4.17]

(3) ~~Monitoring equipment is to record the proper functioning or failure of the *BWMS*.~~The *BWMS* is to be able to produce (e.g. display, print or export) a report of the applicable self-monitoring parameters for official inspections or maintenance, as required. [*G8* / 4.19]

(4) ~~Control equipment is to be able to store data for at least 24 months, and is to be able to display or print a record for inspections. In the event the control equipment is replaced, means is to be provided to ensure the data recorded prior to replacement remains available on board for 24 months.~~The control and monitoring equipment are to be able to store data for at least 24 months. In the event the control and monitoring equipment is replaced, means are to be provided to ensure the data recorded prior to replacement remains available on board for 24 months. [*G8* / 4.20]

(5) ~~Control equipment is to be provided with the ability to correct and re-zero the control equipment meters and the repeatability of the values obtained from measurements.~~For *BWMS* that could emit dangerous gases, a means of gas detection by redundant safety systems is to be fitted in the space of the *BWMS*, and an audible and visual alarm is to be activated at a local area and at a manned *BWMS* control station in case of leakage. The gas detection device is to be designed and tested in accordance with *IEC* 60079-29-1, or other recognized standards acceptable to the Society. Monitoring measures for dangerous gases with independent shutdown is to be provided on the *BWMS*. [*G8* / 4.21]

(6) All software changes introduced to the system after the pre-test evaluation are to be done according to a change handling procedure ensuring traceability. [*G8* / 4.22]

11.4.~~4~~3 Sampling Facilities and methods

(1) The *BWMS* is to be provided with sampling facilities so arranged as to collect representative samples of the ship's ballast water.

(2) Sampling facilities are to in any case be located on the *BWMS* intake, before the discharging points, and any other points necessary for sampling to ascertain the proper functioning of the equipment as may be determined by the Society.

(3) The sampling protocol is to ensure organism mortality is minimized, e.g. by using appropriate

valves and flow rates for flow control in the sampling facility, submerging nets during sampling collection, using appropriate sampling duration and handling times, and appropriate concentrating methodology. [*G8* Annex / 2.2]

11.4.4 Self Monitoring

(1) The information and applicable self-monitoring parameters to be recorded for all systems are to include, inter alia: [*G8* Annex / 5.3]
   (a) general information: ship name, *IMO* number, *BWMS* manufacturer and type designation, *BWMS* serial number, date of *BWMS* installation on ship, *BWMS* treatment rated capacity (*TRC*), principle of treatment (in-line/in-tank);
   (b) operational parameters: all recorded parameters are to be time tagged if applicable:
      i) *BWMS* operational modes and any transition modes, including bypass operations (e.g. uptake, discharge, warming-up, cleaning and startup)
      ii) ballast water pump in operation (yes/no – if information is available from ship)
      iii) flow-rate at system outlet
      iv) Indication of the ballast water tank that is involved in the ballast water operation when practicable
   (c) system alerts and indications
   (d) general alerts include following **i)** to **iv)**
      i) shutdown of system while in operation
      ii) when maintenance is required
      iii) *BWMS* bypass valve status
      iv) status of *BWMS* valves representing system operational mode as appropriate
   (e) operational alerts include following **i)** to **iii)**
      i) whenever a relevant parameter exceeds the acceptable range approved by the Society, the system should give an alert.
      ii) If a safety relevant parameter (safety for crew, cargo and/or the ship) related to the *BWMS* exceeds approved limits, an alert/alarm should be mandatory (e.g. hydrogen level at appropriate measurement point(s)).
      iii) In addition, an alert is to be logged and time stamped also when a combination of relevant parameters exceeds system specifications, even if each single parameter does not exceed its approved range.
   (f) the *SDL* parameters and their corresponding data
   (g) the Society may require additional alerts depending on the design of the system and for future developments

(2) The storage and the record of the data are to be taking into account as follows. [*G8* Annex / 5.5]
   (a) The control and monitoring equipment are to automatically record the proper functioning or failure of a *BWMS* without user interaction and add a time stamp to every entry. [*G8* Annex / 5.5]
   (b) The system is to store the required data in any of *text* format, *pdf* format, *MS Excel* format, *xml* format. [*G8* Annex / 5.6]
   (c) The equipment is be so designed that, as far as is practical, it will not be possible to manipulate either the data being stored by the system or the data which has already been recorded. Any attempt to interfere with the integrity of the data is to be recorded. [*G8* Annex / 5.7]
   (d) Permanent deletion of recordings is not to be possible. The system is to be capable of storing recorded data for at least 24 months to facilitate compliance with **1.2, Part 3 of the Rules for Ballast Water Management Installations**. Where navigation equipment is connected to the monitoring system to provide data for recording, the interfaces are to

comply with applicable parts of International Standard *IEC* 61162, as amended. [*G8* Annex / 5.8]

11.4.5 System Design Limitations (*SDL*)

(1) The low and/or high parameter values for each system design limitation are to be validated to the satisfaction of the Society as follows: [*G8* Annex / 6.2]

(a) The validation is to be overseen by the Society and is to consist of a rigorous evidence-based assessment of a specific claim by the *BWMS* manufacturer that the equipment will operate as intended between pre-stated parameter values. Also, such tests may be combined with land-based and/or shipboard testing if the *QAPP* specified in **11.1.2(22)** establishes that the validation tests will not interfere with the specific procedures. Laboratory or bench-scale testing may also be used in the validation of *SDL*;

(b) Methods other than testing, such as the use of existing data and/or models, may be used in the validation of *SDL*. The source, suitability and reliability of such methods are to be reported.

(2) Claims of open-ended performance (expressed as the lack of either a low or a high parameter value for a *SDL*) are to also be validated. [*G8* Annex / 6.3]

(3) *BWMS* manufacturers may include a margin of error in claiming *SDL*. [*G8* Annex / 6.4]

(4) *SDL* is to be established for all known parameters to which the design of the *BWMS* is sensitive that are important to the operation of the *BWMS*. [*G8* Annex / 6.5]

11.4.6 Cautions During the Type Approval

(1) The Society may allow replacements of non-major components of equivalent specification (independently approved to a recognized and equal operational standard) during type approval. Replacements of non-major components during testing are to be reported in test records specified in **11.6.1**. [*G8* Annex / 1.11]

(2) Upgrades of the *BWMS* that relate to the safe operation of that system may be allowed during and after type approval by the Society and are to be reported. If such safety upgrades directly affect the ability of the system to meet the ballast water performance standards, it is to be treated as a change of a major component, as **11.3.4**. [*G8* Annex / 1.12]

11.4.~~5~~7 Other

~~Electrical and electric equipment installed on weather decks is to comply with IP56 in accordance with *IEC Publication*, or any equivalent thereto.~~

(1) The routine maintenance of the *BWMS* and troubleshooting procedures are to be clearly defined by the manufacturer in the operation, maintenance and safety manual. All maintenance and repairs are to be recorded. [*G8* / 4.8]

(2) All maintenance and repairs after *BWMS* installation are to be taken into consideration so as to be recorded. [*G8* / 4.8]

11.5 Approval Test

11.5.1 General

In cases where products for which approval tests are required are produced, the approval test is to be carried out in accordance with an approval test plan approved by the Society.

11.5.2 Test Witnessing by the Society's Surveyor

The Society’s Surveyor is to be present, as a rule, to witness the approval test when the test is being carried out.

11.5.3 Test Items

Test items are the following items and the details of each test is specified in **11.5.4** to **11.5.~~6~~8**. However, additional tests may be required in cases where deemed necessary by the Society.

(1) Environmental testing
(2) Land-based testing
(3) Shipboard testing
(4) Temperature testing
(5) Evaluation of regrowth testing

11.5.4 Environmental Testing

As for the electrical and electronic sections which make up the *BWMS*, tests are to be carried out in accordance with the test conditions and test methods specified in ~~**Table.2.11-1**~~**1.3, Part 7**, and the satisfaction of the acceptance criteria ~~in **Table.2.11-1**~~ is to be confirmed. ~~In addition, equipment is to be operated satisfactory upon completion of each of the operating environment tests specified in **Table.2.11-1**.~~ Also, the satisfaction of *ISO*/*IEC* 17025, as amended, and relevant standards are to be confirmed. [*G8* Annex / 3.1, 3.2, 3.3]

11.5.5 Land-based Testing

1 The test set-up

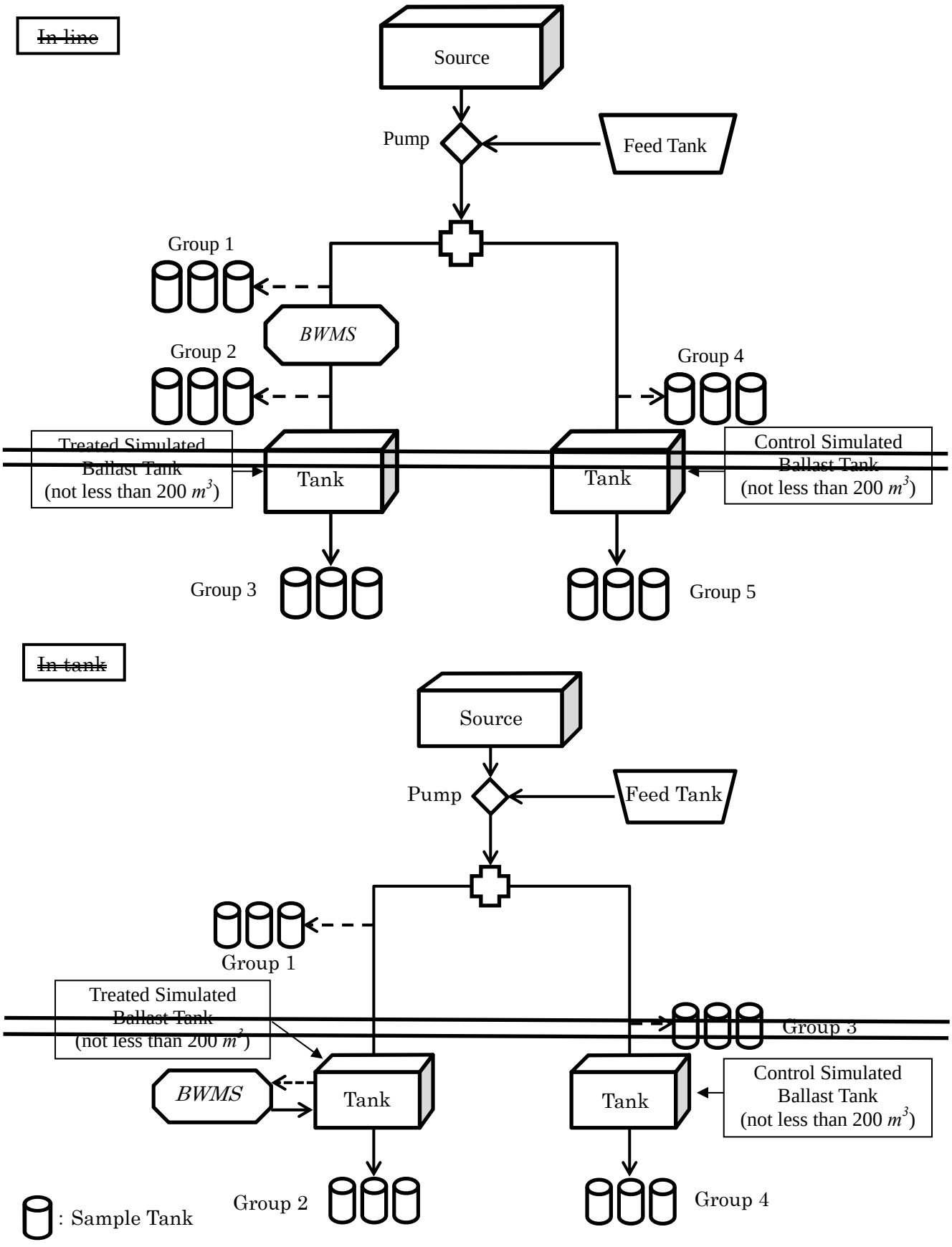
Land-based testing is to be carried out by using test facilities which satisfy the following specifications.

(1) The following facilities are to be provided in accordance with the typical character and the arrangement of the ship ~~(refer to **Fig.2.11-1**)~~. [*G8* Annex / 2.4.12]
   (a) The *BWMS*;
   (b) Pumps in accordance with the treated capacity and pipping; and
   (c) The control and treated simulated ballast tanks to simulate a ballast tank, constructed such that the water in the tank is completely shielded from light.
(2) The requirements for the control and treated simulated ballast tanks that simulates a ballast tank are as follows. [*G8* Annex / 2.4.13]
   (a) a minimum capacity of 200 m^3;
   (b) normal internal structures, including lightening and drainage holes;
   (c) follow standard industry practices for design, construction and surface coatings (Performance standard for protective coatings of dedicated seawater ballast tanks on all new ships and of double-sided skin spaces of bulk carriers (*PSPC*)) for ships; and
   (d) incorporate the minimum modifications required for structural integrity on land.
(3) The test set-up is to include facilities to allow sampling and provisions to supply influent test water to the *BWMS*. [*G8* Annex / 2.4.15]
(4) The test set-up is to be pressure-washed with tap water, dried and swept to remove loose debris, organisms and other matter before starting the testing procedures. [*G8* Annex / 2.4.14]
(5) Land-based testing of *BWMS* is to be independent of the system manufacturer. [*G8* Annex / 2.4.7]

Table 2.11.1 Methods and Acceptance Criteria for Environmental Testing

<table>
<tr><th>Test Items</th><th>Test Condition and Test Method</th><th>Acceptance Criteria</th></tr>
<tr><td>Vibration Tests</td><td>(1) An oscillation frequency of 2 Hz to 80 Hz at the operational condition of the equipment, sweep tests which sweeps at vibration amplitude or acceleration specified in below resonance and searches the resonance are to be carried out in each of the three orthogonal planes at a rate sufficiently low to permit resonance detection.
<table>
<tr><th>Oscillation Frequency</th><th>Vibration Amplitude or Acceleration</th></tr>
<tr><td>2 Hz to 13.3 Hz</td><td>Vibration Amplitude ±1.0 mm</td></tr>
<tr><td>13.2 Hz to 80 Hz</td><td>Acceleration ±0.7 g</td></tr>
</table>
(2) In the absence of any resonant frequency, the equipment is to be vibrated in each plane at 30 Hz with an acceleration of 0.7 g for a period of two hours.
(3) In the presence of any resonant frequency, the equipment is to be vibrated by the resonant frequency (the vibration amplitude or acceleration is to be the same as for the sweep test.) for a period of two hours.
(4) After completion of the above test, a sweep test is to be carried out in accordance with the condition specified in above (1).</td><td>(1) (2) (3): There is no break, deformation or erroneous system performance.
(4): There is no break, deformation, erroneous system performance or significant change in the vibration pattern.</td></tr>
<tr><td>Temperature Tests</td><td>(1) Equipment that is to be installed in an enclosed space which is environmentally controlled, including engine rooms, is to be subjected, for a period of not less than two hours, to temperature conditions of 0°C and 55°C. At the end of each test referred to in the subparagraphs above, the equipment is to be switched on and is to function normally under the test conditions.
(2) Equipment that may be installed in exposed areas on open decks, or in an enclosed space not environmentally controlled is to be subjected, for a period of not less than two hours, to temperature conditions of -25°C and 55°C. At the end of each test referred to in the subparagraphs above, the equipment is to be switched on and is to function normally under the test conditions.</td><td>Confirm that there is no break, deformation or erroneous system performance.</td></tr>
<tr><td>Humidity Tests</td><td>Equipment is to be left switched off for a period of two hours at a temperature of 55°C in an atmosphere with a relative humidity of 90%. At the end of this period, the equipment is to be switched on and is to operate satisfactorily for one hour under the test conditions.</td><td>Confirm that there is no break, deformation or erroneous system performance.</td></tr>
<tr><td>Fluctuation in Power Supply</td><td>Equipment is to operate satisfactorily when affected by the following external power sources:
(1) a voltage variation of ±10% together with a simultaneous frequency variation of ±5%; and
(2) a transient voltage of ±20% together with a simultaneous frequency transient of ±10%, with a transient recovery time of three seconds.</td><td>Confirm normal operation</td></tr>
<tr><td>Inclination Test</td><td>The BWMS is to be designed to operate when the ship is upright and when inclined at any angle of list up to and including 15° either way under static conditions and 22.5° under dynamic conditions (rolling) either way and simultaneously inclined dynamically (pitching) 7.5° by bow or stern. The Society may permit deviation from these angles, taking into consideration the type, size and service conditions of the ship and operational functioning of the equipment.</td><td>Confirm normal operation</td></tr>
</table>

~~Fig.2.11-1 Schematic Diagram of Land-based Testing~~



2 The application of ~~downsized~~ similarity of *BWMS* for land-based testing

With respect to the land-based testing of *BWMS*, ~~downsized~~ similarity may be accepted only if the *BWMS* satisfies the following conditions.

(1) There is no alternation in the basic design of the *BWMS*. [*G8* Annex / 2.4.16]

~~(2) An in-line method *BWMS* is to be one of the following **(a)** to **(c)**:~~

~~(a) The *TRC* of the *BWMS* exceeds 200 m^3/h;~~

~~(b) The *BWMS* whose *TRC* exceeds 200 m^3/h but is less than 1,000 m^3/h may be downscaled to a maximum of one-fifth scale. In such cases, however, it is not to be smaller than 200 m^3/h.~~

~~(c) The *BWMS* whose *TRC* is 1,000 m^3/h or larger may be downscaled to a maximum of one-one hundredth scale in the similarity range, but is not to be smaller than 200 m^3/h.~~

(2) *BWMS* with at least one model with a *TRC* equal to or smaller than 200 m^3/h is not to be downscaled. [*G8* Annex / 2.4.17]

(3) For *BWMS* with at least one model that has a higher capacity than 200 m^3/h or 1,000 m^3/h the following is to be observed for land-based testing. In-line treatment equipment may be downsized for land-based testing, but only when the following criteria are taken into account: [*G8* Annex / 2.4.18]

(a) *BWMS* with at least one model with a *TRC* larger than 200 m^3/h but smaller than 1,000 m^3/h may be downscaled to a maximum of 1:5 scale, but may not be smaller than 200 m^3/h; and

(b) *BWMS* with at least one model with a *TRC* equal to, or larger than, 1,000 m^3/h may be downscaled to a maximum of 1:100 scale, but may not be smaller than 200 m^3/h.

(~~3~~4) The performance of an in-tank method *BWMS* is to be tested in the demonstrable similarity range. [*G8* Annex / 2.4.19]

~~(4) Any downscaling is not to affect the ultimate functioning and effectiveness of the *BWMS*. This is to be certified by using mathematical modelling and/or calculations.~~

~~(5) In cases where the applicant desires approval of a smaller treated capacity model than a land-based testing model which satisfies **(1)** to **(4)** above, it is to be certified that the similarity scaling and flow rate will not affect the performance of the *BWMS*.~~

3 Influent Water

(1) Test ~~organisms~~water ~~may be either naturally occurring in the test water, or cultured species that may be added to the test water.~~is to be natural water. Any augmentation of test water with dissolved organic carbon (*DOC*), particulate organic carbon (*POC*) or total suspended solids (*TSS*) to achieve the minimum required content is to be validated and approved by the Society. As natural *DOC* constituents are complex and primarily of aromatic character, the type of added *DOC* is particularly critical to the evaluation of *BWMS* performance. The validation is to ensure that relevant properties of the augmented water (such as the oxidant demand/*TRO* decay and *UV* absorption in the range of 200 to 280 *nm*, the production of disinfectant by-products and the particle size distribution of suspended solids) are equivalent, on a *mg/L* basis, to that of natural water that would quantitatively meet the challenge conditions. In addition, the validation is to ensure that augmentation does not bias a test for or against any specific treatment process. The test report is to include the basis for the selection, use and validation of augmentation. [*G8* Annex / 2.4.21] ~~The organism concentration in the influent water is to comply with following requirements. Furthermore, the treatment of in case of adding cultured species is to be followed in accordance with Part 4 of Annex *IMO* Resolution *MEPC*.174(58) "*Guidelines for Approval of Ballast Water Management Systems (G8)*"(as amended) or the methods which are deemed equivalent thereto by the Society.~~

(2) The influent water is to comply with the following: [*G8* Annex / 2.4.24]

(a) Viable organisms of greater than or equal to 50 μm or more in minimum dimension are to be present in a total density of preferably 10^6 but not less than 10^5 individuals per cubic meter, and are to consist of at least 5 species from at least 3 different phyla/divisions ;

(b) Viable organisms greater than or equal to 10 μm and less than 50 μm in minimum dimension are to be present in a total density of preferably 10^4 but not less than 10^3 individuals per milliliter, and are to be consisted of at least 5 species from at least 3 different phyla/divisions; and

(c) Heterotrophic bacteria are to be present in a density of at least 10^4 living bacteria per milliliter.

(~~2~~3) Land-based testing is to be carried out taking into account quarantine and discharge regulations. [*G8* Annex / 2.4.26]

(~~3~~4) ~~At least two sets of tests cycles (5 replicates is considered a set) are to be carried out using influent water which includes with 2 kinds of salinity ranges and the density of Dissolved Organic Carbon (*DOC*), Particulate Organic Carbon (*POC*) and Total Suspended Solids (*TSS*) prescribed in **Table 2.11-2**. Furthermore, in cases where two sets of tests are carried out under adjacent salinity ranges, each salinity range is to be separated by at least 10 *PSU* (*Practical Salinity Unit*). For a *BWMS* which makes use of active substances, in cases where the density of *DOC*, *POC* and *TSS* are adjusted artificially, the change of the density active substance and relevant residual production as well as the formation of relevant residual production which were applied and approved are to be confirmed in accordance with *IMO* Resolution *MEPC*.169(57) "*Procedure approval of ballast water management systems that use of active substances (G9)*", as amended.~~

For any given set of test cycles (five are considered a set) a salinity range is to be chosen for each cycle. Given the salinity of the test set up for a test cycle in fresh, brackish and marine water, each is to have dissolved and particulate content in one of the following combinations in **Table 2.11-1**. [*G8* Annex / 2.4.20]

(5) Use of standard test organisms (hereinafter referred to as "*STO*") is to comply with the following: [*G8* Annex / 2.4.23]

(a) The use of standard test organisms (*STO*) is permissible if the challenge levels in naturally occurring water at the test facility require supplementation.

(b) Procedures, processes and guidance for the use of *STO* are to be based on the most relevant and up to date available scientific data.

(c) The use of *STO*, including concentrations and species, is to be recorded within the test records specified in **11.6.1**. The test records are to include information pertaining to the evaluation and justification for the use of *STO*, an assessment of the impact of their use on other test parameters and potential impacts on the test being undertaken. The information contained within the records are to reflect both the positive and negative impacts of the use of *STO*.

(6) The *BWMS* is to be tested in conditions for which it will be approved. For a *BWMS* to achieve an unlimited Type Approval Certificate specified in **11.6.2** with respect to salinity, one set of test cycles is to be conducted within each of the three salinity ranges with the associated dissolved and particulate content as prescribed in **Table 2.11-2**. Tests under adjacent salinity ranges in the above table are to be separated by at least 10 *PSU* (*Practical Salinity Unit*). [*G8* Annex / 2.4.22]

4 Test Items

The methods and acceptance criteria for land-based testing are specified in **Table 2.11-~~3~~2**.

Table 2.11-~~2~~1 Influent Water

	~~Salinity~~		
	~~>32 *PSU*~~	~~3 to 32 *PSU*~~	~~<3 *PSU*~~
~~Dissolved Organic Carbon (*DOC*)~~	~~>1 *mg/l*~~	~~>5 *mg/l*~~	~~>5 *mg/l*~~
~~Particulate Organic Carbon (*POC*)~~	~~>1 *mg/l*~~	~~>5 *mg/l*~~	~~>5 *mg/l*~~
~~Total Suspended Solids (*TSS*)~~	~~>1 *mg/l*~~	~~>50 *mg/l*~~	~~>50 *mg/l*~~

	Salinity		
	Marine 28 – 36 *PSU*	Brackish 10 – 20 *PSU*	Fresh < 1 *PSU*
Dissolved Organic Carbon (*DOC*)	>1 *mg/l*	>5 *mg/l*	>5 *mg/l*
Particulate Organic Carbon (*POC*)	>1 *mg/l*	>5 *mg/l*	>5 *mg/l*
Total Suspended Solids (*TSS*)	>1 *mg/l*	>50 *mg/l*	>50 *mg/l*

Table 2.11-~~3~~2 Methods and Acceptance Criteria for Land-based Testing.

Test Items	Test Method	Acceptance Criteria
Land-based Testing	1. A single test cycle is to be as follows, ~~and 5 test cycles are to be carried out. (refer to **Fig.2.11-1**)~~at least two test cycles in each salinity are to be conducted in order to evaluate compliance with the ballast water performance standard at the minimum holding time specified by the *BWMS* manufacturer. [*G8* Annex / 2.4.5] (1) the uptake of ballast water by pumping; (2) the storage of ballast water for ~~at least 5 days *1~~ at the minimum holding time specified by the *BWMS* manufacturer.; (3) treatment of ballast water within the *BWMS*, except the influent water in the simulated ballast water tank*2; and (4) the discharge of ballast water by pumping.	・To be carried out in accordance with the test plan. ・No incorporating of sea water and tank leakage. ・To be performed in accordance with the *TRC* specified in the test plan.
	2. The following items are to be recorded for each sample taken . (1) The number of viable organisms is to be measured and recorded. The phylum and kind of the organisms is to be based upon size class in accordance with the minimum dimension of the sample. (2) The number of the following bacteria in the sample is to be measured and recorded: [*G8* Annex / 2.4.25] (a) Coliform group and coliform; (b) Enterococcus group and enterococcus; (c) Vibrio cholerae and vibrio cholera of toxin production (serotype O-1 and O-139); and (d) Heterotrophic bacteria. (3) Parameters (e.g., treatment flow rate, *UV* transmission, concentration of injection medicine, filter differential pressure, concentration of total residual oxidants (*TRO*) and power consumption, etc.) which affected the *BWMS* during the test cycle are to be recorded. It is to be verified that the treatment equipment performs within its specified parameters, such as power consumption and flow rate, during the test cycle. The range of operational flow rates that a *BWMS* is expected to achieve in service, at the maximum and minimum operational flow rates (where it is appropriate for that technology), is to be verified after the filter on the discharge side of the pump. [*G8* Annex / 2.4.28, 2.4.29] (4) When the sample is taken, its *pH*, temperature, salinity, dissolved oxygen, *DOC*, *POC*, *TSS* and turbidity (*NTU: Nominal Turbidity Unit*) are to be recorded. [*G8* Annex / 2.4.30]	・The organism concentration of the influent water is to satisfy **11.5.6-3.**

Table 2.11-~~3~~2 Methods and Acceptance Criteria of Land-based Testing (continued)

Test Items	Test Method	Acceptance Criteria
Land-based Testing	3. Samples are to be taken in accordance with the following, and an analysis of the organisms and bacteria found in each sample is to be carried out. (1) Samples during the test are to be taken immediately before the treatment equipment, immediately after the treatment equipment and upon discharge after the appropriate holding time. [*G8* Annex / 2.4.31] (2) The control*[3] and treatment*[4] cycles may be run simultaneously or sequentially. The influent water is to be taken upon influent and discharge. [*G8* Annex / 2.4.32] (3) The preparation and facilities for samples are to be taken into consideration so as to have as little adverse effects as possible on the organisms. [*G8* Annex / 2.4.33] ~~(4) When taking the samples specified in Fig. **2.11-1**, each sample is to be taken 3 times from groups 1 to 5 in the case of in-line types, from groups 1 to 4 in the case of in-tank types.~~ (~~5~~4) Samples for measuring the following organism and bacteria are to be collected as separate samples each. (a) organisms greater than or equal to 50 *μm* in minimum dimension; (b) organisms greater than or equal to 10 *μm* and less than 50 *μm* in minimum dimension; and (c) Coliform group and coliform, enterococcus group and enterococcus, vibrio cholerae and vibrio cholera of toxin production (serotype O-1 and O-139) and heterotrophic bacteria.	~~・For 1 test cycle, the average discharge result of organisms of greater than or equal to 50 *μm*, no greater than 50 *μm* and greater than or equal to 10 *μm* in minimum dimension from control water is to be over 10 times of ballast water performance standard.~~If in any test cycle the discharge results from the control water is a concentration less than or equal to 10 times the values in the ballast water performance standard, the test cycle is invalid. [*G8* Annex / 2.4.36] ・As for the treated water at the time of discharge, the ~~average~~ number of viable organisms greater than or equal to 50 *μm* in minimum diameter in the replicate sample is to be less than 10 viable organisms per cubic metre. [*G8* Annex / 4.7.2] ・As for the treated water at the time of discharge, the ~~average~~ number of viable organisms of greater than or equal to 10 *μm* and less than 50 *μm* in minimum dimension during replicate sampling are to be no greater than 10 per 1 *ml*. [*G8* Annex / 4.7.3] ・As for the treated water at the time of discharge, the ~~average~~ number of the colony of vibrio cholera of toxin production (serotype O-1 and O-139) is to be less than 1 *cfu* per 100 *ml*, or less than 1 *cfu* per 1 *g* (wet weight) of zooplankton samples. [*G8* Annex / 4.7.4] ・As for the treated water at the time of discharge, the ~~average~~ number of the colony of coliform in the replicate samples is to be less than 250 *cfu* per 100 *ml*. [*G8* Annex / 4.7.5] ・As for the treated water at the time of discharge, the ~~average~~ number of the colony of enterococcus in the replicate samples is to be less than 100 *cfu* per 100 *ml*. [*G8* Annex / 4.7.6] ・No averaging of test runs, or the discounting of failed test runs has occurred. [*G8* Annex / 4.7.7]
	4. Analysis of the amount of sample water, organism and bacteria is to be carried out in accordance with the following: (1) For the enumeration of viable organisms greater than or equal to 50 *μm* or more in minimum dimension: [*G8* Annex / 2.4.34.1] (a) ~~For a comparison of organisms of greater than or equal to 50 *μm* in minimum dimension included in the sample water against the ballast water performance standard, at least 20 *l* of influent water and 1 cubic metre of treated water are to be collected 3 times. If samples are concentrated for enumeration, the samples are to be concentrated using a sieve no greater than 50 *μm* mesh in the diagonal dimension.~~Influent water is to be collected over the duration of uptake as one, time-integrated sample. The sample is to be collected as a single, continuous sample or a composite of	~~・The statistical analysis of *BWMS* is to consist of a t-test*[5] which compares the water of the control and treatment or a similar statistical test.~~ ・The live/dead judgement of the organism and the measurement of the number of viable organisms are to be according to the methods specified in Part 4 of the *Annex* of *IMO* Resolution *MEPC.*~~174~~279(~~58~~70) "*2016 Guidelines for Approval of Ballast Water Management Systems (G8)*" (as amended) or methods which are deemed equivalent thereto by the Society.

Table 2.11-~~3~~2 Methods and Acceptance Criteria of Land-based Testing (continued)

Test Items	Test Method	Acceptance Criteria
Land-based Testing	sequential samples, e.g. collected at intervals during the beginning, middle and end of the operation. The total sample volume is to be at least 1 m^3. If smaller volume is validated to ensure representative sampling of organisms, it may be used. Control and treated discharged water are to be collected as one time-integrated sample over the duration of discharge from the tank(s). The sample may be collected as a single, continuous sample or a composite of sequential samples, e.g. collected throughout the beginning, middle and end the operation. The total sample volume is to be at least 3 m^3; (b) If samples are concentrated for enumeration, the organisms are to be concentrated using a mesh with holes no greater than 50 μm in the diagonal dimension. Only organisms greater than 50 μm in minimum dimension should be enumerated; and (c) The full volume of the sample is to be analysed unless the total number of organisms is high, e.g. 100. In this case, the average density may be extrapolated based on a well-mixed subsample using a validated method; (2) ~~For the evaluation of organisms greater than or equal to 10 μm and less than 50 μm in minimum dimension included in sample water, at least 1 l of influent water and at least 10 l of treated water are to be collected. If samples are concentrated for enumeration, the samples are to be concentrated using a sieve no greater than 10 μm mesh in the diagonal dimension.~~For the enumeration of viable organisms greater than or equal to 10 μm and less than 50 μm in minimum dimension: [*G8* Annex / 2.4.34.2] (a) Influent water is to be collected over the duration of uptake as one, time-integrated sample. The sample is to be collected as a single, continuous sample or a composite of sequential samples, e.g. collected at intervals during the beginning, middle and end of the operation. A sample of at least 10 l is to be collected, and a fraction may be subsampled for transport to the laboratory, provided it is representative of the sample and is a minimum of 1 l. A minimum of three, 1 ml sub-samples is to be analysed in full to enumerate organisms. Control and treated discharged water are to be collected as one time-integrated sample over the duration of discharge from the tank(s). The sample may	

Table 2.11-~~3~~2 Methods and Acceptance Criteria of Land-based Testing (continued)

Test Items	Test Method	Acceptance Criteria
Land-based Testing	be collected as a single, continuous sample or a composite of sequential samples, e.g. collected throughout the beginning, middle and end the operation. A sample of at least 10 *l* is to be collected, and a fraction may be subsampled for transport to the laboratory, provided it is representative of the sample and is a minimum of 1 *l*. A minimum of six, 1 *ml* sub-samples are to be analysed in full to enumerate organisms. (b) The sample may not be concentrated for analysis unless the procedure is validated. (c) The full volume of the sample is to be analysed unless the total number of organisms is high, e.g. 100. In this case, the average density may be extrapolated based on a well-mixed subsample using a validated method; (3) ~~For the evaluation of bacteria, at least 500 *ml* of each sample is to be collected in sterile bottles.~~For the evaluation of bacteria: [*G8* Annex / 2.4.34.3] (a) For the influent and discharge samples, a minimum 10 *l* sample referred to in **-2(2)(a)** of test method in **Table 2.11-3**, or another sample at least 10 *l* in volume and collected in a similar manner, a sub-sample of minimum 1 *l* may be transferred to a sterile container for analysis; (b) A minimum of three, subsamples of appropriate volume taken from the 1 *l* subsample described above **(a)** are to be analysed for colony forming units of bacteria listed in the ballast water performance standard. (4) The samples are to be analysed for viable organisms within 6 hours of being taken or treated in such a way so as to ensure that proper analysis can be performed. [*G8* Annex / 2.4.35]	

Notes:

The order of (*1) and (*2): To be taken using the actual treatment method of the *BWMS*.

(*3) The control cycle: The leading cycle of the influent water from the source tank to the control tank.

(*4) The treatment cycle: The leading cycle of the influent water from the source tank to the control tank through the *BWMS*.

~~(*5) t-test: the statistical number using a mathematical distribution (t-distribution).~~

11.5.6 Shipboard Testing

During shipboard testing, it is to be verified that the entire *BWMS* is in good working order and complies with the ballast water performance standard on a ship in which it is actually in use.

1 Testing Conditions

(1) Shipboard testing is to be carried out in accordance with the test plan. Shipboard testing of *BWMS* is to be conducted by the test facility, independent of the *BWMS* manufacturer, with the system being operated and maintained by the ships' crew as per the operational manual.

[*G8* Annex / 2.3.2]

(2) ~~The *BWMS* is to be operated at the *TRC* described in the test plan.~~Following documents are to be submitted.

(a) Documentation that an inline *BWMS* is of a capacity to reflect the flow rate of the ballast water pump for the full rated capacity range of the *BWMS*; [*G8* Annex / 2.3.3.2]

(b) Documentation that an in-tank *BWMS* is of a capacity to reflect the ballast water volume that it is intended to treat within a specified period of time; [*G8* Annex / 2.3.3.3]

(3) The amount of ballast water tested during shipboard testing is to be consistent with the normal ballast operations of the ship. [*G8* Annex / 2.3.3.4]

(4) The discharge of treated ballast water in three consecutive valid test cycles is to be in compliance with the ballast water performance standard. [*G8* Annex / 2.3.3.9]

(5) ~~The viable organism concentrations contained in both the untreated ballast water and ballast water intended to be treated (limited to organisms greater than or equal to 50 *μm* in minimum dimension and organisms greater than or equal to 10 *μm* and less than 50 *μm*) are to exceed 10 times the value of the ballast water performance standard upon uptake, and the viable organism concentration contained in the untreated ballast water (limited to organisms greater than or equal to 50 *μm* in minimum dimension and organisms greater than or equal to 10 *μm* and less than 50 *μm*) is to exceed the values of the ballast water performance standard upon discharge.~~The uptake water for the ballast water to be treated is to contain a density of viable organisms exceeding 10 times the maximum permitted values in the ballast water performance standard. [*G8* Annex / 2.3.3.6]

(6) The test cycles, including invalid and unsuccessful test cycles, are to span a trial period of not less than six months. The six-month shipboard test period starts and ends with the completion of a successful test cycle or invalid test cycle that meets the ballast water performance standard. The three consecutive and valid test cycles that are required in specified in **(4)** above are to be suitably separated across the six-month period. [*G8* Annex / 2.3.3.8, 2.3.3.10]

(7) The quality of water such as *pH,* temperature, salinity, dissolved oxygen, *DOC*, *POC*, *TSS* and turbidity is to be measured and recorded at the time the samples are taken. [*G8* Annex / 2.3.3.11]

(8) The following items relevant to the *BWMS* are to be recorded during the shipboard testing: [*G8* Annex / 2.3.3.12]

(a) Ballast water operations including the volumes and locations (port or location information) of uptake and discharge, and if heavy weather was encountered;

(b) Investigations and reports of the possible reasons for the occurrence of an unsuccessful test cycle, or a test cycle discharge failing the ballast water performance standard;

(c) A record of any maintenance and repairs performed on the *BWMS* during the testing;

(d) The operation record of any parameters (e.g., treatment flow rate, *UV* transmission, concentration of injection medicine, filter differential pressure, concentration of total residual oxidants (*TRO*) and power consumption, etc.) which affected the *BWMS*; ~~and~~

(e) Functioning of the control and monitoring equipment of the *BWMS*~~.~~;

(f) Documentation that the *BWMS* was operated continuously throughout the test period for all ballasting and deballasting of the ship; and

(g) Documentation detailing water quality parameters identified by the testing organisation, should be measured as appropriate and practicable.

2 Test Items

The test method and acceptance criteria are shown in **Table 2.11-~~4~~3**.

Table 2.11-~~4~~3 Test Method and Acceptance Criteria of Shipboard Testing

Test items	Test method	Acceptance criteria
Shipboard testing	**1** A shipboard test cycle includes steps (1) to (4) below: [*G8* Annex / 2.3.1] (1) The uptake of ballast water of the ship; (2) The storage of ballast water on the ship during a voyage*[1]; (3) The treatment of the ballast water, except in control tanks*[2]; and (4) The discharge of ballast water from the ship.	・No contamination by sea water and leakage from tanks, etc. is observed. ・The *BWMS* is operated at the *TRC* described in the test plan.
	2 Samples are to be taken in accordance with the following, and the analysis of the organisms and bacteria included in each sample is to be carried out. ~~(1) For the control tank~~ ~~(a) Three replicate samples of influent water, collected over the period of uptake (beginning, middle, and end).~~ ~~(b) Three replicate samples of discharge control water, collected over the period of discharge (beginning, middle, and end).~~ ~~(2) For treated ballast water~~ ~~Three replicate samples of discharge treated water, collected at each of three times during the period of discharge (3 times at the beginning, 3 times at the middle, and 3 times at the end).~~ (~~3~~1) ~~Sample size~~For the enumeration of viable organisms greater than or equal to 50 *μm* or more in minimum dimension: [*G8* Annex / 2.3.3.7.1] (a) ~~For the enumeration of organisms greater than or equal to 50 *μm* in minimum dimension, samples of at least 1 m^3 are to be collected. If samples are concentrated for enumeration, the samples are to be concentrated using a sieve no greater than 50 *μm* mesh in diagonal dimension.~~Influent water is to be collected over the duration of uptake as one, time-integrated sample. The sample is to be collected as a single, continuous sample or a composite of sequential samples, e.g. collected at intervals during the beginning, middle and end of the operation. The total sample volume should be at least 1 m^3. If smaller volume is validated to ensure representative sampling of organisms, it may be used. Treated discharged water is to be collected as one time-integrated sample over the duration of discharge from the tank(s). The sample may be collected as a single, continuous sample or a composite of sequential samples, e.g. collected throughout the beginning, middle and end the operation. The total sample volume is to be at least 3 m^3. (b) If samples are concentrated for enumeration, the organisms are to be concentrated using a mesh with holes no greater than 50 *μm* in the diagonal dimension. Only organisms greater	・The viable organism concentration contained in the uptake water (limited to organisms greater than or equal to 50 *μm* in minimum dimension and organisms greater than or equal to 10 *μm* and less than 50 *μm*) exceeds 10 times the value of the ballast water performance standard~~, and control tank viable organism concentration exceeds the values of the ballast water performance standard upon discharge~~. [*G8* Annex / 2.3.3.6] ・The ~~average~~ density of organisms greater than or equal to 50 *μm* in minimum diameter in the replicate samples is less than 10 viable organisms per cubic meter upon discharge. [*G8* Annex / 4.7.2] ・The ~~average~~ density of organisms less than 50 *μm* and greater than or equal to 10 *μm* in minimum diameter in the replicate samples is less than 10 viable organisms per milliliter upon discharge. [*G8* Annex / 4.7.3] ・The ~~average~~ density of vibrio cholera (serotype O-1 and O-139) is less than 1 *cfu* per 100 *ml*, or less than 1 *cfu* per 1 *g* (wet weight) zooplankton samples upon discharge. [*G8* Annex / 4.7.4] ・The ~~average~~ density of E.coli in the replicate samples is less than 250 *cfu* per 100 *ml* upon discharge. [*G8* Annex / 4.7.5] ・The ~~average~~ density of intestinal enterococci in the replicate samples is less than 100 *cfu* per 100 *ml* on discharge. [*G8* Annex / 4.7.6] ・Determination of the viability and the enumeration of viable organism concentration is to be carried out in accordance with Part 4 of the *Annex* of *IMO Res. MEPC.*~~174~~279(~~58~~70) "*2016 Guidelines for Approval of Ballast Water Management Systems (G8)*", as amended, or by methods which are deemed equivalent by the Society. ・No averaging of test runs, or the discounting of failed test runs has occurred. [*G8* Annex / 4.7.7]

Table 2.11-~~4~~3 Test Method and Acceptance Criteria of Shipboard Testing (continued)

Test items	Test method	Acceptance criteria
Shipboard testing	than 50 *μm* in minimum dimension are to be enumerated. (c) The full volume of the sample is to be analysed unless the total number of organisms is high, e.g. 100. In this case, the average density may be extrapolated based on a well-mixed subsample using a validated method. ~~(b) For the enumeration of organisms greater than or equal to 10 *μm* and less than 50 *μm* in minimum dimensions, samples of at least 1 *l* are to be collected. If samples are concentrated for enumeration, the samples are to be concentrated using a sieve no greater than 10 *μm* mesh in in diagonal dimension.~~ (2) For the enumeration of viable organisms greater than or equal to 10 *μm* and less than 50 *μm* in minimum dimension: [*G8* Annex / 2.3.3.7.2] (a) Influent water is to be collected over the duration of uptake as one, time-integrated sample. The sample is to be collected as a single, continuous sample or a composite of sequential samples, e.g. collected at intervals during the beginning, middle and end of the operation. A sample of at least 10 *l* is to be collected, and a fraction may be subsampled for transport to the laboratory, provided it is representative of the sample and is a minimum of 1 *l*. A minimum of three, 1 *ml* sub-samples should be analysed in full to enumerate organisms. Treated discharged water is to be collected as one time-integrated sample over the duration of discharge from the tank(s). The sample may be collected as a single, continuous sample or a composite of sequential samples, e.g. collected throughout the beginning, middle and end the operation. A sample of at least 10 *l* is to be collected, and a fraction may be subsampled for transport to the laboratory, provided it is representative of the sample and is a minimum of 1 *l*. A minimum of six, 1 *ml* subsamples are to be analysed in full to enumerate organisms. (b) The sample may not be concentrated for analysis unless the procedure is validated. (c) The full volume of the sample is to be analysed unless the total number of organisms is high, e.g. 100. In this case, the average density may be extrapolated based on a well-mixed subsample using a validated method.	

Table 2.11-~~4~~3 Test Method and Acceptance Criteria of Shipboard Testing (continued)

Test items	Test method	Acceptance criteria
Shipboard testing	(3) For the evaluation of bacteria: [*G8* Annex / 2.3.3.7.3] (~~e~~a) ~~For the evaluation of bacteria, a sample of at least 500 *ml* is to be taken from both the influent and the treated water. In the absence of laboratory facilities on board, toxicogenic tests based upon requirements are to be conducted in an appropriately approved laboratory. However, this may limit the applicability of this test.~~For the influent and discharge samples, the minimum 10 *l* sample referred to in paragraph above **-2(2)(a)**, or another sample at least 10 *l* in volume and collected in a similar manner, a sub-sample of minimum 1 *l* may be transferred to a sterile container for analysis. (b) A minimum of three, subsamples of appropriate volume taken from the 1 *l* subsample described above **(a)** are to be analysed for colony forming units of bacteria listed in the ballast water performance standard.	

Note:
The order of (*1) and (*2)：To be taken using the actual treatment method of the *BWMS.*

11.5.7 Temperature Testing

The effective performance of *BWMS* through a ballast water temperature range of 0°C to 40°C (2°C to 40°C for fresh water) is to be verified as follows.

(1) Testing on a low-range temperature (the lowest possible temperature between 0°C and 10°C), a mid-range temperature (between 10°C and 20°C) and a high-range temperature (the highest possible between 20°C and 40°C) [*G8* Annex / 2.5.1]

(2) Testing during land-based, shipboard, laboratory or bench-scale testing and/or the use of existing data and/or models, provided that their source, suitability and reliability is reported. [*G8* Annex / 2.5.2]

11.5.8 Evaluation of Regrowth Testing

Evaluation of regrowth testing is to be conducted as follows. The evaluation of it is not intended to evaluate contamination in ballast tanks or piping, such as may arise from the presence of untreated water or residual sediments. Moreover, any neutralization of ballast water required by the *BWMS* is to occur at the end of the holding time, and immediately before the enumeration of organisms. [*G8* Annex / 2.6.5, 2.6.6]

(1) The evaluation of the regrowth of organisms is to be undertaken to the satisfaction of the Society in land-based and/or shipboard testing in at least two test cycles in each salinity. [*G8* Annex / 2.6.1]

(2) In the case of land-based testing being performed with a holding time of less than five days, a sufficient volume of treated uptake water is to be held under conditions similar to conditions in the relevant holding tank. In the case of shipboard testing, water is to be retained on board for the evaluation of regrowth during a shipboard test cycle. Additional bench-scale testing may be used to supplement the land-based and/or shipboard testing. [*G8* Annex / 2.6.2]

(3) In the case of a *BWMS* that includes mechanical, physical, chemical, and/or biological

processes intended to kill, render harmless, or remove organisms within ballast water at the time of discharge or continuously between the time of uptake and discharge, regrowth is to be assessed in accordance with section land-based testing specified in **11.5.5** or shipboard testing specified in **11.5.6** with a holding time of at least five days. [*G8* Annex / 2.6.3]

(4) Otherwise, the enumeration of organisms to assess regrowth is to be undertaken at least five days after the completion of all of the mechanical, physical, chemical, and/or biological processes intended to kill, render harmless, or remove organisms within ballast water. [*G8* Annex / 2.6.4]

11.6 Approval

11.6.1 Test Records

The manufacturer is to prepare records of the approval test after completion of the test, to obtain verification by the Society's attending surveyor and then to submit them, in triplicate, to the Society. Then, following items are to be incorporated. [*G8* Annex / 2.6.7, 2.7.1, 2.7.2, 2.7.4, 6.6]

(1) The name and address of the laboratory performing or supervising the inspections, tests or evaluations, and its national accreditation or quality management certification, if appropriate;

(2) The name of the manufacturer, and the trade name, product designation (such as model numbers), and a detailed description of the equipment or material inspected, tested or evaluated;

(3) The time, date, and place of each approval inspection, test or evaluation;

(4) The name and title of each person performing, supervising, and witnessing the tests and evaluations;

(5) Executive summary, introduction and background;

(6) All test results related to **11.5.3**;

(7) Test results for each test cycle including followings.

(a) Experimental design, methods and procedures;

(b) Results and discussion, including a description of any invalid test cycle and a comparison to the expected performance;

(c) In the case of land-based testing, test conditions including details on challenge water preparation in line with **11.5.5-3**;

(8) Any of the following documents related to the inspections, tests or evaluation.

(a) A description or photographs of the procedures and apparatus;

(b) A reference to another document that contains an appropriate description or photographs;

(9) At least one photograph that shows an overall view of the equipment or material tested, inspected or evaluated and design details.

(10) Photographs that show each occurrence of damage or deformation to the equipment or material that occurred during the approval tests or evaluations.

(11) The operational safety requirements of the *BWMS* and all safety related findings that have been made during the inspections, tests or evaluations.

(12) An attestation that the inspections, tests or evaluations were conducted as required and that the report contains no known errors, omissions, or false statements. The attestation must be signed by:

(a) The manufacturer or manufacturer's representative, if the inspection, tests or evaluations are conducted by the manufacturer; or

(b) The chief officer of the laboratory, or the chief officer's representative, if the inspection or tests were conducted by an independent laboratory;

(13) Appendices, including:

(a) The complete test plan and the data generated during tests and evaluations reported under above **(7)**, including at least:
  i) For land-based tests, whether ambient, cultured or a mixture of test organisms have been used (including a species-level identification for cultured organisms, and an identification to the lowest possible taxonomic level for ambient organisms);
  ii) For shipboard tests, the operating parameters of the system during successful treatment operations (e.g. dosage rates, ultraviolet intensity and the energy consumption of the *BWMS* under normal or tested Treatment Rated Capacity, if available);
  iii) For System Design Limitations, details of all procedures, methods, data, models, results, explanations and remarks, leading to validation; and
  iv) Invalid test information;
(b) The *QMP*, the *QAPP* and Quality Assurance and Quality Control records;
(c) Maintenance logs including a record of any consumable components that were replaced; and
(d) Relevant records and tests results maintained or created during testing.

(14) Other documents deemed necessary by the Society

11.6.2 Notification of Approval

1 The Society, when satisfied upon examination of the submitted documents and the attending surveyor's report, will issue a certificate of approval specifying the approval number, approval date, items of approval (the model name, manufacture, type, relevant drawings name and relevant drawings number of the *BWMS*) and approval conditions (operating condition and *SDL* etc). In addition, the Society will affix approval stamps onto documents it deems necessary out of those submitted in accordance with **11.2**, and return them back to the applicant. [*G8* / 5.4, 5.5, 6.1, 6.2, 6.3, 6.4, 6.5, *G8* Annex / 7.1]

2 For details on the certificate and the type approval report, refer to *IMO Res*. *MEPC.*279(70), as amended. [*G8* Annex / Part 7]

11.6.3 Renewal of Approval

1 The term of validity of approval in the preceding **11.6.2** will be 5 years. [*G8* / 6.8]

2 (Omitted)

3 (Omitted)

11.6.4 Revocation of Approval

(Omitted)

11.7 Examination of Products

11.7.1 Examination of Products

(Omitted)

11.8 Announcement of Approval

11.8.1 Announcement of Approval

(Omitted)

Part 6 MACHINERY

Chapter 12 APPROVAL OF USE OF WELDED TYPE PIPE JOINTS UNDER SPECIAL REQUIREMENTS

12.1 General

Paragraph 12.1.1 has been amended as follows.

12.1.1 Scope

In accordance with the requirements in **D12.6.1-1(1)(a)**, **Part D of the Guidance for the Survey and Construction of Steel Ships** (hereinafter referred to as "the Guidance"), **N5.12.1-1(5), Part N of the Guidance**, **Table S5.4.1-2**, **Part S of the Guidance**, the requirements of this chapter apply to the tests and inspections, etc. for the approval of use for pipe joints of a butt welded type and pipe joints of a slip-on sleeve welded type (hereinafter referred to as "pipe joints") made of materials complying with international or national standards such as *ISO*, *JIS*, etc.

12.5 Approval Tests

12.5.1 Notification and Announcement of Approval

Sub-paragraph -1 has been amended as follows.

1 The Society (Head Office) is to approve the use of pipe joints made of materials complying with international or national standards such as *ISO*, *JIS*, etc. in cases where it considers the results of confirmation and approval tests appropriate, and to issue a "Certificate of Approval", which includes the name of the manufacturer, kind of pipe joint, processing method, heat treatment method, name of the manufacturer of the primary material, primary material grade mark, the valid period of approval etc. In addition, the Society is to stamp all data, which it deems necessary, submitted in accordance with the requirements in **12.2.2** and **12.4.4** with its seal of approval and return such data to the applicant.

EFFECTIVE DATE AND APPLICATION (Amendment 1-1)

1. The effective date of the amendments is 29 June 2018.

Amendment 1-2

Part 2 EQUIPMENT

Chapter 1 APPROVAL OF MANUFACTURING PROCESS OF ANCHORS

1.6 Approval of Manufacturing Process of High Holding Power Anchors

1.6.1 High Holding Power Anchors

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

The approval procedure for manufacturing of high holding power anchor (the anchor specified in **2.1.4-2, Part L of the Rules**, having the holding power two times or more of that of ordinary anchor, and if it is used without subjected to the reduction as specified in **27.1.3-3, Part C of the Rules**, such anchor may not be dealt with as a high holding power anchor), is to be as follows in addition to the requirements specified in **1.2** through **1.5** of this chapter.

((1) and (2) are omitted.)

(3) Holding Power Test

(a) The anchors for testing are to be two anchors having different mass (At least one is an anchor having a mass equivalent to 1/10 of the maximum mass to be approved or more. ~~and the other is an anchor having a mass equivalent to 1/10 of mass of that anchor or more.~~) and two anchors for comparison having a mass equivalent to that of the test anchors. For testing of high holding power anchors, a previously approved high holding power anchor may be used where an approved ordinary anchor is not available.

(b) The size of chain cable used for the test is to be suitable for the anchor mass. The length of the cable for each anchor is to be such that the pull on the shank remains horizontal. For this purpose, the ratio of cable length to water depth of water is to be 10 as standard, but not less than 6.

(~~b~~c) The holding power measuring test is to be carried out ~~in three of the soil (sand, silt and clay)~~ at sea on various types of bottom, in principle, soft mud or silt, sand or gravel and hard clay or similar compounded material three times ~~on~~for each test anchor and ~~once on~~ each anchor for comparison where the anchors are to be dragged at a fixed speed (as slow as practicable). Tests are to be carried out from a tug but shore-based tests may be accepted as an alternative. The pull is to be measured by a dynamometer or equivalent means. The sea bed for testing is to be of virgin bed for each attempt of testing. However, the number of test attempts may be increased/decreased as considered necessary or appropriate by the Society. After testing, the damage conditions of anchors is to be recorded as far as practicable.

(~~c~~d) Where sufficient data is submitted, and if the Society considers it appropriate, all or parts of the holding power measuring test may be omitted.

((4) and (5) are omitted.)

1.7 Approval of Manufacturing Process of Super High Holding Power Anchors

Paragraph 1.7.1 has been amended as follows.

1.7.1 Super High Holding Power Anchor

The approval procedure for manufacturing of super high holding power anchor (the anchor specified in **2.1.4-2**, **Part L of the Rules**, having the holding power four times or more that of ordinary anchor. If it is used without the reduction of mass as specified in **27.1.3-4, Part C of the Rules**, such anchor may not be dealt with as a super high holding power anchor), is to follow the requirements in **1.2** through **1.6** of this chapter. However, the anchor for holding test specified in **1.6** are to be ~~two~~ three test anchors having different masses (~~One is an anchor having a mass equivalent to, 1/5 of the maximum mass to be approved or more and the other is an anchor having a mass equivalent to 1/5 of mass of that anchor or more.~~(the bottom, middle and top of the approval mass range.) and ~~two~~ three anchors for comparison, each having a mass equivalent to that of the test anchor~~s~~. Any approved high holding power anchor or super high holding anchor may be used in place of an ordinary anchor.

EFFECTIVE DATE AND APPLICATION (Amendment 1-2)

1. The effective date of the amendments is 1 July 2018.

2. Notwithstanding the amendments to the Guidance, the current requirements apply to materials other than those for which the application for survey is submitted to the Society on and after the effective date.